THE MODEL ENGINEER

Edited by
PERCIVAL MARSHALL
C.I.Mech.E.

Offices :
13-16 FISHER ST., LONDON, W.C.1

Vol. 78 No. 1926

April 7th : 1938

SMOKE RINGS

Society Co-operation

IN looking through the catalogue of the recent very successful Exhibition of the Nottingham Society, I have been much impressed by the excellent co-operation given by neighbouring societies in the Midland area by way of loan exhibits. I find that out of the total number of models on view—just over 200—no less than 88 were contributed by the Leicester, Pinxton, Peterborough, Norwich, North Staffordshire societies, and the Nottingham Model Aero and Model Yacht clubs. Having in mind the problems of dispatch and return of these models, mostly over a distance, I must congratulate the exhibitors on their commendable support of their Nottingham friends. Every model thus loaned calls for a personal effort and, possibly, inconvenience, of some kind on the part of the owner, and it is good to find that this spirit of co-operation exists in such a high degree. The Nottingham members alone can make a fine show, but the mass effect of the enlarged display made with the help of the other societies must have considerably deepened the impression made on the minds of the visitors as to the variety of interest and value of model engineering work. I know that the Nottingham members have themselves contributed to the success of other local Exhibitions in the Midlands, and have no doubt that they will continue to do so in the future, when invited. Such displays are doing most valuable propaganda work for the cause in which we are all interested, and I hope that such effective and willing co-operation will long continue to be a feature of society life.

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West Midlands Power Boating

I AM asked to say that the Easter meeting of the West Midlands Model Engineering Society will be held at the boat pool on the afternoon of Tuesday, April 19th, running beginning at 3 o'clock. All members with boats are asked to be present and bring their boats with them. The preparations for the loco. track round the pool are making good progress. Mr. K. G. Williams, the builder of "Faro," of 41.15 m.p.h. fame, gave the club an interesting paper, recently, on the record and development of this boat. We hope to be able to quote from this in the near future.

* * *

Model Making as an Adventure

IN a recent letter from our friend Monsieur G. M. Suzor, I find this passage: "I am working, at the moment, on a boat motor, which I hope, naturally, will be a little marvel—but, between ourselves, we must wait and see! Apart from that, as I have no spare time, I am making a model power-driven 'plane, which will also be—perhaps—another marvel, or, more simply, a mass of broken wood after its first flight!" I like that spirit of adventure in which M. Suzor approaches his model making; hoping for success, but recognising, yet undeterred by, the possibility of failure. It is the spirit which leads to achievement, and we know how well M. Suzor has succeeded in the past.

* * *

A G.E.C. Dinner

I RECENTLY had the privilege of attending the second Annual Dinner of the Model Engineering and Arts and Craft Club, the membership of which is drawn from the staff of the well-known General Electric Company. This pleasant little function follows the yearly Exhibition of members' work, and a feature of the evening's programme was the presentation of Cups and Diplomas to the successful competitors by the Hon. Mrs. L. C. Gamage, whose husband, a director of the G.E.C., has accepted the office of President of the Club. Mr. C. R. Dando, who responded to the toast of "The Club," spoke of the great progress it had made, and said that a well-equipped model engineering workshop was now at the disposal of members. Mr. T. W. Heather, another of the Company's directors, presided in happy fashion over the gathering, and paid tribute to the work of the Committee, and in particular to the services of

Mr. L. Ricards, the Hon. Secretary, who devoted so much energy to the efficient conduct of the details of the Club's affairs. Among the lighter touches of the evening's oratory was a remark by Mr. D. S. Reay, who said that the salesmen of the G.E.C. had the reputation of being so efficient that they could sell something they had not got to someone who did not want it. He believed that some enthusiast in the Company had applied this principle to the Club's annual competition by trying to persuade a member to make a model of something he had never heard of for a prize which did not exist!

* * *

A Diesel Train for the L.M.S.R.

ON the 24th March last, a new three-car articulated Diesel-hydraulic train was given a trial trip from Euston to Tring and back, prior to being placed in service on the Oxford to Cambridge cross-country line. The train is powered by six Leyland 125 b.h.p. oil engines running up to a maximum of 2,200 r.p.m., two engines being mounted under the floor of each car, and drive the inner axles of the adjacent bogies, so that only the two extreme axles of the train are not driven. The under-frames are of welded construction, while the car bodies are timber-framed, with welded steel outer panelling. The entire unit, unloaded, weighs 73 tons; it was built at Derby works, and is designed for a maximum speed of 75 m.p.h. Nevertheless, on its trial run, with some fifty people on board, it succeeded in reaching 80 m.p.h. at several places *en route*, on both the outward and inward journeys. Designed by Mr. W. A. Stanier, in order to compare operating costs with those of steam traction on comparatively short cross-country services, the train has seating capacity for 24 first-class and 138 third-class passengers; its motive power is derived from engines that are of a well-known and reliable design. The articulation of the train is, however, of a new type, enabling the cars to be of maximum length without causing excessive "throw-over" on a 3½-chain radius curve.

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Models on Escapade

A RATHER remarkable adventure, in which three types of models were fortuitously involved, was witnessed by a large crowd at Brockwell Park, London, S.W., on a recent Sunday morning. It began when a model aeroplane, flown from one of the grassy slopes near the pond, chose the water of the latter for a landing place. This was a particularly unfortunate choice, as it happened that the rowing boat normally kept on the pond for retrieving disabled or becalmed craft, and similar purposes, had been temporarily removed for its annual overhaul. The model aeroplane, floating well beyond reach, was, therefore, in imminent danger of sinking and becoming a complete loss, until the owner of a model steamboat decided that it might be possible to steer his boat sufficiently close to the 'plane to pick it up, and tow it inshore. This very difficult manœuvre was accomplished in a manner worthy of the best traditions of British seamanship, but, unfortunately, the heavy drag of the waterlogged 'plane so retarded the steamer that it lost steerage way, and the two craft ploughed round in tight circles, still far from shore. Thus it happened that they fouled the rigging of yet another craft, a model sailing yacht, and the trio proceeded to execute an eccentric waltz, evading with uncanny perversity any sufficiently close approach to the bank to enable them to be reached by one of the eager cordon of would-be rescuers. Eventually, sail and steam decided to take different courses, and the latter broke away, leaving the yacht and 'plane in even more erratic gyration; after a few more minutes of this, the yacht tired of its giddy antics, and managed to break away. The rescue of the 'plane was eventually effected by means of a weighted cord swung from a long pole, but many casts were necessary before this device was successful. When it was finally handed over again to its owner, the 'plane was, from superficial appearance, at any rate, very little damaged by its prolonged wetting and rather ungentle handling.

* * *

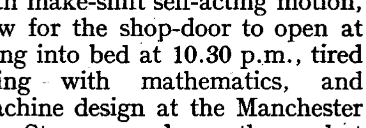
Th'owd Beam Injin

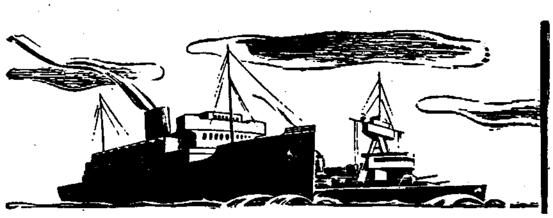
A CORRESPONDENT, who signs himself an "Old Lancashire Reader," sends me a newspaper cutting of some verses, written in broad Lancashire dialect, purporting to be the lament of an old beam engine about to be scrapped after eighty years of service, through the coming of electrification. It is very cleverly written, but is much too long for me to reproduce. Readers who would like to enjoy it, will find it in the *Rochdale Observer* for February 26th of this year. It has reminded me of my own days in Lancashire machine-shops of many years ago. These thoughts hold memories of clogs and corduroys, cold shop-floors, flaring gas-jets, broken windows stuffed with waste, turning with hand-tools pressed against the shoulder, lathes with make-shift self-acting motion, waiting in the snow for the shop-door to open at 6 a.m., and tumbling into bed at 10.30 p.m., tired out after wrestling with mathematics, and mechanics, and machine design at the Manchester Technical School. Strenuous days, those, but softened, and even made very happy, by the kindliness and cheery companionship of the warm-hearted Lancashire folk with whom I worked, and whose lot I shared.

* * *

M. Suzor's Book

WE have obtained a small stock of Monsieur Suzor's excellent book, "Petits Moteurs," recently reviewed in the "M.E.," and can supply these at the price of 3s. per copy, plus postage 4d.





MODEL
MARINE
NOTES

An Original Model Marine Steam Plant

By "ARTIFICER"

(*Concluded from page 604, Vol. 77*)

APOLOGIES are due for the rather disproportionate interval which has elapsed since the preceding portion of this article, but the temporary hold-up has been due to experimental developments arising from careful tests of the plant with different methods of boiler firing. As a result of the data established in the course of these tests, both the efficiency and the simplicity of the methods originally employed have been considerably improved, and it has been thought desirable to wait until the experiments were complete before concluding the article.

One incidental development of the improved boiler firing has been a marked increase in the evaporative rate of the boiler, so much so, in fact, that it has been found desirable to fit a larger feed-pump, and, in order to cope with higher engine speed, this has been geared down four-to-one, instead of being direct-driven, as originally. The latter type of pump is, however, still recommended where more usual methods of firing are employed and the loaded speed of the engine is less than 2,000 r.p.m.

Feed-pump

Fig. 5 shows the pump as arranged for direct-drive. It is driven from an eccentric which may be attached either to the end of the crankshaft, or, if found more convenient, to the propeller-shaft, so long as the latter is adequately supported by an adjacent bearing. The barrel of the pump is clamped in a cast standard, which is adapted to be bolted to the engine-bearers; this method of fixing has the advantage that the complete pump-barrel and valve-box may be removed for inspection in a few seconds, by simply removing the gland-cap and slackening the clamp-screw. It is also possible to adjust the end-clearance of the plunger by sliding the barrel to or from the shaft before tightening the clamp.

The valve arrangement of this pump is by no means new, but has been selected by reason of the ready accessibility of both valves and, also, their general efficiency. The exact adjustment of lift limits is readily carried out, and it is found, in practice, that this has an important bearing on pumping efficiency, especially at high speed. Rustless steel ball-valves, 5/32″ diameter, are employed, and their lift is restricted to a bare 1/32″.

The form of eccentric shown is one which is readily adapted to any convenient shaft, but, for an engine built in accordance with the design shown in Fig. 2, it is an advantage to form the eccentric on the boss of the flywheel, or to shoulder the latter down and attach an eccentric to it, as this keeps the entire arrangement more compact and self-contained. It will be found that the foot of the standard carrying the pump-barrel will come outside the engine-bearer, unless this is very wide, but it is a comparatively simple matter to fit a small angle-bracket to the outside of the bearer to form a pump-mounting. The standard may be reversed, so that the ribbed part of the casting is nearest the shaft, if this is found more convenient.

It will be noted that the displacement of this pump is 3/16″ bore by 3/16″ stroke, which will be found reasonably correct for direct driving at moderate speed, provided that a by-pass valve is fitted to the feed-line to enable fine adjustment to be made as required. One point about engine-driven feed-pumps in general which should be noted is that there is not a rigid relationship between the displacements of the engine and pump-cylinders, as many people seem to suppose. The amount of water which must be supplied by the pump depends on so many factors which are generally impossible to determine beforehand, that definite rules, or even approximate ones, for pump dimensions cannot be laid down. For instance, an engine which runs on high-pressure steam will require less water fed to the boiler for a given power output than one which runs on

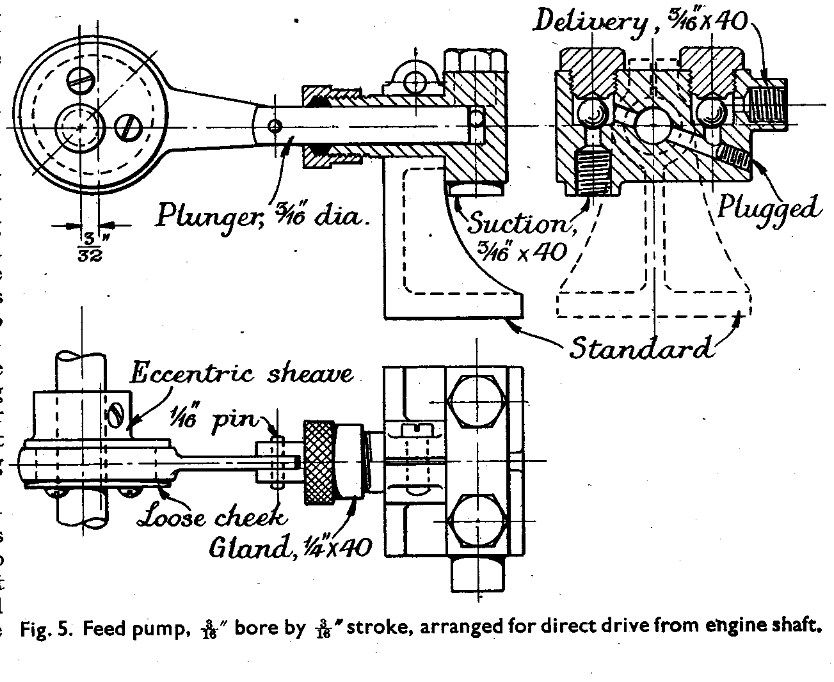


Fig. 5. Feed pump, 3/16″ bore by 3/16″ stroke, arranged for direct drive from engine shaft.

low-pressure steam. Again, a steam engine has a wide flexibility range, and may develop the same power at either a high torque with low speed, or low torque with high speed, so that it is clear that a feed-pump driven by the engine will, relatively, under-feed the boiler in the former case, and over-feed it in the latter. This condition arises when changes are made in the size or pitch of the propeller in a model power boat, and practical proof may easily be produced by carefully adjusting the boiler-feed in any boat with a given propeller, and then changing it for one of different load characteristics, when it will be found that feed adjustment is entirely upset.

Geared Feed-pump

When the engine r.p.m. *under load conditions* are in excess of 2,000, it is advisable to run the pump at reduced speed, and the relative displacement must be increased. As seen from the preceding paragraph, however, this increase will not be in direct proportion to the gear reduction, as the engine torque/speed and pressure balance have to be re-adjusted. The pump, as shown in Fig. 6, is geared to run at one-fourth engine speed, and the bore and stroke are increased to 5/16" both ways. There is very little need for further comment on this arrangement, as the gearing is a simple spur and pinion, and the only further alteration is the use of an open eccentric rod which allows the engine-shaft to pass through without touching it in any position of the stroke.

Boiler Firing

While it is quite practicable to fire the boiler by means of an ordinary blowlamp, having a nozzle sufficiently small to go inside the firing-tube with a small air-space around it, the boiler is really designed for use with an atomising burner, which has been the subject of the later experiments referred to. This form of burner is, on the whole, much more efficient and far less troublesome than the usual vaporising blowlamp which is almost universal for small model steamers; but in spite of its success for industrial purposes, it has hitherto been rather neglected by model engineers.

The fundamental principles of atomising burners are fairly well understood, but it may be explained that, in any burner utilising liquid or even gaseous fuel, the essential requirement for proper combustion is that each molecule of the fuel should be brought into contact with the necessary amount of oxygen required to consume it completely. In the case of gas, this is a very simple matter, as the relative nature and density of this is similar to that of atmospheric air, so that it will readily mix in the tube of a Bunsen burner; but, if a high intensity of combustion is required, the air must be supplied forcibly by a fan or blower. With liquid fuels, the much higher density makes intimate mixing with air far more difficult, and the method which has hitherto been generally favoured for burners on a small scale has been to turn the liquid into a gas by heating, and to spray it into a mixing tube, in which it acts as an injector-jet to induce sufficient air for combustion, in much the same way as the Bunsen burner. Although this method is essentially simple, and, also, highly effective if properly carried out, it involves a certain delicacy of adjustment, and is liable to derangement by cooling off or carburisation of the burner, so that it can be—and very often is—extremely troublesome in practice.

In the atomising burner, no attempt is made to vaporise the fuel (though, in certain cases, it may be found desirable to heat it, in order to reduce its viscosity, but this only applies to quite heavy oils), but its admixture with the air is effected by breaking it up into a fine spray, or mist, employing either a mechanical (pressure) atomiser, or an injector similar to a paint or perfume spray. The former device necessitates the use of a fuel-pump, which must be capable of fine metering adjustment, but the latter only requires a small supply of compressed air or steam at sufficient pressure to effect atomisation—which is not very high, in the case of light fuels,

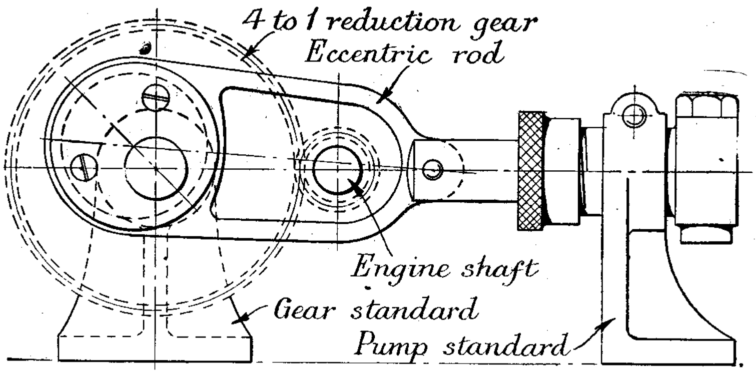
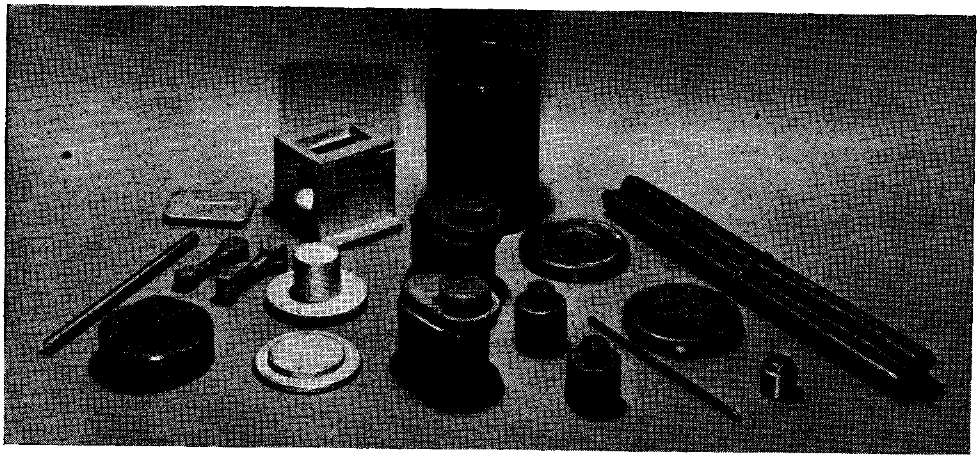
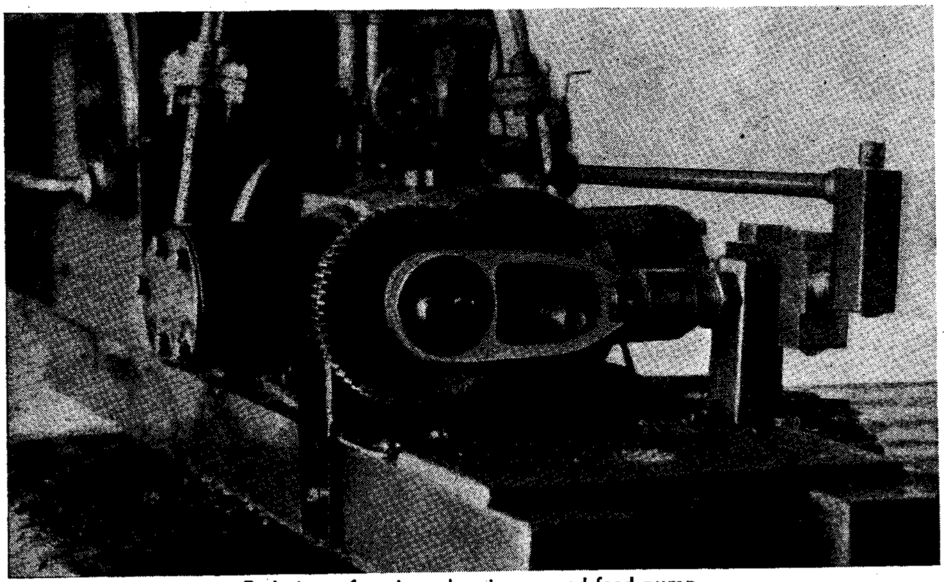


Fig. 6. Arrangement of gear-driven feed pump, 5-16 in. bore by 5-16 in. stroke. (Dimensions of valves the same as direct-driven pump.)



A set of engine castings and boiler materials for constructing the Blakeney steam plant.



End view of engine, showing geared feed pump.

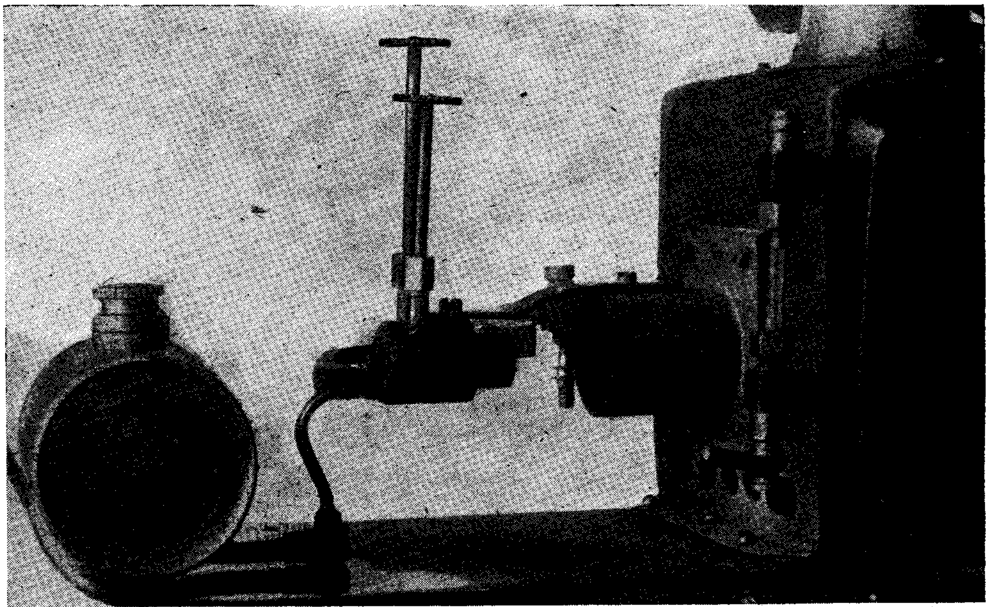
such as ordinary lamp-oil (paraffin or kerosene). Air is induced to mix with the atomised fuel in the same way as in the Bunsen or oil-vaporising burner, but its advantages over the latter are that carbonisation is impossible, and the actual fuel orifice, being only at atmospheric pressure, is much larger than that of the blowlamp, and thus far less liable to become choked, or put out of adjustment. For this reason, atomising burners are generally entirely consistent and trouble-free, when once properly adjusted, and they are not liable to be put out of action by cold draughts, but they have at least one thing in common with the blowlamp—that their initial design and adjustment is no haphazard matter, and a considerable amount of skill and experiment may be necessary to ensure their success.

The burner illustrated in Figs. 7 and 8 is the latest of several constructed and tested out by Messrs. Blakeney in conjunction with this plant, and, though none of the burners have been failures, this particular one has succeeded beyond all expectations.

It will be noted that the body of the atomiser consists of a cylindrical brass block having steam and fuel inlets on its rear face, and two regulating valves for these, respectively, projecting from the top. The steam passage passes through the centre of the block and terminates in a jet at the front, with the oil-passage to one side of it. Both are enclosed inside a front cap, having a central atomising or combining nozzle.

The operation of the atomiser is as follows: steam escaping from the centre jet, and passing through the orifice of the combining nozzle, will expand so that it completely fills the latter, and, in doing so, will create a partial vacuum in the space around the jet. This will induce fuel to follow the steam, the further expansion of which, outside the nozzle, will break up the fuel into fine particles, which readily combine with air, and the resultant spray can be lit up with a match, no preliminary heating being necessary. (The intensity of the draught through the flame-tube, however, is liable to blow out matches, and a more substantial igniting flame is an advantage.) Metering of the fuel to obtain the right quantity for correct combustion is effected by means of the appropriate valve, while the control of the steam by the other valve enables the volume of the flame to be adjusted.

There is one marked difference in the character of the flame produced by an atomising burner, as compared with that of a blowlamp; whereas the latter is concentrated in a small parallel jet, the atomising burner produces a conical flame, which almost completely fills the furnace, and is, therefore, most



A close-up of atomising burner and fuel tank in position. The tee-piece and connection for rubber bulb on steam pipeline can be seen immediately behind mouth of firing tube.

effective for steam generation. Although it is advisable to ensure that the steam fed to the atomiser is dry, the presence of water particles in the steam will not extinguish the flame, but may cause a good deal of hissing and spitting. Apart from this, the burner is quite as silent as the so-called "silent flame" vaporising burner.

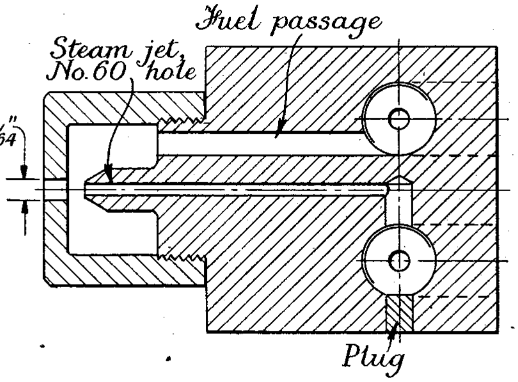


Fig. 7. Plan view of atomiser, section on centre line. (Twice full size.)

Quite heavy fuels may be effectively consumed by means of an atomising burner, provided that it is suitably adjusted, and sufficiently high spraying pressure is employed ; but, as errors in adjustment would result in dense smoke and odorous fumes, the greater latitude of clean combustion afforded by paraffin (kerosene) is to be preferred.

As will be seen from the photograph, the atomiser is attached to the boiler by means of a strip of flat bar, cranked so as to centre the atomiser, and slotted so that the latter may be adjusted to or from the firing-tube.

Starting-up

In the case of a burner which depends on a supply of steam for its operation, the question naturally arises as to how steam may be raised in the first place. Most industrial burners of this type have some arrangements for an auxiliary supply of compressed air, either by hand or power—or, in some cases, a small flash boiler, which heats up almost instantaneously, is used to supply the burner. The problem is solved in the simplest possible way in the Blakeney plant, by the use of a small rubber bulb, connected to a T-piece in the steam-pipe leading to the atomiser. This bulb is of the type employed in scent-sprays, having suction- and delivery-valves incorporated in it, and it is connected by a rubber tube to a ball check-valve in the lower limb of the T-piece.

When starting up the burner, it is only necessary to squeeze the bulb about once every two seconds or so, and an actual test showed that the length of time required to get up steam, with a normal level of water in the boiler, was about two minutes, so that it is by no means a laborious proceeding. As soon as steam-pressure is available, the check-valve of the hand-bulb is automatically closed, and the steam takes over the atomising job ; the bulb and its tube may then be removed. Variation of steam pressure within fairly wide limits only affects the volume of spray delivered, and the amount of steam required to work the atomiser is quite small.

As will be seen from the photograph, no pressure is applied to the fuel in the tank, and it is, in fact, situated below the level of the atomiser, the filler-cap being ventilated, as for gravity-feed. Re-fuelling while the burner is in operation is thus practicable.

The use of this burner may call for slight modification of the ventilation-holes in the boiler, as it was found, during tests with the original boiler, that these could be increased with advantage. As a matter of fact, the firebox space of this boiler is a little on the small side to employ a burner of this type to its fullest advantage, and the flame tends to "overflow" at every available aperture, when working at full bore. This point might be borne in mind when making the boiler-casing, as another inch of space at the front would give more adequate room for combustion ; but it is large enough for the normal steaming requirements, when the necessity for forcing the burner to its utmost does not arise.

One great advantage in an atomising burner operated by steam pressure, over the more common blowlamp, is that, in the eventuality of a failure of the feed water, so that the boiler runs dry, the burner would also fail, instead of burning away at full blast, to the detriment or complete destruction of the boiler.

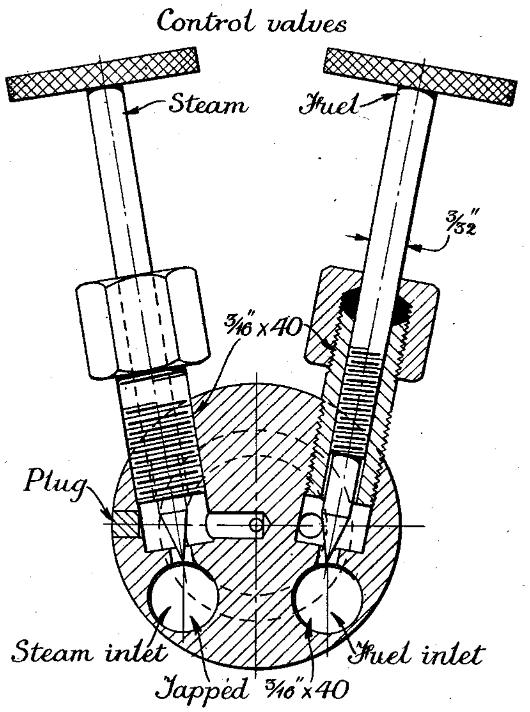


Fig. 8. Cross section of atomiser on centre line of control valves. (Twice full size.)

Alternative Methods of Firing

The use of an ordinary blowlamp for firing this boiler has already been referred to. It is also fully practicable to adapt it to the use of solid fuel, and it is possible that further information on this may be available later. One objection to the use of solid fuel, which may account for its lack of popularity for model marine boilers, is that it calls for a certain amount of space under the grate, thus raising the centre of gravity of the boiler, and, also, for a watercooled ashpan to avoid damaging the hull, especially if it is of wood. It is, however, possible to avoid raising the boiler by modifying the furnace design, extending it about 3" further from the tubes to accommodate an inclined grate, raised to about the level of the present firing-tube at the front. A draught-regulator could thus be fitted to admit air below the grate ; also, an ashpan containing water, without increasing head-room. It would be necessary to lag the furnace very heavily to prevent the casing becoming excessively hot, and, in this respect, a layer of Stourbridge firebrick is much more efficient and durable than asbestos. The provision of an exhaust blast-pipe would be most important when using solid fuel.

Materials for the Blakeney Steam Plant

The description of this plant has aroused a great deal of interest among readers, and many of them have expressed a wish to obtain castings and parts for constructing it. Messrs. Blakeney have, therefore, made arrangements for the supply of engine and feed-pump castings, copper tube and flanged end-plates for the boiler, and complete atomising burners. Announcements to this effect, giving detailed prices, will be found in the "M.E." advertisement pages, but it should be understood that the object of this article has been purely to call attention to a model plant with original and progressive features of design, and its commercial possibilities are quite a secondary and incidental consideration.

In the Wake of the Power Boats

By THE SPECTATOR

I HAVE, recently, been quite surprised at the number of people I meet in a business way who are, or have been, interested in model engineering. Two acquaintances, in particular, whom I have known some time, gave me quite a shock ; I had always supposed them both to be men whose hobby would probably be "commercial ethics" or "business efficiency as applied to home life." In the company of both, a few weeks ago, I made a few notes on the back of THE MODEL ENGINEER, and both were surprised to find *me* interested in it. The ultimate result was that I discovered that one has had a weakness for making small oscillating engines ever since he had one as a small boy, and the other makes anything he happens to think of in the way of engine parts, without ever making a complete engine. My wide—if rather scrappy—knowledge of model engineering, in general, allowed me to enjoy the rôle of a maestro, though I am fairly certain they did not believe my assertions of the speeds of model boats. Beside these two, there are three others whom I have discovered to be interested in model engineering, only during the past six months. What makes it all the more curious is, that in the previous ten years, I have not met more than one, outside of ordinary model engineering circles. I suggest you carry a "Universal" engine and boiler, or a 15 c.c. hydroplane "in your pocket," and use them as paper-weights during business ; they'll serve to show you are interested, and help others who are keen to "break the ice," and, also, may mean a new member for your club.

Drawings in the Workshop

Drawings in general, and particularly those on white paper, have an annoying habit of getting a spot of dirty grease right on some small dimension, or else getting so threadbare that they are in several pieces before the job they depict is finished. This means that, at the best, it is an irritating inconvenience, and may lead to a quite serious mistake, if the drawing does not happen to be absolutely correct to scale.

It is not an uncommon practice, in works where a particular print is going to be in the shops for some time, to paste it on a piece of card, or three-ply, and give it a coat of thin varnish, which can be sponged clean.

Where one's own drawings are concerned, it is not at all a bad idea to do them on tracing paper, and get blueprints from them. These prints are quite inexpensive, one 13" by 8" costing 3d. Place a sheet of ordinary drawing-paper underneath, so that a white surface is shown, and do your pencil-lines lightly at first, so that they can be rubbed out if you make a mistake ; go over them firmly afterwards, and endeavour to make them all of the same density. White, matt surface tracing-paper, in conjunction with a 2H pencil, will turn out originals which will give quite good prints. Should you wish to add anything to a blue-print, it is usually possible to do so by dissolving a few lumps of common soda in water and using it as ink ; after a short while, the blue bleaches out, leaving a white mark.

Prints on white paper, with dark brown lines, are available at the same price as blues, and this is sometimes useful if, for instance, you want to get out several drawings of a boat showing first the lines, then the ribs, and, finally, the arrangement of the plant. Prints can be used and the details added, which is very much better than having to do the whole drawing each time, or making it look like a wire puzzle with everything on the one.

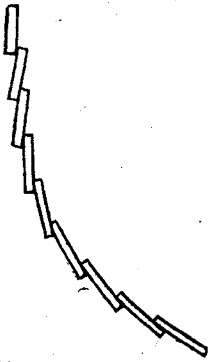
Lifeboats

The lifeboats on prototype models are, quite frequently, rather skimped, and spoil an otherwise good model. The fairly accurate reproduction of these very essential features of boats will improve the appearance in quite a surprising way.

The prospective builder has the choice of two alternatives: he may either make the boats solid and cover them with a tarpaulin, or finish them correctly to show the internals. Not infrequently, he splits the difference, and makes one complete and one solid. I propose to describe the simple construction of a complete ship's boat, as the solid simpler version may be constructed in the same way, but with the internal work omitted.

No doubt, most readers are familiar with the system of model boat construction known as the "bread and butter" method. As its name implies, the construction consists of building the boat up with layers of wood, along lines taken horizontally through the length, the layers or planks are screwed together, the lines shaped and the planks then separated, and the centre sawn out to leave a thin wall all round ; the pieces are then glued together and the result is a comparatively light hull, which is produced very much quicker than the average amateur could do it if carving from the solid piece of timber.

In the case of the lifeboats for the model tug *Gondia,* three pieces of wood should be sufficient, the piece at the bottom being, perhaps, a little thinner than the middle and upper planks. The jointing faces of the wood should first be planed or scraped flat, as if drawn down flat by the screws, there will almost certainly be trouble when finishing the boat. The middle piece is screwed to the lower with countersunk screws, and the upper piece to the middle; the screws passing into the lower piece would not be too long, and should be placed in the centre, so that there is no fear of their coming through when the carving is going on.



How the planking is arranged on clinker-built boats.

The actual shaping should follow the marking-out of the plan on the top piece. Cut templates of the sections of the boat and concentrate on reproducing them in their correct places first; once this has been done, rounding-off and fairing the lines is fairly simple. If there is a shortage of suitable tools and your woodworking ability is not so good, don't hesitate to use a file and finish with sandpaper. The stem, stern and keel should be added when the boat is otherwise finished, as, being essentially square, it will not retain this feature if made from the one piece of wood, the sandpapering is certain to take its edges off.

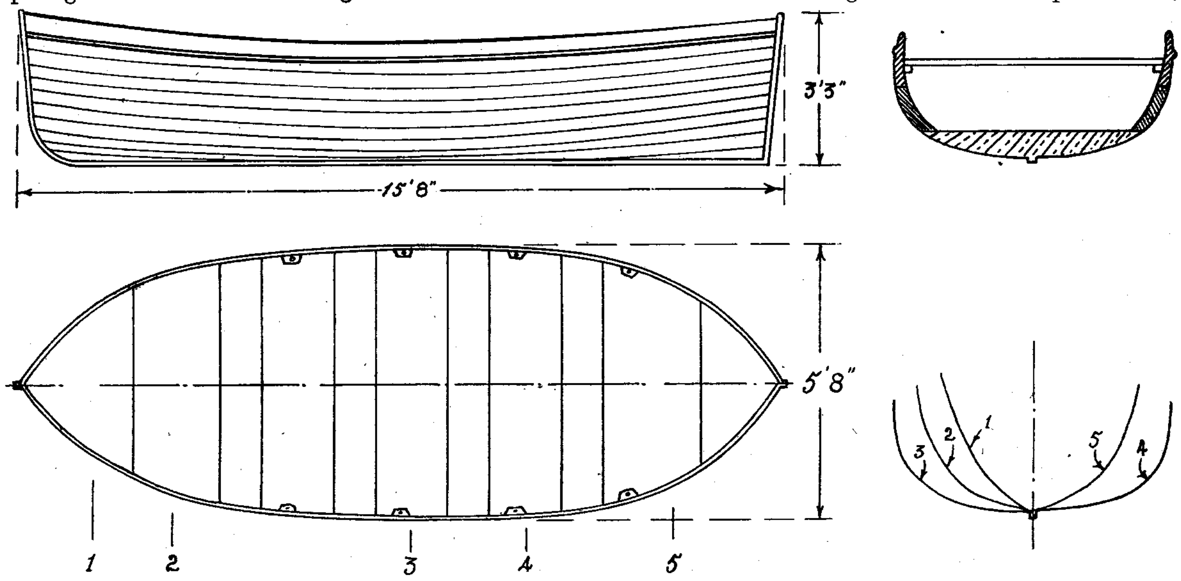
The next step is to glue the two upper pieces together. Brush the glue on the jointing faces of both pieces, rub them together gently until you can feel that there is a tendency for them to stick, and then lay them on a flat board, right way up, and put a weight on top to keep the joint flat until it is set. With the two upper pieces glued together, the inside can be smoothed off so that the joint is no longer to be detected. Before glueing on the bottom piece, it should be deeply engraved to represent the floorboards, or duckboards; I think the latter is the correct term.

These lifeboats are clinker-built, which, as most readers will know, means that each plank in the hull overlaps the one below it. This rather important detail is very frequently overlooked, which entirely spoils the effect; I would suggest that if you must economise on labour on the boats, that you make them solid and cover with tarpaulin, and finish the outside correctly, rather than finish them inside and not outside. The planking effect is quite easily obtained by marking the lines, carefully going over them with a sharp knife, and then taking a wedge-shaped paring-out with a chisel.

Internal ribs will improve the appearance, the longitudinal rib on which the seats are mounted being fixed to the vertical ribs. Sockets for rowlocks are a simple enough job, and should be glued and pinned. Finally, the finish is white, and should be applied with some care, or the planking will tend to fill up, and the corners become too rounded.

Suitable Engines for the Model Tug

In the past few weeks, I have had three letters from readers asking if certain engines are suitable for the *Gondia,* and I think that if I mention them, it may save others unnecessary mental exercise. No. 1: an I.C. engine, as used in speed boats, is



Lifeboat for model tug "Gondia." Top right: suggested three sections for 'bread and butter' construction.

With the outside lines finished, the three pieces of wood can be taken apart and the centre of the two upper pieces cut out with a fretsaw; don't make the walls too thin at first, as, when the three pieces are finally glued together, the inside of the boat will need generally cleaning up to an even surface. After the centre has been cut out, there will be a short grain in places, and this will make them fragile, so they should be handled with care.

definitely not the right thing for this model; if you want to use such an engine, make a model oil-engined tug *and* detune the engine so that it runs at moderate speed, is a first-pull starter, and *keeps* **running.** No. 2: the Stuart "Double Ten" is quite suitable—or, indeed, any engine of similar type, such as triple-expansion or compound. No. 3 has rather got me; I haven't the faintest idea what size turbine would be suitable.

SHOPS, SHED AND ROAD

A Column of Live Steam

By " L.B.S.C."

Ancient History, By Request

Here is a tale that I've been going to tell for a long time past, and now take the opportunity, in answer to some recent requests. Several brothers have had a chance of perusing one of the catalogues issued by the late firm of James Carson & Co., Ltd., in the 1909-1911 period, and have been very much impressed by the contents. The guaranteed performances of the locomotives listed, their low price, realistic appearance, and so on and so forth, coupled with the varied assortment of castings, finished parts, material and sundries, offered at a figure very low even in those days, and absolutely ridiculous when compared to present-day costs, have given our friends " very furiously to think." Knowing that I have a good knowledge of the construction of the engines, having repaired and re-built some of them, they want to know how it was done ; and whether brothers with slender and shallow pockets, and meagre kit, could hope to turn out a satisfactory job by copying Carson construction as far as possible. Well, let's do a little investigating, then judge for yourselves.

Why They Did the Job

There is not the slightest doubt that the Carson engines were some of the finest commercially-built workers ever put on rails. The frontispiece of the 1911 catalogue shows a reproduced photograph of a 2½" gauge 4-6-0 (a Caledonian " Cardean ") hauling a flat car with a child seated on it ; and underneath are the words " All our 2½" gauge locomotives are guaranteed to pull a minimum load of 50 lb., and to do so under all ordinary conditions." Note they say "minimum." Further along, describing an 0-8-2 Lancashire and Yorkshire tank engine, they state that one of these engines hauled a train consisting of seven bogie coaches, two bogie wagons, and thirty-seven four-wheel wagons ; a train nearly 40 ft. long. With a steam pressure of 60 lb. only, this outfit went so fast that the " tail wagged," and the last twelve vehicles jumped the road. These claims, at the time, seemed exaggerated, and were, in fact, ridiculed in several quarters ; in reality, Mr. James Carson *under-estimated* the power of his productions. They could actually do much more than the catalogue claimed, as you'll presently see.

The chief secret of these performances was in the valve-gear. In the 1909 catalogue, it is stated that experiments had been carried out for some time with valve-gears, and the only really satisfactory arrangement was the "full" valve-gear, with proper early cut-off and expansion period. Consequently, the firm adopted it. Another factor which helped the successful operation of the " old Carsonians " was their paraffin burner. True, it had certain drawbacks, such as choked nipples, and a tendency to " backfire " ; but it was free from obnoxious fumes, and very cheap to run, besides giving all the heat required.

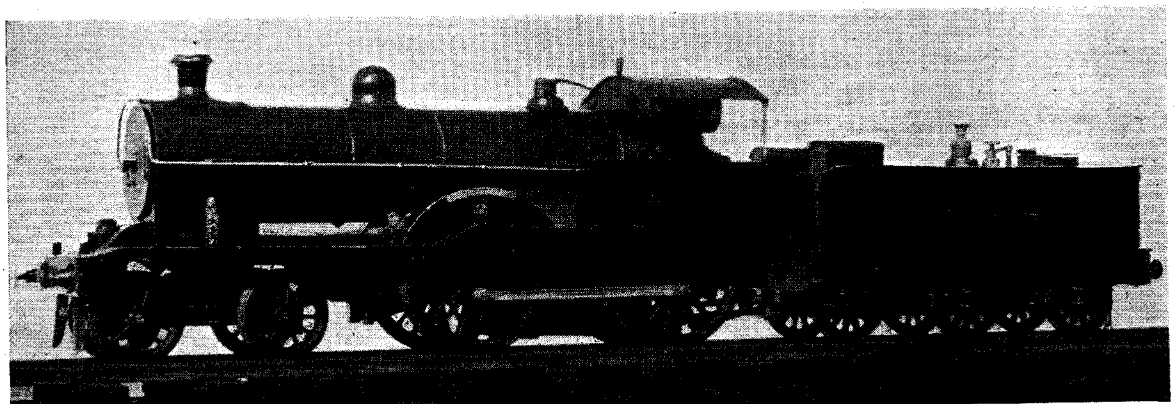


Photo by] As lively as ever, after 27 years ! [*C. J. Grose*

Why They Were Cheap

The gauge 1¾", 2", and 2½" engines were built on "mass-production" lines, and the construction was reduced to the rock-bottom of simplicity; but the remarkable part about it was, that the engines were correctly proportioned, exceedingly realistic in appearance, and contained all the essential parts of a full-sized locomotive, though, naturally, without the detail. For instance, on the 2½" gauge L.N.W.R. "Precursor" type 4-4-0 shown in the picture, the bogie frames were simple castings which merely needed drilling for the axles, and attaching to the cast bolster with a single stout screw each side. This could be assembled and erected in a few minutes, yet gave a bogie which had all the essential running features of a fully-equalised and separately-sprung bogie. Note: the wheels were practically "scale" size, a feature not hitherto found on even expensive commercially-built engines.

Castings entered very largely into the construction. The main frames were made from steel plate, but they finished up just ahead of the cylinders; the front part of the frame, buffer beam, and cylinder flap was a one-piece iron casting, to which the main frames were screwed. The casting had lugs for attachment to the running-board. Proper cast horn-blocks, with sliding axleboxes and spiral springs, ensured an easy-riding engine which would keep the road at high speed. The trailing end of the frame assembly was also a one-piece casting, combining drag-beam and cab deck or footplate, which was cast solid to the depth of the drag-beam, thus reproducing the drag casting of big sister, and counterbalancing the weight of the cylinders at the leading end, as in big practice. Wheels were correct size, with properly-shaped flanges; and the coupling-rods were cast German silver, which needed no bushing, the crank-pins being screwed tightly into the wheel bosses.

Carson's were up against a difficulty with the cylinders, but they got over it very well. Owing to their insistence on "scale," the cylinder-block was necessarily short, which, in turn, entailed a narrow piston to keep to correct stroke. This meant that the bores had to be absolutely true, and the pistons fitted to a fine clearance, to prevent steam blowing past. On the engine illustrated, the cylinders are formed from a plain rectangular block of hard gun-metal, 1⅜" long. The front covers are formed by a single oblong plate attached by five screws, and, consequently, there are no spigots at that end. Separate circular covers are provided at the back, and these have 1/32" spigots, which, with a 1/32" clearance each end, and 1" stroke, leaves 9/32" available for piston length. Actually, they were a shade over ¼", and well fitted, the packing groove being a bare ⅛" wide and 5/32" deep. Piston-rods were German silver, and the glands merely bits of 5/16" rod, screwed, drilled, and cross-slotted at the outer end.

The steam-chest had two compartments, one for each valve, the exhaust passing up through a hole drilled in the dividing wall. A couple of half-round grooves were filed in the bottom of the wall, to allow steam and oil to pass from one compartment to the other. The valves were cast German silver, operated by nut-and-slot drive, and were very long, as the ports were spaced in an unusual manner. They were rectangular, but very wide apart, the distance between exhaust and steam-ports being over twice the width of the latter, instead of once or less. The idea was, that the exhaust port should always be wide open, and never covered at any position by any part of the valve-lap. This had a lot to do with the free running. A single plate formed a cover for both compartments, and was held down by six long screws and the blast-pipe, which was screwed into the tapped hole in the dividing wall, passing through a clearing hole in the cover, and holding same down by a shoulder or step. Lubrication was provided by a small displacement lubricator screwed into the left side of the steam-chest. I did away with this on the engine in the picture, and fitted a combined dope-cup and snifting-valve in its place, with a big displacement lubricator in front of the steam-chest.

The motion, whilst being unquestionably "all there," was the acme of simplicity. The guide-bars were merely bits of round rod, shouldered down at one end, the full-sized end being just pushed into blind holes in the cylinder covers, whilst the shouldered ends were supported in holes drilled in the motion-plate. The crossheads were gunmetal castings, slotted to take the little ends of the single-strapped German silver connecting-rods, which were secured by a single screw. The crank axle was a steel casting, machined on journals and crank-pins only. The motion on the engine shown is full Joy's. The pins in the vibrating-links are not furnished with die-blocks, but slide direct in the guide slots in the reversing shaft. Incidentally, this shaft, cast in gun-metal, with curved slides properly machined out, was priced at 3s. 6d., finished ready to fit! All the links of the Joy gear were German-silver strip. Some engines were reversed by a simple wheel and screw, and some by a lever, which worked on a pivot without any quadrant plate, being supported by the box-shaped wheel splasher inside the cab.

The boiler, of water-tube pattern, was another simple job. The smokebox was cast in one piece and needed no machining; neither did the door, which had the hinges and lug cast on. A 1/16" hole drilled through hinge and lugs, and the insertion of a wire hinge-pin, was all the work needed; the assembly was attached to the frames by two screws. A wire catch prevented the door from accidentally opening. The boiler casing was thin brass tube, split and opened out, the throatplate, cast in iron and needing no machining, being attached by a couple of screws. The boiler had a cast backhead with hollow down-comer, and here I reckon Carson's made a mistake, as the downcomers used to become choked with scale (nobody ever seemed to realise that these little boilers became as "furred up" as a domestic kettle, and so never thought of washing them out occasionally!) and the ends of the tubes got blocked up. I found several with burnt tubes. Some engines had two tubes, some three or four. The barrel on this particular example is 2" diameter and 9½" long, an average size. The backhead fittings usually consisted of a ¼" water gauge without cocks, a pull-out pin-type regulator, and a steam gauge. No blowers were fitted. Some of the engines had a quadrant regulator of the plug-cock pattern; also, some earlier ones had a "window" water gauge, a bit of ordinary flat glass covering a slot in the boiler backhead.

Some of the earlier engines had no provision for feeding the boiler; but as they ran 25 minutes or so on one filling, this was not a very great sin of omission. A general stop had to be made, in any case, to put some more paraffin in the fuel tank, so it was very little extra trouble to unscrew the safety-valve (usual ball type) and pour a drop more water in. Steam was raised again in a couple of minutes or so. However, the later engines had a small vertical hand-pump on the footplate, directly connected to a clack on the backhead, and this pump took its supply from the tender *via* a plain bit of rubber hose.

Carson's were the first to make and sell a paraffin burner of the horizontal vaporising type; and all their $2\frac{1}{2}''$ gauge engines and certain of the larger sizes, were fitted with these burners as standard. As mentioned earlier, they were somewhat prone to light back at the nipple, but I found out the cause of that trouble, and eliminated it. Anybody who makes up one of my "improved Carson" burners can put a lighted match or taper to the nipple, and it will promptly give a sharp pop and blow out the match or taper, just as though it was annoyed at being interfered with in its legitimate duty, which it carries on without interruption. The Carson burners, as was only natural, did their little bit towards making the engines powerful and efficient, the heat generated being much greater than that obtained from spirit; thus the boilers were always kept at a temperature sufficient for all ordinary purposes, and a little bit extra for luck.

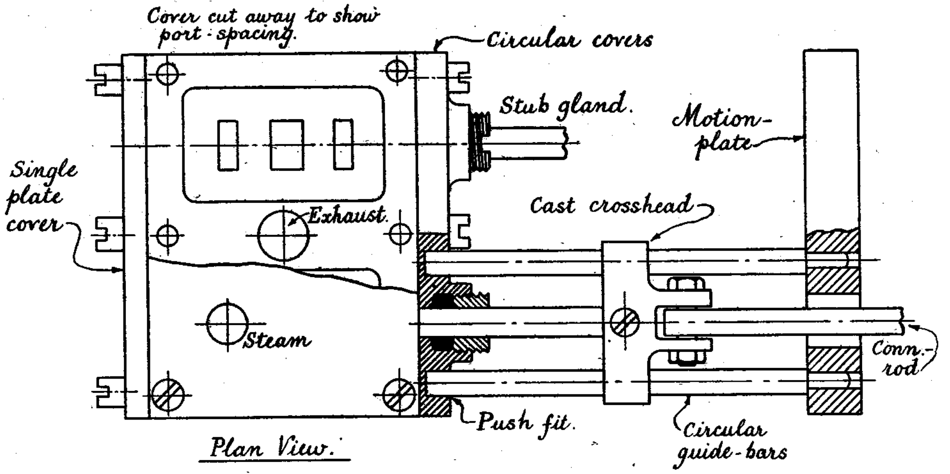
The top works of the engines were mostly built from castings. In the one illustrated, the running-board, splasher, and side of cab are all cast in one piece, needing no machining, and attached by two screws only—less than five minutes' work! Anybody who has built up the top works of a small engine, piece by piece, even by aid of the simple "Live Steam" sketches, can realise the vast saving of time and labour, and can also realise why Carson's were able to keep their prices down. The cab front was another casting, attached to sides by a couple of screws, and the whole was surmounted by a sheet-metal removable roof.

Tenders were built up on a couple of steel frames with cast dummy springs, axle-boxes, etc., all complete, the wheel bearings consisting of little brass blocks with springs above them, hidden inside the cast dummy. This idea has been "re-invented" by several people since Carson's time; great minds still think alike! The tender tanks were mostly horseshoe pattern, the oil container being separate, and fitted in the "well." The usual "trimmings" were provided. Prices of $2\frac{1}{2}''$ gauge engines varied from £10 10s. for a 4-4-2 tank, to £15 for a 4-6-2 tender engine. The set of machined parts, including complete finished valve-gear, averaged £4, and the whole bag of tricks could be assembled as easily as a present-day radio set, and in about the same time.

Carson's also built smaller engines, spirit-fired, and larger ones, coal-fired, $3\frac{1}{2}''$ gauge and upwards, at proportionate prices, with the same guarantee of performance.

The first Carson engine I re-built was a $2\frac{1}{2}''$ gauge L.N.W.R. 4-6-0, "Experiment" class, which had been absolutely "run to pieces." I replaced the German silver motion-work and coupling-rods by steel, added a feed-pump, re-bored the cylinders, fitted new pistons, and introduced a "monkey-gland" into the works; fitted a coal-fired boiler of "Claughton" type, and put a new tank in the tender, with a hand-pump. She is still at work. Since then I have titivated up quite a number of them. The particular one shown in the picture was made up by a Lancashire brother, Mr. R. Stephens, from a set of Carson parts, about 1911. Some years ago, he sold her to an old friend, who turned her over to me for a few odd jobs, among which was the fitting of one of my axle-dodger oil burners, and a bigger lubricator. She went very well for a long time, and a few weeks ago she came to pay me another visit for a kind of "shed day." There was nothing radically wrong; the boiler needed washing out, the burner required a new nipple, glands were blowing, and a few running adjustments were needed, after which I took her out on the track, and she pulled me a mile at a time, non-stop, without the slightest effort.

Before returning her to her owner, I carried out an interesting experiment, by taking the oil burner off, and temporarily installing in place of it, the discarded six-wick spirit-lamp which originally belonged to the old "Director" locomotive mentioned in these notes several times recently. A make-shift spirit-tank was rigged up in the tender, feeding the burners *via* a cock and $\frac{1}{8}''$ pipe, drip sight-feed fashion. With this ragtime "poison-gas" outfit, steam was raised in a couple of minutes, and the 27-year-old veteran hauled me around the track at a speed equal to about 120 miles per hour, for a mile and two laps non-stop, blowing off at 100 lb. all the time, except for an occasional few seconds while I was pumping a little more water in the boiler with the hand-pump. She has no automatic feed. She only stopped when the "juice" gave out. Now, in case anybody thinks I'm romancing, though they ought to know me better by this time, this test was witnessed by no less a person than the deputy managing-director of Messrs. Bassett-Lowke, Ltd.—to wit, Commander A. B. Lockhart, who was so much impressed by the performance of the old engine that he took details of her; and I shouldn't be at all surprised to find future "B.L." engines incorporating modernised Carson methods of construction, and bearing the Carson guarantee of performance.



Typical "Carson" inside cylinders.

The Nottingham S.M. & E.E. Exhibition

THE most successful show held by the Nottingham Society of Model and Experimental Engineers was staged at the Victoria Baths, Nottingham, on March 9th to 12th. The show was officially opened by Mr. G. Dixon, the City Gas Engineer, and the President of the Society, Councillor Wallis Binch, presided at the ceremony.

The Exhibition was divided into sections, as follows: (1) locomotives ; (2) stationary engines and miscellaneous models ; (3) ships ; (4) " O " gauge railway ; (5) passenger-carrying railway ; (6) models driven by compressed air ; (7) open competition entries ; (8) aeroplanes ; (9) trade stands.

Locomotives and Stationary Exhibits

The locomotive stand staged many fine exhibits, foremost of which was a huge 7¼" gauge G.W.R. " King," by S. A. Battison. Mention must also be made of M. Hendy's 3½" gauge 4-6-0 ; A. J. Witty's 2½" gauge L.N.E.R. " Pacific " ; R. Whomsley's four-cylinder L.M.S. " Pacific " ; S. L. Weston's four-cylinder G.W.R. "King" chassis in 2½" gauge ; and a beautifully finished coal-fired M. R. single, by H. W. Evans, in " O " gauge.

The finest model on the stationary engine stand was, undoubtedly, A. V. Lowe's six-cylinder " Maserati " engine, the unusual method of valve operation causing much comment. Other notable exhibits were F. Smith's electric winding engine, and a very handsome horizontal engine with many etceteras loaned by R. Bradbury. In the miscellaneous class, a most uncommon model was exhibited by H. O. Clark (President of the Norwich Society), to illustrate the method employed by the Egyptians of up-ending an Obelisk, the builder demonstrating its action to a delighted crowd in his own inimitable manner. Two small brass cannons, by A. P. Drake, showed the effect of recent articles in the " M.E.," although the builder cannot, by any stretch of imagination, be called a beginner.

In the ship class, C. W. Allen's model of a Hanseatic cog was much admired, while S. H. Knight's 1" scale model of a cabin cruiser, complete with all internal furnishings and electric propulsion, drew much attention. A. J. Witty's river cabin motor-launch, two small waterline models by J. W. Briers, Mr. Arrowsmith's super-detail galleon (loaned from Stoke), a very neat 15 c.c. hydroplane by A. C. Hutton, and a very dainty model of a Union Castle liner, to a scale of 50 feet to one inch, by D. Lewington, were models of outstanding interest.

A number of yachts, loaned by the Nottingham Model Yacht Club, formed a most attractive picture.

Working Exhibits

The " O " gauge railway, showing considerable development since last year, drew the attention of the younger element, but, strange to say, the realistic slow runing of an 0-6-0 tank, with goods train, did not appear to please them ; evidently, they preferred the fast-running passenger trains.

The passenger-carrying track was in charge of the Chairman, T. W. Lawson, and W. T. W. Rolls, and was kept busily occupied. The locomotives in service were: " Uncle Jim's " " James Milne " ; J. Wood-Mason's 3½" gauge " Lord Nelson " ; W. T. W. Rolls's " Royal Scot " ; T. W. Lawson's 3½" gauge L.N.E.R. " Pacific " ; L. P. Scrimshaw's 4¼" gauge " Pacific " ; P. H. Ruffle's 3½" gauge L.N.E.R. " Pacific " ; C. D. Bates's 2½" gauge 4-4-0 ; assisted, on the Saturday, by the " Sarawak " Trophy winner, R. S. E. Hill's " Dyak," from Norwich.

The compressor stand drew its usual quota of attention, as there is, undoubtedly, a fascination in watching models in motion. H. O. Clark exhibited a collection of his famous re-conditioned antiques, almost all of which were to be seen working on this stand. Among other models to be seen working were R. Neville's portable engine ; F. Day's traction engine ; and a horizontal hauling engine and beam engine, by F. Smith.

Championship Cup Entries

The standard of entries received for the Open Championship Cup was very high indeed, and caused much perturbation to the judges. Prominent on this stand were a rope-making machine, designed and built by F. A. Beard, of Peterborough, for the production of scale model ropes for ships' rigging ; a beautifully carried out model of a horizontal drop-valve uniflow engine, by B. C. Symes, of Doncaster ; a remarkably complete triple-expansion engine, with exhaust turbine, by J. A. Mulhern, of Liverpool ; a working model Lancashire loom, by T. Jolly, of Manchester ; a 1" scale rotative beam engine, by J. G. Wilson, of Lincoln ; a 3½" gauge 4-6-4 tank locomotive, with Baker valve-gear, by R. Brown, of Doncaster ; a 2½" gauge 2-6-0 locomotive, by D. G. Barnett, of Lincoln ; a model of Blenkinsop's rack rail locomotive, by H. Murray, of Derby ; and a very neat 3½" gauge " Royal Scot " chassis and completed tender, by R. Ward, of Norwich. To do justice to the exhibitors, the judges were compelled to increase the number of awards in this class.

The aeroplanes were exhibited by the Nottingham Model Aero Club, who made up a most attractive display. Many types were represented, from tiny scale models to 'planes of 5 ft. wing-span, powered by compressed air and petrol engines.

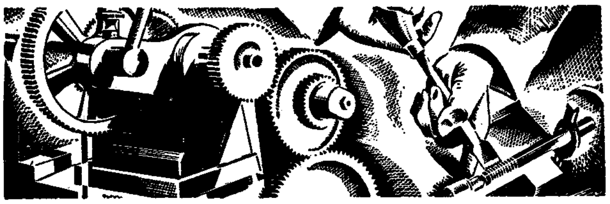
The trade were represented by four local firms: Messrs. Pools Tool Co., Ltd. ; Messrs. Photo-Supplies, Ltd. ; Messrs. Beecroft & Son ; and Messrs. C. Hall & Sons, plus Messrs. G. Kennion & Co., from London.

Visitors and Judges

In all, over 200 models were exhibited, and the show was attended by 5,704 people, including visitors from London, Manchester, Sheffield, Liverpool, Birmingham, Norwich, Derby, Stoke-on-Trent, Leicester, Lincoln, Doncaster, and Burton-on-Trent. Notable absentees this year were " Uncle Jim " (J. C. Crebbin) and " The Professor " (E. Maddock), but they atoned for their absence by sending a ship-letter telegram from the S.S. *Arlanza*—an action which was much appreciated.

The Society wishes to place on record its acknowledgments to Captain R. S. Alston and A. J. R. Lamb, for judging the exhibits in the competitions ; to J. C. Crebbin, for the loan of " James Milne " ; to J. Wood-Mason, for running his " Lord Nelson " on the track ; to Messrs. Air Pumps, Ltd., Battersea, London, for the loan of the air compressor ; and to H. O. Clark and the Societies of Norwich, Peterborough, Stoke-on-Trent, Leicester, and Pinxton, for the loan of models.

TOOL-ROOM TOPICS



Limit-Gauges for Dovetail Slides

By R. HUTCHESON

THE last article dealt with the measuring of dovetail slides, and, more especially, with the "cylinder" method of gauging. To-day, dovetail slides are produced for many small machines in quite large numbers, so that they may be economically made to "limits," and limit-gauges of some sort are required in their manufacture, and such gauges may be either profile- or cylinder-gauges.

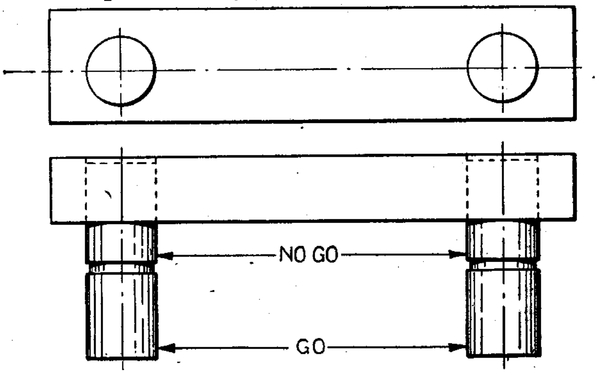


Fig. 1. Limit-gauge with stepped plugs.

Fig. 1 shows a limit-gauge embodying measuring-cylinders. The gauge comprises a bar, in which are set two stepped plugs. The tolerance on the slide is fixed by the designer, and, from one or other of the formulæ already given, the diameters of the two steps of the plugs can be readily determined. The forward ends of the plugs are smaller than the rear ends, and, in using the gauge, the slides must be machined to such a size that the two small steps can enter the angles, but the larger steps cannot.

When making the above gauge, the formulæ is utilised to find the diameter of two pairs of cylinders—the two sizes of steps—which are the same distance apart but which will just enter the angles of the slides when at the lower and upper limits.

Another form of this gauge employs cylinders of the same diameter, but pitched at different centres, the centres corresponding to the distances pairs of cylinders should be apart to just rest in the angles of slides that are at the lower and upper limits respectively. A gauge of this kind is shown in Fig. 2. Three plugs, all of the same diameter, are set in a bar. The distance A is equal to the centre-to-centre

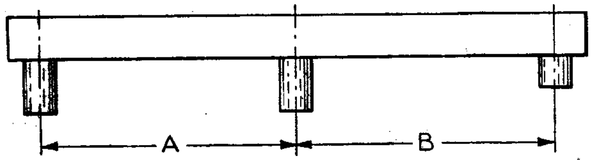


Fig. 2 Limit-gauge with differently spaced plugs.

distance of a pair of cylinders for one limit; the distance B corresponding to the centre-to-centre distance of the cylinders at the other limit. It will be obvious that two separate gauges, each having two plugs, could be used—one for the high and the other for the low limit, instead of making the centre-plug of three to serve a dual purpose.

Instead of using a gauge of which the plugs are an integral part, gauging may be done as shown in Fig. 3, using separate rollers and a limit-gap gauge, as shown at *a*, for testing the male slides, and two end measuring-rods at *b* whose lengths differ in accordance with the limits allowed on the female-slide.

It must be borne in mind that all these tests must be accompanied by an independent checking of the angles, as has been mentioned previously.

Profile-gauges can be adapted for limit-gauging. In Fig. 4, a male slide is shown, and the gauge is indicated as being in two parts. This gauge enables the angles to be checked, as well as the width of the slide. In use, the two halves of the gauge are applied to the work, and the gap between them is tested by

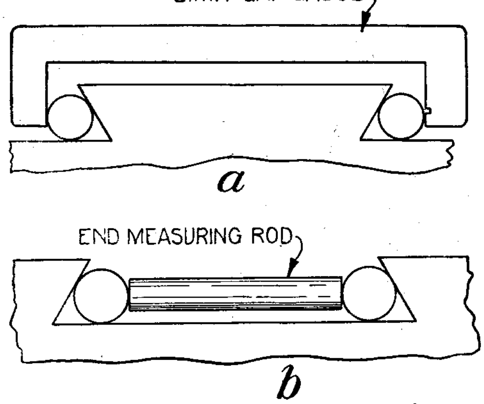


Fig. 3. Gauging with separate rollers (*a*) checking a male slide by a limit gap gauge (*b*) checking a female slide by end measuring rods.

means of two feeler-, or slip-gauges, the slide being within the desired limits, as regards width, when the thin gauge will enter the gap, but the thicker gauge will not. Fig. 5 shows a profile-gauge made in halves in a similar manner, for the testing of a female slide. Instead of making the gauge in two parts and using two feelers, the gauge may consist of three parts. One part is applied to the slide. The other two parts vary in length by an amount corresponding to the tolerance permitted on the work, and the slide is machined to such a size that the smaller part can be

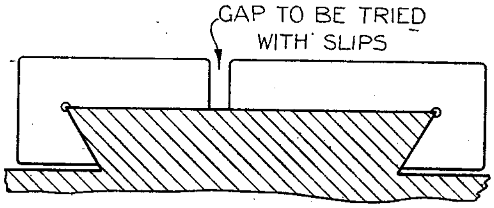


Fig. 4. A profile-gauge in two parts for gauging a male slide.

used in conjunction with the part already on the slide, but the larger part cannot.

Acute-angled Gauges

This is, perhaps, an opportune moment to deal with another query: " How can a gauge, such as is shown in Fig. 6, be made with a sharp corner to the angle? " The querist points out that, usually, gauges made of flat plate have holes drilled in the

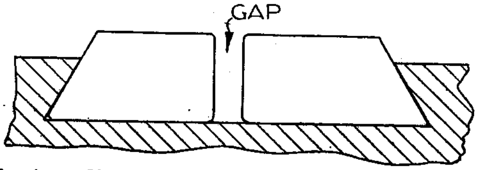


Fig. 5. A profile-gauge for checking a female slide to limits.

corners (Fig. 7), and these holes afford clearance for the file or grinding-wheel, and that great difficulty is experienced in getting out the sharp corners if it is not desired to drill a hole.

If the angle to be worked out is not very acute, the method to adopt is indicated in Fig. 8. A half-round file is employed, and a flat safety side is ground on it, so as to make, with the flat side of the file, a considerably sharper angle than that which it is desired to produce. By using a very fine file,

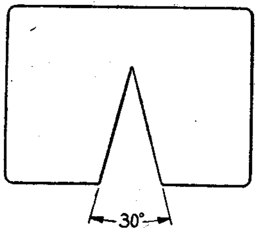


Fig. 6. The type of angle gauge correspondent desires to make.

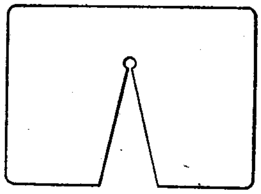


Fig. 7. The usual form of angle gauge with clearance hole at corner.

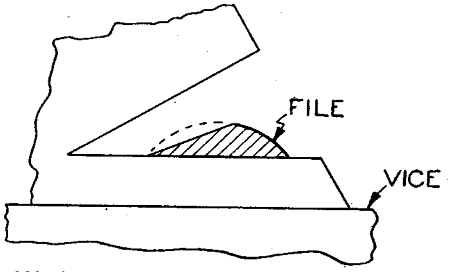


Fig. 8. Working out an acute recess with a file specially ground to shape.

almost dead smooth, it will be possible to get right into the sharp corner.

Instead of working out an acute angle to a sharp corner by direct methods, there is another way of producing the angle. Incidentally, this method is practised considerably by press-tool makers, when they wish to obtain die-openings that would otherwise be difficult to work out. This method involves making the gauge or die in several parts.

Suppose, now, we are wishing to make the gauge shown in Fig. 6, the construction shown in Fig. 9 can be employed. The gauge-proper is in two parts, which are held together by a strap, to which they are secured.

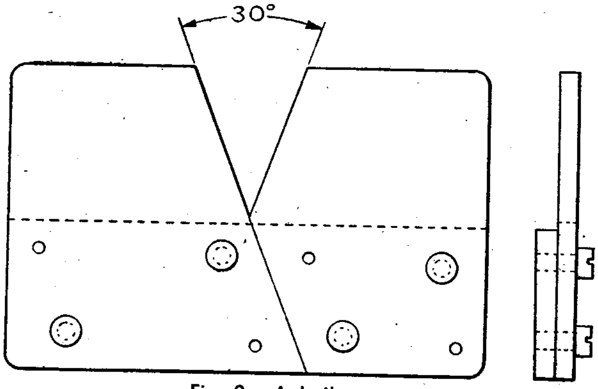
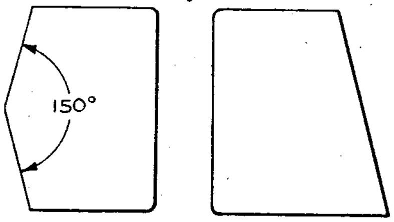


Fig. 9. A built-up gauge.

One piece of plate (Fig. 10) is ground or filed to have two inclined sides, the inclination being 180° minus the gauge-angle—in this instance, $180° - 30° = 150°$. The other plate (Fig. 11) has one dead straight edge filed or ground on it. The two plates are clamped to the strap, so as to butt hard against one another, and the whole assembly is drilled and tapped to



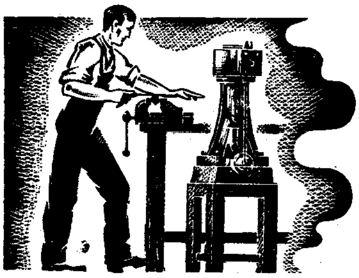
Figs. 10 and 11. The two parts of the built-up gauge that form the sides of the angle.

receive steady-pins and screws, by which the parts are held together. By constructing the gauge in this manner, a sharper corner is obtained in the angle than could be got by filing.

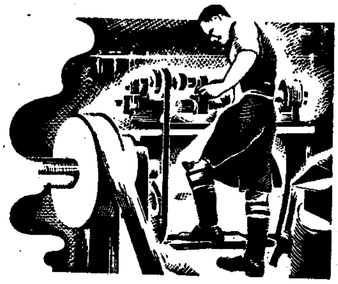
For the Bookshelf

The Engineer's Sketchbook by **Thomas** Walter Barber (London: E. and F. N. Spon, Ltd.). **Price 10s. 6d., postage 5d.**

This is the sixth edition of a very unusual, but very useful book. It is, in effect, an illustrated encyclopædia of mechanical appliances and movements of every kind. There are nearly 3,000 illustrations in diagram and sketch form of engine and machine details, tools, devices for transmitting power and motion, cranes, lifting appliances, chains, cranks, boilers, gearing, presses, lubricators, locking devices, valve-gears, cams and variable motion gears, water-wheels, and a hundred other branches of mechanical interest. A short definition or description accompanies every illustration. It is a valuable reference-book for designers and inventors, as well as being most instructive from an engineering educational point of view. There are 355 pages packed with mechanical information.



METAL CRAFT
IN THE
SCHOOL WORKSHOP



Hacksaws and Sawing

By NATHAN SHARPE

(*Continued from page* 277)

FIG. 5 shows another adjustable frame with a pistol-grip handle, while Fig. 6 shows a very effective and convenient frame of quite recent introduction, the "Eclipse" No. 20T. The frame here is of steel tube, enormously strong for its light weight. Adjustment is made by sliding the tube through the die-cast handle, fixing it in the desired extension by a pin passing through both. The adjustable thumb-rest, for the left hand, should be specially noted, as, also, the fact that the handle is so shaped as to bring the line of thrust further back on the blade.

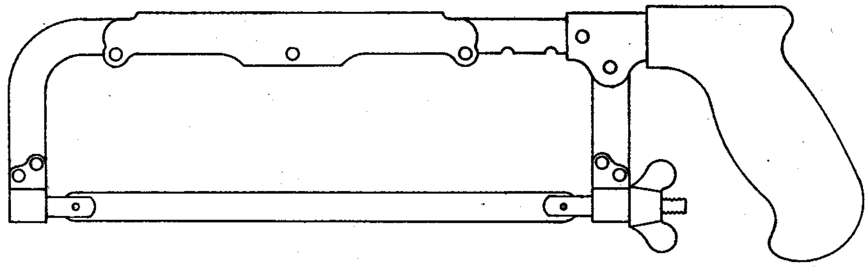


Fig. 5. Pistol-grip adjustable hacksaw frame.

All adjustable frames are made to take blades of all lengths from 8″ to 12″ by inch steps. A few makes will take blades from 6″ up by half-inch steps, useful for using up otherwise sharp blades which have been accidentally broken near one end, when the broken end can be locally softened and re-holed.

Sheet-Metal Hacksaws

Cutting up sheet metal by hacksaw is far preferable to performing the same operation by shears, or by hammer and chisel, as the distortion inevitable to either of these latter methods is entirely avoided, and less waste need be left to clean off the cut edges. However, unless one is sawing strips of less width than the depth of the frame, the back of the saw frame soon fouls the material, and further progress becomes impossible. To overcome this difficulty, the "Shetack" hacksaw was designed (see Fig. 7). It consists of a stiff tubular back, to which the horn-shaped handle is attached, and to which a triangular web of stout sheet steel is riveted. To the ends of the hypotenuse of this web, the anchorage and straining screw are fixed. In use, the web passes freely through the cut made by the saw, the anchoring-pin remaining above the material being cut, the straining-bolt below. This frame uses any 12″ regular pattern hand-blades which will make a kerf of 0.040″ minimum width, and the makers supply blades with suitable set, specially adapted for use with it.

Another sheet-saw, on similar lines, uses special triangular blades.

Girder-saws

Although they are not of great interest to the average metal-worker, it may be as well to mention that hacksaw frames of extra-depth capacity—that is, having a much greater distance between the back of the blade and the inside of the frame—are regularly made for use in cutting deep sections of metal, such as rails, girders, and structural steel sections generally, when this must be done by hand. Such frames are known as "girder" or "rail" saws, and are available in most reputable makes. One firm, at least, offers them in capacities of 6″, 8″

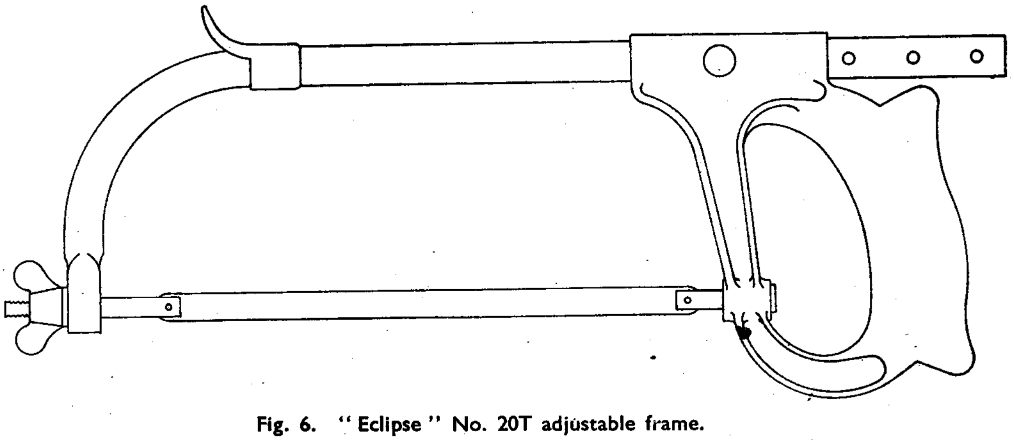


Fig. 6. "Eclipse" No. 20T adjustable frame.

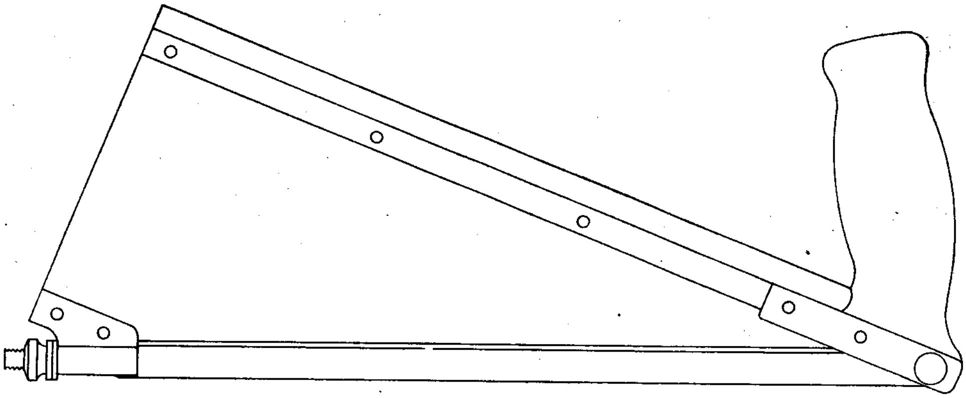


Fig. 7. "Shetack" frame.

and 10", to take 12" blades, and a larger one of 11" depth to take 14" saws. The same firm makes an adjustable rail saw-frame in two depths, 5½" and 10½", to use blades of various lengths from 9" to 18". Girder frames can be had with handles on both ends, also, for two-man use.

Metal saws, in "hand-saw" form, are made by Disston's, in a variety of tooth-pitches. A fine-pitched tooth is used for cutting metal-clad wood mouldings, as used in shop-front construction, coarser-toothed saws for sawing steel bar, shafting, and structural sections. They are, naturally, more expensive than the ordinary hand-saw, and, on account of their harder temper, need much more care in using. For the same reason, they are harder to set and sharpen.

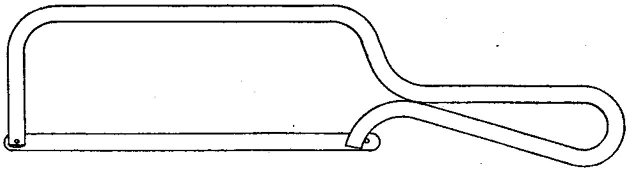


Fig. 8. Wire frame for Midget hacksaws.

Midget Hacksaws

At the other end of the scale from the girder-frames come the "midget" hacksaws. These use fine-toothed narrow blades, 6" long. A very popular form of frame, for this size blade, is illustrated in Fig. 8. It is made from spring-steel wire, and depends for the tensioning of the blade entirely on the spring of the frame. Another form of frame, for using midget-blades in confined places, is shown in Fig. 9. A small drawback which the spring-frame has shown in the writer's hands is a liability to decrease its tension slightly on the outward stroke, resulting in the blade bowing and buckling on the back. Perhaps this might be avoided by facing the teeth towards the handle, and cutting on the pulling stroke; but, in the writer's opinion, such a practice would be an awkward exception to the usual habit of cutting on the forward stroke.

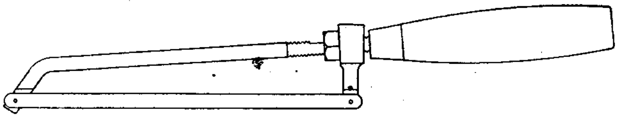


Fig. 9. Midget Small-space frame.

Back-saws

Workers in the silver-smithing (hammered metal-work) crafts make considerable use of small back-saws for cutting brass, copper, and gilding metal sections, as well as the more precious metal. Such saws are obtainable in various lengths, from 4" to 7", at very inexpensive prices. They should be used for non-ferrous metals only. A modified pattern of "jeweller's back-saw," as these are sometimes called, is shown in Fig. 11, wherein the blades are detachable from the back, facilitating the replacement of a blunt or worn-out saw. This frame has a useful thumb-rest at the far end.

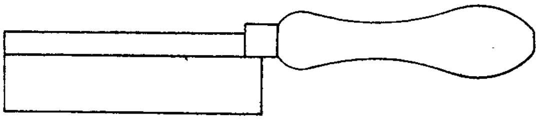


Fig. 10. Brass back jeweller's metal saw.

Keyhole and Pocket Hacksaws

Next to be considered are those metal saws which depart from the bow-saw definition, and are specially adapted to cutting, or commencing to cut, in confined and narrow places. First among these may be mentioned the Goodell-Pratt No. 237 keyhole hacksaw, illustrated in Fig. 12. This uses a flat blade, 7½" long, 0.031" thick (0.042" over the "set" of the teeth), tapering in width from 3/16", at the extreme tip, to ¾" at its broadest. The blade is held in the malleable handle, shown by a couple of grub-screws. The actual available cutting-edge is 5¼" long.

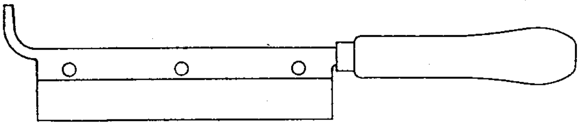


Fig. 11. Renewable blade back-saw.

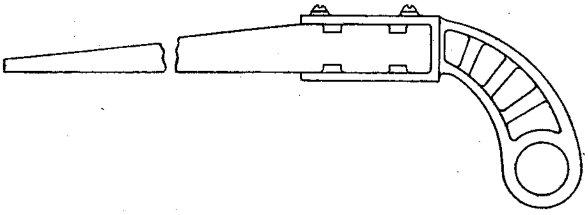


Fig. 12. Goodell-Pratt keyhole hacksaw.

(To be continued)

First Steps in Model Engineering

Workshop Advice, Experience and Philosophy for Readers of all Ages

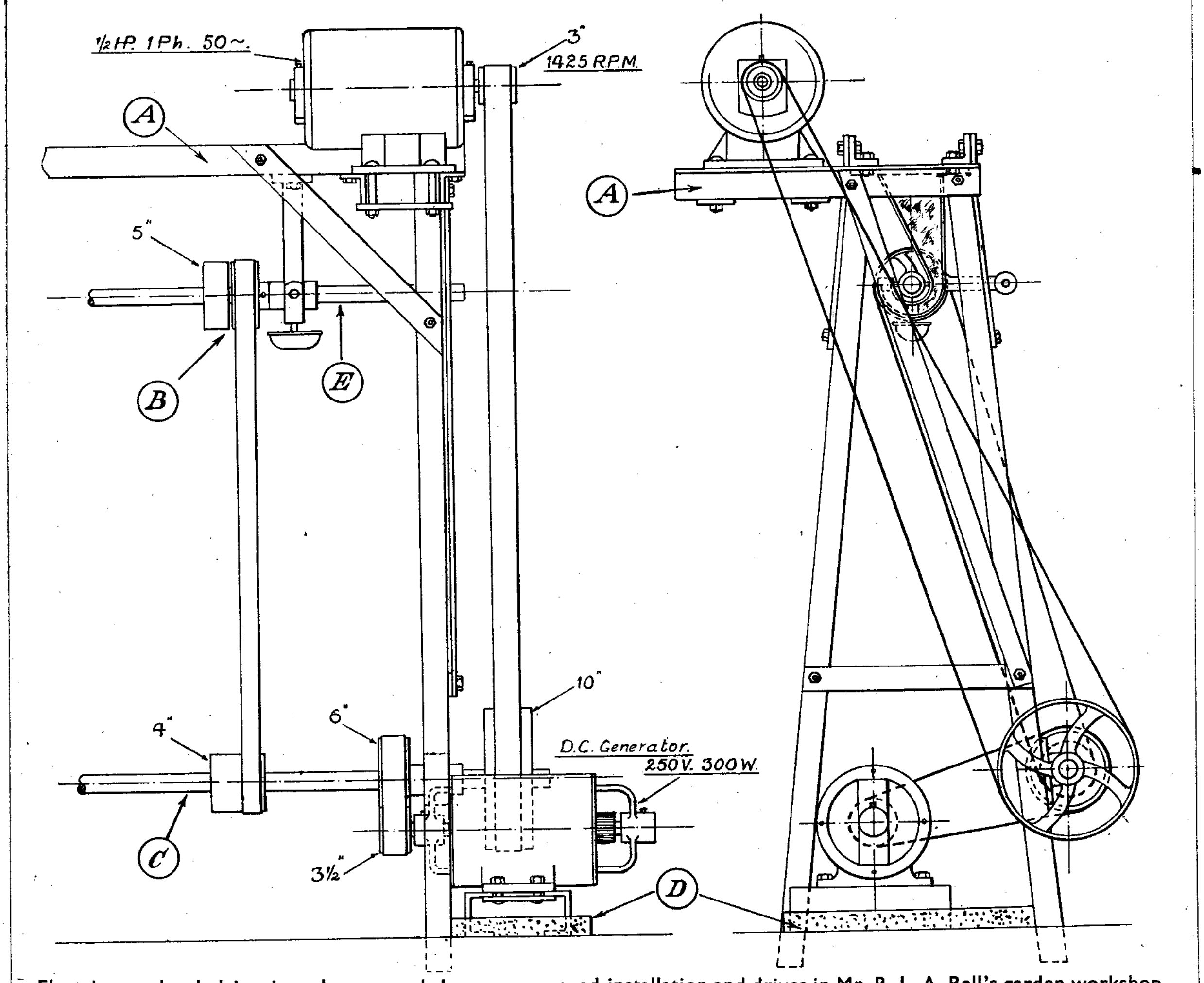
By " INCHOMETER "

Electric Drive in a Home Workshop

A considerable while ago, photographs of the garden workshop at Mr. R. L. A. Bell's home, Yeovil, were published in " First Steps " ; an account of the equipment and his model engineering pursuit accompanied the illustrations. Now, he has effected a re-arrangement of the drive layout, and sent particulars, with a drawing, which should be helpful to others who may be planning a drive system for model engineering equipment. Herewith, I will quote from his letter: " The previous arrangement, with the electric motor on the floor, worked all right mechanically, but occupied far too much room, in order to afford a reasonable length of drive. The small bench built over it, for supporting the grinder and lathe-tools, got in my way. Something in one's way, when doing work, is a great deterrent to concentration on the job in hand—with myself, at any rate—so I have cleared it out, ' lock, stock and barrel ' ; the accompanying drawing shows the present arrangement, which I find to be ideal. I would have preferred to have the motor placed right on top centrally, but the slope of the roof prevents this accomplishment. So, with some contriving, and the addition of a few more bits and pieces to the existing framework, the whole is now a solid job, and running is perfect."

Connecting the Motor

" The wiring to the motor is run in tube from the starting-switch on the wall, at lathe headstock end. The tube is clipped to frame top member ; the whole is earthed to prevent shock, in event of the insulation failing at any place at motor or accessories."



Electric overhead drive in a home workshop, re-arranged installation and drives in Mr. R. L. A. Bell's garden workshop. *A*, sliding adjustment support for motor ; *B*, fast and loose pulleys ; *C*, main shafting, 426 revs. per minute ; *D*, concrete foundation for dynamo ; *E*, countershaft, 340 revs. per minute. Belt-striking gear is not shown.

Auxiliary Drive

" In addition, I have fitted an auxiliary overhead drive, a dividing device using lathe change-wheels, and a small drilling and milling-spindle. The latter, however, is more or less temporary, until I can make a proper milling and drilling attachment."

Overhead-gear Drive

"The overhead-gear is in the form of a pivoted and weighted arm, carrying two jockey-pulleys; these latter are arranged for universal adjustment. The drive is taken from a wide-flanged pulley, fixed on the countershaft; it can be shifted to any position along the shaft, and locked there by means of a set-screw. The arm is supported on, and can swivel around, a vertical pin fixed to a clamping arrangement, which can be set anywhere along the two top members of the framing. The arm itself can move in a vertical plane around a pin, and is weighted at its back end to tension the ¼" diameter round belt, used to drive the spindle. The movement around the vertical pin—that is, movement in a horizontal plane—can be locked. The whole may be set up in any position to give any angle of drive; this gear will, no doubt, prove useful in many jobs of work."

A Dividing Contrivance

"The dividing device is simply an extension to the tail-end of the lathe mandrel. It is screwed internally, to engage with the thread, and is fitted with a locking-nut, and can thus be readily attached or removed. The end is turned to fit the bores of my change-wheels; the arrangement for locking these in place is similar to that on the lathe. The detent is mounted on an adjustable arm; the whole is held by an extension of the bolt, which locks the change-wheel quadrant of the lathe."

Tool-grinder and the Dynamo

"The grinder has been installed in its old position, as in the photograph I sent to you; the wiring has been extended from the dynamo to it, in tube. The dynamo has proved useful on many occasions. I have re-calibrated several D.C. voltmeters (0 to 250 volts), and it has been of service for various other jobs of an experimental nature, which one, naturally, does for one's friends."

Silencing Noise of Belts

"Everything now runs perfectly, and I have hit on a simple cure for silencing the 'click' of the belt-fasteners on the main driving belt. I procured an old motor-car tyre inner tube, of fairly large size; having cut sections from it, they were stretched over the 10" diameter pulley, until the face was completely covered, the edges being afterwards trimmed off flush with the sides. The motor-pulley was treated in the same way, with motor cycle size tube. This device completely prevents belt-fastener clicking noise; in addition, the coefficient of friction between belt and pulley is greatly increased; the belts can be run slacker, and do not require any dressing."

Making a Slide-Rest Screw

"Also, I have made a present to my lathe of a new cross-slide screw and nut, 10 threads per inch, left-hand square, with ball-handle and loose index collar. The latter was easily divided by means of the dividing-gear I have described. Around the nose-end of the lathe mandrel, I have fitted a felt-lined dirt-excluder ring, where it protrudes through the bearing. The screw and nut were an interesting, though very ticklish, piece of work, as the diameter is only 7/16", and length 13" between centres. The travelling-steady was used, when I was cutting the screw, and, as I do not, personally, believe in using any sort of lapping process to obtain a running fit of screws and nuts, I made a special tap, using the same tool as was used for cutting the screw. Having screw-cut the nut (gunmetal) within a thousandth or two of an inch of size, the tap put through just did the trick, and the fit came out perfect."

G.W.R. "King" Class Locomotive

Now, Mr. Bell contemplates building a G.W.R. "King" class model locomotive, but has been unable to obtain drawings or information about the internal arrangements of motion, etc., though he has an official general-arrangement drawing of engine and tender; so, without knowledge of the general layout, cannot know "the possibility of the job." He intends a real scale model, so far as this may be possible.

Convenience of Electric Drive

The drawing illustrates, by the overhead position of the motor, the convenience afforded by electric drive. You will notice that Mr. Bell has alleviated that most disadvantageous of drives—the vertical—by sloping the line of pulleys. With this instance, also, the driver-pulley being the top one, the weight of the belt tends to assist its adhesion on the small-diameter pulley, where it has the lesser facility of grip. This is a helpful incidental, because, by the direction of running, the lower side of the belt is the slack, and, therefore, tends to fall away from the pulleys. The upper side would, preferably, have been the slack; it would then tend to close around the pulleys and assist the grip. A horizontal drive is preferable to one inclined, or vertical, especially when the upper side of the belt can be the slack. But one may have to compromise, and, with his discovered plan of rubber-covering the faces of the pulleys, a trouble-free and efficient drive is demonstrated. With a reservation, however: will this rubbered drive withstand a test of time, and continue satisfactory? Under conditions of heavy continuous working some rubber-faced belts, I am informed, eventually, have given considerable trouble. But I am cautious of disparaging particular makes and kinds of driving belts, because much depends upon selection for a service, and management and treatment. In a workshop, oil is liable to get on to a belt; oil is very detrimental to rubber—causes it to soften, become sticky, and tend to peel away. Probably, Mr. Bell will advise me if trouble does occur later on; even then, it will not be much expense to renew the rubber coverings.

Cost of Electric Drive

From enquiry received, some home mechanics hesitate about installing an electric motor, because they are apprehensive of the cost of running. If Mr. Bell could—now, or later on—give an actual figure of cost of driving which obtains with his motor, it would be helpful, in this respect. Though it may appear as if a ½ h.p. motor would consume, approximately, half a supply unit, for an hour of working in a home workshop, the motor does not usually work at full load, or continuously. It is switched on and off repeatedly, during, say, an evening's use, and, probably, works in a range of load from very light to about half-load capacity. An electric motor is a self-regulating machine, taking current in proportion to the work-load obtaining at any moment. Consumption of supply will, consequently, prove to be a sort of average, difficult to estimate, but generally less than one has anticipated. If any reader who has actually checked the cost of running his workshop motor, will be kind enough to let me know the figure and circumstances, I shall be obliged, and pleased, to incorporate the information in "First Steps"; it would be interesting and useful.

A Novel Electric Light Reflector

Visiting an acquaintance, a few weeks ago, I was impressed by the excellent lighting effect upon his study table from a pendant electric lamp suspended over it. Naturally, I looked to ascertain if the light was directed from a particularly good, or special, reflector. It is a special reflector, so far as I had seen in use; in fact, it is an ordinary round tin pouring funnel of large size, about 5″ diameter across the mouth, inverted to serve as a reflector. The lamp and socket are contained in it, and the flexible cord is passed through the spout. Simply a tin funnel, costing a few pence, threaded upside-down over an ordinary flexible cord suspended electric lamp. Various sizes of such funnels are sold; I commend the idea, from actual observation, for workshop service. As a precaution, a rubber—or other—insulating sleeve might be threaded over the cord where it enters the spout. The wires in small, flexible, electric cords are very fine gauge, hair-like; sometimes, fracture occurs and a wire works through the insulation. An insulating sleeve would prevent the funnel from becoming "live" by a protruding wire touching it.

Blower for a Gas Blowpipe

An enquiry has been referred to me from a model engineer who contemplates making the gas blowpipe, described in THE MODEL ENGINEER Handbook No. 46, page 26, but is requiring information about making a blower to supply the air-blast. Air to a blowpipe requires to be at substantial pressure; the means I would recommend for service in a home workshop is a foot-bellows, such as obtainable from the generality of tool-dealers. There is an article describing, with drawings, how to make a bellows of this kind (also, a blowpipe) in THE MODEL ENGINEER of September 29th, 1910; the issue, I am informed, is now out of print, but the volume (No. 23) may be accessible at a public library. Another device, about which he inquiries, is the "Chinese blower"; this consists of an elongated box, square, in which an easy-fitting piston works. The device is, actually, a simple air-blowing pump; there is a piston-rod, working through a stuffing-box, provided with a handle, or might be connected to a power drive. Inlet and outlet valves are provided at each end of the box, the latter opening into a wind-trunk, to which the delivery-pipe is connected. The arrangement is double-acting, air being delivered at each stroke of the piston. A description and drawing are given in the issue of February 22nd, 1906; this volume (No. 14) might also be consulted at a public library.

Improving Warped Drawing Boards

Drawing-boards and tee-squares often give trouble especially if not of the best class) by warping and wearing out of truth. Changes in the seasons affect the boards and the same, as well as wear and tear, affect the squares.

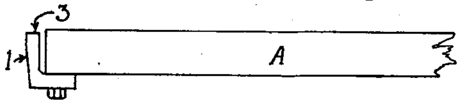
The devices shown on sketches *A*, *B* and *C* were devised to do away with all the various troubles following on such conditions, and they do so most effectively.

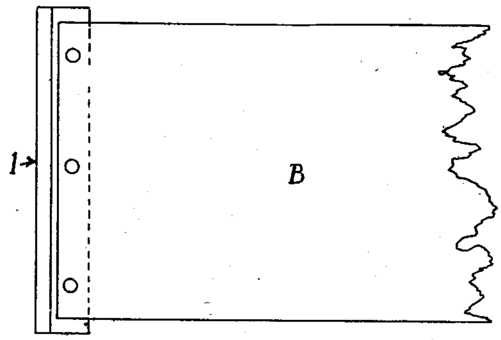
Referring to the sketches, the part marked 1 is a strip of manganese bronze (the section of this depends on the size of the board, but it is all the better for being quite rigid and "stiff"). The strip is fixed on the under-side of the board, as shown, with three steel flat-head bolts, the heads being let in "flush." The hole in the middle is a close fit on the bolt (both as regards the board and the bronze strip). The outer bolts are, also, a tight fit in the wood, but, in the metal strip, the holes are made so that, while a good fit on the bolts *sideways*, they are slotted fully 1/16″ on each side of the bolt, in the direction of the length of the strip. Before fixing the strip, it will require to be made quite straight, and have any twist taken out; and, *after* it has been firmly screwed down, the edge indicated by arrows at 1 will be filed, or ground, or scraped to a good steel straight-edge or surface-plate. The top side of the strip should be about 1/16″ lower than the working surface of the board.

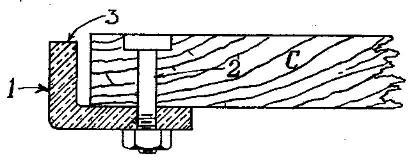
The manganese bronze guiding strip is shown here projecting slightly beyond the edges of he board. Depending on how the blade is attached to the tee-squares stock, the amount of this projection will have to be varied to enable the required working area of the board to be entirely utilised. (This point can easily be got at by laying on a sheet of paper and trying on the tee-square.)

To obtain the best results from this idea, a strip of "stainless steel" from 2″ to 3″ long, and of a width equal to the thickness of the stock of tee-square, by, say, ⅛″ thick, is securely fixed to the inside edge of the stock by 3 cs. screws, one piece at each end, and, when screwed down perfectly solid, filed absolutely level and parallel.

When properly fitted, this idea abolishes all future troubles that necessitate, in some cases, frequent "tuning up" of the boards and tee-squares, and the







strips of steel fixed to the square, limit the bearing surface to the ends, and thus prevent rocking, with all the inaccuracies, etc., this gives rise to.

The writer fitted two sets thus, many years ago, and they have had nothing done to them since. All the former annoyances from warping, etc., have been ended.—J.A.F.

Calculating the Power of Pelton Water Motors

A READER recently submitted the following query relating to a Pelton water motor. As this subject is of interest to other users of small water power, we append a full reply in which the method of calculating both power and proportions of this type of water motor is explained. The query from W.E.H. (Kidderminster), is as follows :—

"I have in my possession a 2-h.p. Pelton wheel which has ¾″ inlet pipe with 3/16″ nozzle. This wheel develops its 2-h.p. at a fall of 400 feet. What h.p. could be developed with a fall of 200 feet? Can any of the shortage of fall be overcome by using a larger supply pipe and nozzle?"

Your query states that you have a Pelton wheel water motor, which develops 2 h.p. with a fall of 400 feet, and that the machine is fitted with a nozzle that is 3/16″ bore. Have you actually verified that the machine gives 2 h.p., as it is difficult to believe that it would do so with such a small bore nozzle as 3/16″? On first principles, and assuming the best conditions, for the motor to develop 2 h.p. with the smallest bore inlet pipe possible (in which the kinetic head is always two thirds of the static head) we would get the quantity of water required as :—

$$\frac{2 \times 33000}{2/3 \times 400 \times 10 \times \cdot 8} = 31 \text{ gallons per min., and}$$

allowing 80 per cent. efficiency. From this the jet diameter is found thus :—

The velocity for a kinetic head of 2/3 of 400, $= V_1 = \sqrt{2g \times H_1} = \sqrt{2 \times 32.2 \times 266} = 131$ feet per second from which the jet diameter should be :—

$$\sqrt{\frac{31}{2.04 \times 131}} = .34'' \text{ which is transposed from}$$

the well known formula :—

$$V_1 = \frac{\text{g.p.m.}}{2.04 \times d^2}$$

Where V_1 = vel. in feet per second. d = dia. in inches.

The figure .34″ requires to be divided by a jet coefficient to allow 31 g.p.m. to be actually passed which would bring the bore up to :—

$$\frac{.34}{.94} = .362'' \text{ dia.}$$

You further state in your query that the supply pipe to the motor is ¾″ bore. This also is an anomaly, as with a pipe this size, the whole of the useful head would be absorbed by friction, which would leave a minus quantity for kinetic head, as far as we are concerned. To prove this, using Box's rule the :—

$$\text{g.p.m.} = \sqrt[2]{\frac{3 \times h \times (3d)^5}{L}}$$

where h = head lost in pipe, in feet. L = length of the pipe in feet.

Then assuming the length of the pipe to be 50 feet more than the fall (it couldn't be much less than this), we get—

$$\text{g.p.m.} \sqrt[2]{\frac{3 \times 400 \times (3 \times \frac{3}{4})^5}{450}} = 12.4$$

Which means that with only a ¾″ pipe, from a height of 400 feet, you would only get 12.4 gals. per min. to trickle through, leaving no kinetic head at all, as all the head would be lost in driving the 12 gallons through the pipe. It will, therefore, be seen that nothing like 2 h.p. could be developed using this main. A penstock much larger, will therefore have to be provided. In order to avoid expensive pipe lines, it is customary to design them so that one third of the static head is allowed as loss due to pipe friction. In these circumstances the maximum power is obtained in relation to the size of the pipe. Applying these considerations for this case, we find :—

$$\frac{H}{3} = h = \frac{\text{g.p.m.}^2 \times L}{3 \times (3d)^5}$$

from which, we can get the dia. of the pipe that will give us the correct size for the maximum power of 2 b.h.p., this is :—

$$\text{dia. in inches} = \sqrt[5]{\frac{31^2 \times 450}{3 \times 133}} \div 3 = 1.35''.$$

Of, course the nearest size to this that can be obtained is 1½″ as pipes of 1.35 dia. are not made unless specially ordered. At the same time, it will be seen that this is nearly double the size of that stated in the query.

Your question as to what h.p. could be developed with a fall of 200 feet using the motor as it is, with a .362″ bore nozzle, and assuming the same size pipe of 1½″ bore we proceed to compute as follows :—

The g.p.m. through this nozzle with the reduced head of 200 feet is obtained from the formula :—

$$\text{g.p.m.} = \sqrt{H}\left(\frac{d}{.282}\right)^2 = \sqrt{200}\left(\frac{.362}{.282}\right)^2$$

= 23.3 g.p.m.

The head lost in friction when 23.3 g.p.n. is flowing through 250 feet of 1½″ pipe (adding the extra 50 feet to the fall as before) is :—

$$h = \frac{\text{g.p.m.}^2 \times L}{(3d)^5 \times 3} = \frac{23.3^2 \times 250}{4\tfrac{1}{2}^5 \times 3} = 24.6 \text{ feet.}$$

The kinetic head will therefore be 200 − 24.6 = 175.4 feet, from which we obtain the h.p. :—

$$\text{B.H.P.} = \frac{175.4 \times 23.3 \times 10}{33000} \times 80\% = 0.99 \text{ B.H.P.}$$

Finally, you ask what size larger supply pipe would be necessary to still give the 2 h.p., by increasing the quantity of water, but with only half the head, viz: a 200 foot fall.

The required size pipe would be found as follows, assuming as before that to keep the cost of same the minimum for the maximum power, we get :—

$$\text{Quantity of water to develop 2 h.p.} = \frac{2 \times 33000}{2/3 \times 200 \times 10 \times .8}$$

= 62 gallons per min.

The new jet diameter for this amount of water is :—

$V_1 = \sqrt{2g\ H_1} = \sqrt{2 \times 32{\cdot}2 \times 133} = 92{\cdot}5$ feet per second,

$$\text{so the jet dia.} = \sqrt[2]{\frac{62}{2.04 \times 92.5}} = \cdot 574'' \text{ dia. which}$$

has to be divided by the co-efficient .94; making the actual small end of the nozzle .61 inches diameter. It should here be mentioned that in order to get the best efficiency from the nozzle, giving a well defined jet of water, the cone should have a gradual taper down from the 1½″ bore of the inlet pipe to the jet diameter, and this cone should have an included angle of 13½ degrees. A special bit should be made to do this and the bore of the cone polished afterwards. From this we obtain the size of the penstock, having arranged that :—

$$\frac{H}{3} = h = \frac{\text{g.p.m.}^2 \times L}{3 \times (3d)^5} \text{ we get :—}$$

corrected size for pipe in this case for the fall of 200 feet and allowing 250 feet for the total length.

$$d = \sqrt[5]{\frac{62^2 \times 250}{3 \times 66.6}} \div 3 = 1.82''$$

The nearest size in this case will of course be 2″ bore. If, of course, there is a long run of horizontal pipe between the actual vertical fall, and the water motor, still larger bore piping may have to be installed due to the added pipe friction, otherwise the above deliveries would not be realised.

Workshop Hints and Gadgets

Short original and practical contributions to this page are invited from readers, and will be paid for. Write on one side of the paper only ; address items to the Editor of THE MODEL ENGINEER, *and mark envelopes " Workshop Hints."*

Tool Angle Gauges

Turning-tool angles vary widely, according to the metal of the work in hand ; therefore, it is difficult

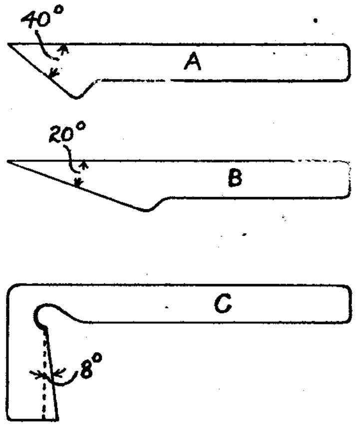


Fig. 1. Tool angle gauges.

to lay down any hard-and-fast rules. For instance, the old-time turner will use a certain top-rake angle on a particular piece of steel, and alter it when cutting another piece which, by sight, looks exactly the same. In order to help those turners who have not had the experience of years in the workshops, here are a few hints on tool angles and simple gauges which are easily made.

When cutting wrought-iron and mild forms of steel, the top-rake angle should be about 40 degrees.

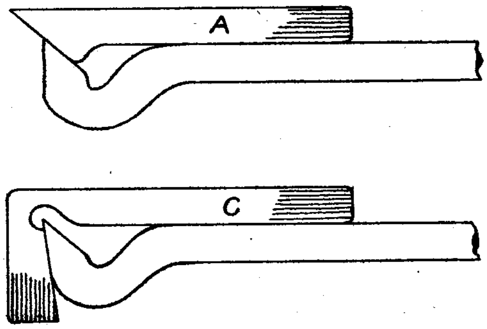
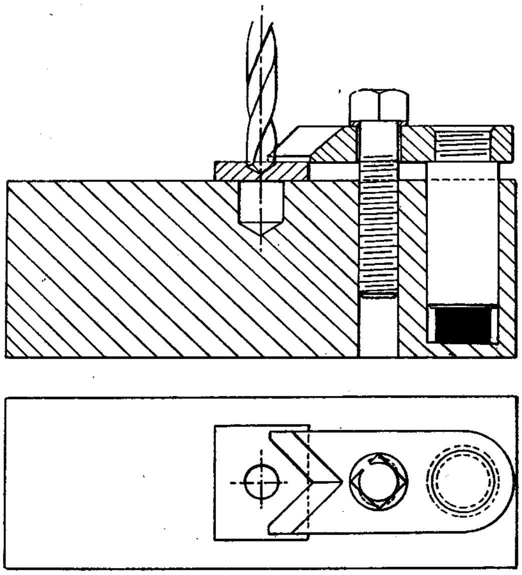


Fig. 2. Gauge applied to tool.

A suitable gauge, for this angle, is indicated at *A* in the illustrations, and can be made in metal plate, 1/16″ thick. For cast-iron, the top-rake angle should not be more than 20 degrees, and an angle-gauge for this is indicated at *B* (Fig. 1). Most of the tools should have a clearance angle of about 8 degrees, and a suitable gauge is indicated at *C* (Fig. 1). Tools for brass should have no top-rake, but the clearance can be increased to 10 degrees. The top-rake angle for iron is indicated at *A* (Fig. 2), and shows how it is applied to the tool when grinding. An illustration of the application of the clearance angle gauge is indicated at *C* (Fig. 2). By making a few gauges of this kind, it is a simple matter to test the tools, from time to time, and so keep a check on the angles.—W. J. SAUNDERS.

A Drill-Pad for Small Pieces

The sketch is a suggestion for making a drilling-block to carry small washers, plates, levers, and such-like, with the least obstruction to sight and



manipulation, in the style of clamp. This has no packing to come on the way, or to adjust, the clamp being kept level by the plug, a close fit in its hole. The disc of soft rubber, at the bottom, acts as a lifter, when the screw is slackened. The bevelled vee, on the clamp, will grip all shapes close to the hole.—F.H.

QUERIES AND REPLIES

Querists must comply with the Conditions and Rules given with the Query Coupon in the Advertisement Page of each issue.

7,494.—Chrome-plating.—H.M. (Prestwich)

Q.—I wish to do some chrome-plating on models. Will you please tell me where I can get chrome-salts for this work? I shall only want small amounts.

A.—We would advise you to get in touch with Messrs. W. Canning & Co., Ltd., Plating Engineers and Supply Merchants, St. John Street, Clerkenwell, London, E.C.1, who will quote you prices, and supply. It is necessary, by the way, to carry on chromium-plating under proper conditions of ventilation, due to the giving-off of deleterious matters.

7,484.—Bending Copper Tubing.—H.W.S. (Dorset)

Q.—I have to make some sharp bends in some lengths of ½" copper tubing, which will have to be loaded. I want something that will melt easier than lead. Would half lead and half bismuth, melted together, make a lower melting-point alloy to load the above with? If not, could you let me know what will do?

A.—A very good material, to load copper pipes in bending, is "rosin," which is easily melted, and must be allowed to set before operation. Theoretically, it is assumed to pulverise in the bending, and then re-arranges its grains so that they leave the compression side and go to the tension side, in which case, the circularity of section at the bend is maintained. This can only be theory, because the pipe-bend would have to be destroyed by sectioning to prove it; otherwise, the loading has to be again made molten to withdraw it. There is a low-melting alloy, or was, called "Easy Bend" on the market, but by whom marketed, we have no record. An equivalent, somewhat similar to the solder called "Wood's Metal," is made up by 2 parts bismuth, 1 part tin, and 1 part lead, which is stated to melt at 210° F. It will, therefore, clear from the pipe by boiling in water. It is really pewterer's soft-solder. It melts, therefore, at about one-third the temperature of lead.

7,489.—Trouble with ½ h.p. Two-stroke Petrol Engine.—H.S. (Cambridge)

Q.—I have a ½ h.p., governor, two-stroke petrol engine coupled to a 12-volt car dynamo, occasionally running on a steady lamp load of 15 volts, 8 amps. I have always thought it was not working properly, for, after about a quarter of an hour, the governor jerks about intermittently, with an accompanying thump in the engine, which does not seem consistent with a *steady* load. I have only recently noticed that, after about a quarter of an hour from starting, large bubbles appear at the hot water end, in the water-tank. I have, also, noticed, and am puzzled by, the fact that the water-pipe from the engine warms up, for about a quarter of an hour, and then goes cold, although, a little while ago, there was a steady increase in the heat of the water. I have thought this might be due to a cracked cylinder (although water is always drained off), or a faulty joint. As I am at a disadvantage for any necessary overhaul, I do not want to have the engine unnecessarily taken down (as it has never, so far, been touched, and has done little work), and should be glad if you could kindly give me any advice as to what to do. Is there any connection between the bubbles in the water-tank, and the occasional thump of the engine, mentioned above? Or is the appearance of bubbles merely something normal to the water circulation?

A.—It is extremely difficult to diagnose the trouble with your engine on the available data, but we can give you one or two hints, which may be helpful. Uneven governing may be caused by mechanical faults in the governor itself, or the control-rods, links, etc. Either excessive backlash, slackness of joints, or tightness, due to lack of lubrication or bent pivots, may cause jerking to occur, though the usual symptom, in such cases, is "hunting," or alternate fast and slow running of the engine. It is, however, possible that the cause of the trouble is not in the governor, or the mechanical system at all, but that, in actual fact, the load *does* suddenly vary, owing to electrical faults in the generator. An ammeter in the circuit would help to detect any loose contact, or similar fault, which may exist. The appearance of bubbles in the water-cooling system is certainly not normal, as they should not be formed, unless the jacket temperature is practically up to boiling-point; the inference is that they are caused by gas leakage from a crack, or faulty joint in the cylinder. We can offer no explanation whatever of the water outlet cooling off, after initial warming-up, when running the engine.

7,490.—"Blower" Size of Centrifugal Pump.—W.C. (Southend-on-Sea)

Q.—Would you kindly tell me the size and speed of centrifugal pump, to get an equivalent pressure as that in an average 15 c.c., two-stroke crankcase?

A.—Your requirements are rather vaguely stated, but it is extremely difficult to devise a *small* centrifugal blower, capable of producing a pressure measureable in more than a few inches head of water. (Two feet head of water are equal to a little over 1 lb. per sq. in.) The reason for the fact that small blowers are not so efficient as large ones is that, as they utilise the centrifugal force of the air passing through them, and this depends upon mass multiplied by velocity, it is clear that, when the mass is reduced, the effect of velocity, also, becomes less. In practice, this means that small blowers have to be run at incredibly high speeds, in order to develop reasonable efficiency; and such speeds cannot be obtained by ordinary gearing, without considerable mechanical losses.

Practical Letters from our Readers

Model Speed Boat Rules

Dear Sir,—Now that we are about to embark upon another year of hectic boat racing, I would like to make some suggestions for setting-up a set of model speed boat racing rules that could be really called international. Personally, I see no reason for any changes in boat specifications. The model engine manufacturers are all set making 30 c.c., 15 c.c., and 10 c.c., and it's not an overnight job to change.

Here are a set of rules I would like to see adopted ; the only changes which may be required for the British boats are a change in length of line and in length of race.

Our 52 ft. 6 in. cord equals 1/16 mile per lap, so that four laps equal ¼ mile.

Proposed International Model Power Boat Rules

Class " A ": 12 to 16 lb. steam or gas unlimited.

Class " B ": 7 to 12 lb. steam unlimited ; 50 c.c. for multi-cyl. gas ; 30 c.c. for single-cyl.

Class " C ": 5 to 7 lb., 15 c.c.

Class " D ": under 5 lb., 10 c.c.

Line, 52 ft. 6 in. long, held 48 in. above water ; each lap equals 1/16 mile ; 4 laps, or ¼ mile, constitutes a race.

Timing: divide time in seconds into 900 ; this gives miles per hour.

Starting: timekeepers are located ¼ lap to right, and start timing when the boat has made three-quarters of a lap.

We have a sheet on which are all the figures set up by half-seconds for times from 12 to 60 m.p.h. We also have a standard sheet for all clubs to keep records of each boat, to be put in loose-leaf cover and index cut for owner's name. All data has space for listing, and these sheets are sent in, at the end of the year. Space allotted for timekeepers' signatures ; also, for notary public.

Felt pennants will be supplied, at end of season, for all boats making records as follows:—

Class " A," 30 m.p.h. or over ; Class " B," 25 m.p.h. and over ; Class " C," 20 m.p.h. and over ; Class " D," 15 m.p.h. and over. All club boats have a letter, a number and a letter, as, for example, D-10-A means a Detroit boat, No. 10, Class " A."

I see no reason why these rules cannot be adopted as international. The length of cord makes simple calculations, and everyone will know just what to do.

Yours faithfully,

R. A. Hill,
Sec., D.S.M.E.
Pres., A.M.P.B.A.

1,098, Lakepointe, Detroit, Mich.

[Mr. Hill's letter contains quite a number of practical suggestions, which we commend to the notice of model power boat clubs in this country, as the desirability of a standard set of international racing rules is beyond question. The matter of the length of line, however, is one which, usually, must be regulated to suit the size of the pond, and few ponds in this country would allow a line of the proposed length to be used. It is not quite clear what particular advantage is gained by allowing boats a ¾-lap flying start, as the usual half-lap is generally considered ample, and has the advantage of allowing boats to run either clockwise or anti-clockwise, without necessitating a change in the location of the timekeepers.—*Ed.,* " M.E."]

Preventing Rust on Tools

Dear Sir,—May I endorse Mr. C. R. Cosens' solution of the rust problem by means of anhydrous lanolin. I came across this in a Model Engineer back number, and the results are satisfactory. I warm my tools and then apply the lanolin, as I think benzine—the solvent used—is rather dangerous in a home workshop.

I wonder if any reader knows of a less dangerous solvent for lanolin?

Yours truly,

Prescot. C. C. Allison.

Steam Engine Modelling

Dear Sir,—In a recent issue of the " M.E.," in " Smoke Rings," you say that the modelling of steam engine types has not yet been wholly exhausted. I agree with you, and think that a good horizontal or vertical type could be got out with advantage, and for the following reasons:—Why not try out the *poppet-valve* type, say, in conjunction with central exhaust, as in the *Uniflow* engine? We have had laps and leads of slide-valves and piston-valves expounded upon time and time again, but few of us have tried out what has been proven in big practice as *the* most economical system, as far as concerns the reciprocating steam engine.

Such horizontal engines as we have access to, appear to present certain difficulties in the attachment of the cylinder to trunk guide- and bed-plate combinations, and they are all more or less intended for high speeds, where the beauty of the working parts under power is lost in a whirl. My idea would be a fairly long-stroke, slow-working engine. This, however, might not commend itself to the uniflow system ; but, even so, it would be good to look at, interesting to make, and the admission and cut-off could be set, re-set, and altered for experimental purposes, all of which should afford pleasureable entertainment. The initial cost of castings, for such an engine, should not be so very costly, particularly if the cylinders, bearings, and such-like were destined to suit either a horizontal or vertical engine. Some may demur at this on technical grounds, but we have to remember that the working *model* is not intended for *continuous* running. In other words, whilst we are working at our ordinary daily work, the model is doing *nothing*.

Most of us hate to see the old steam engine being supplemented by its odoriferous competitor, and, whilst we *cannot* afford to ignore the latter, we should, at least, be able to say of the steam engine that we modelled it up, and, including the period of *its last efforts,* and if we eventually have to abandon our long-cherished old pal, let us do so reluctantly, and with the reverence and affection it has earned.

It would ill-become us to wholly desert him in his worst hour—and at a time when even *he* is losing some of his own identity with the new gew gaws being thrust upon him, such as case-hardened valve-cams and mechanism, superheated steam, pre-heating his steam between stages (think of his digestion!), whilst, with it all, he is still lighter-built than his arch-enemy, and still flourishing his remaining dominating factor—elasticity.

In big marine practice, even should he have a breakdown, half of him will still work; whereas his arch-enemy, under like conditions, has to have his firing sequence synchronise with his crank sequence; otherwise, *he* is out of luck, and finds himself firing one cylinder *against* the other in a mild kind of suicide.

Yours truly,

Lakewood, Ohio. P. W. Wilson.

Institutions and Societies

The Society of Model and Experimental Engineers

A very successful meeting was held at the Caxton Hall, Westminster, on Thursday, March 24th, with an attendance of 81 persons, who listened to an interesting and informative lecture from Mr. Geoffrey Parr on "Television."

The next meeting will be held at the Caxton Hall, Westminster, at 7 p.m., on Tuesday, April 12th, 1938, when the Rt. Hon. the Earl of Northesk will deliver his Presidential address. This will deal mainly with observations on North American Railways made during his recent tour of Canada and the United States.

Full particulars of the Society, with membership application forms, may be obtained from the Secretary, H. V. Steele, 14, Ross Road, S.E.25.

Kingston-upon-Hull Model Power Boat Club

By the courtesy of the Hull Education Committee, and Mr. L. Miller, Organising Head, the Club held its Seventh Annual Exhibition, on March 12th, at the Model Making Centre, East Hull Men's Institute, Williamson Street. Some 500 people passed through the building, and were keenly interested, and many questions were asked and explained.

Prominent among the power boat exhibits was Mr. L. Bratley's 30 c.c. engine, which, last year, attained 41.12 m.p.h. (this member has gone one better this year—of this, more later); W. Rea's 30 c.c. twin-port, which, last year, "did its stuff" consistently, as many as 26 laps consecutively at 25 m.p.h. With a different hull and a few alterations, it should show a considerable increase in speed this year.

In the 15 c.c. class was D. Cape's two-stroke of his own design, and W. Atkin's 15 c.c. four-stroke, with his super-lightweight hull; both of these were work-manlike jobs. Among these exhibits was the "Jordan Cup," presented by Jordan's Motors, Ltd., Hull, the leading motor-cycle dealers in this town, and R. Rand's 30 c.c. "Grayson" engine, nearing completion.

In the prototype class were working models of S. Smith's 3 ft. model tug, plated hull, power plant complete with superheater, water feed-pumps, bilge ejector, etc.; keeping it company was J. Patchett's 3 ft. model of a local trawler; R. D. Hobson's sea-going tug, with compound engines; Mr. Frank Dunn's cross-Channel steamer, looking rather worse for wear after seven years' hard running; A. Hahn's flash steam coastal motor-boat, shown at last year's "M.E." Exhibition—this model caught the eye; S. Taylor's unfinished cabin cruiser, the hull being an exceptional piece of woodwork. On this side were several engines and boilers in various stages of construction.

In the general class was a fine stationary steam plant, by G. Hamer, and a well-finished horizontal engine, by J. Carter; also, a working model of a naval quick-firing gun, which was a beautiful piece of work, by the same member.

In the locomotive section was J. Proud's 1" gauge "Pacific," coal-fired, and a 2½" gauge "Atlantic," oil-fired, which were very much admired; several unfinished locos. in "bits and pieces" were on view.

Two old-time galleons made a striking contrast; several other exhibits were on view together; also, the various models under steam were the centre of attraction.

The Exhibition was voted a huge success by all.

Hon. Secretary, Mr. Frank Dunn, 26, Fourth Avenue, Greenwood Avenue, Hull.

The Junior Institution of Engineers

Friday, April 8th, 1938. At 39, Victoria Street, S.W.1, at 7.30 p.m. Ordinary meeting. Paper: "Some Types of Surface Heat Exchangers," by R. Sutcliff (Assoc. Member, Durham Bursar). Projections.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. Unless remuneration is specially asked for, it will be assumed that the contribution is offered in the general interest. All MSS. should be accompanied by a stamped envelope addressed for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co., Ltd., 13-16, Fisher Street, London, W.C.1. Annual Subscription, £1 1s. 8d., post free, to all parts of the world. Half-yearly bound volumes, 11s. 9d., post free.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 13-16, Fisher Street, W.C.1.

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The asterisk [*] denotes that the subject is illustrated