A Model Compound Condensing Engine.

By C. S. BAHRETT.

(*With Coloured Supplement Presented with this Issue.*)

ABOUT 1902, when I was serving my apprenticeship with a firm of lift engineers, a friend, who was serving his with the Thames Iron Works, became fired with the ambition to build a decent-sized compound engine. He \vas not particularly keen on a purely marine engine as I had expected him to be, but thought he would make *it a* non-reversing engine for dynamo driving. With this end in view, and wlth the experience gained in constructing several simpler models, I prepared a set of drawings for him and had the patterns made for the engine proper; the condenser was not decided on till later.

A set of castings was made by the Cannon Foundry, of Goswell Road, and he got to work, completing the boring of the cylinders, planing bed plate and fitting main bearings, machining crankshaft (from forging) and cylinder covers, whilst I prepared drawiags and patterns for the air pump.

After about twelve months on it (at intervals) his enthusiasm began to wane, and his fancy turned to gas engines; the poor old compound was put on the shelf, and the new love gained all his attention.

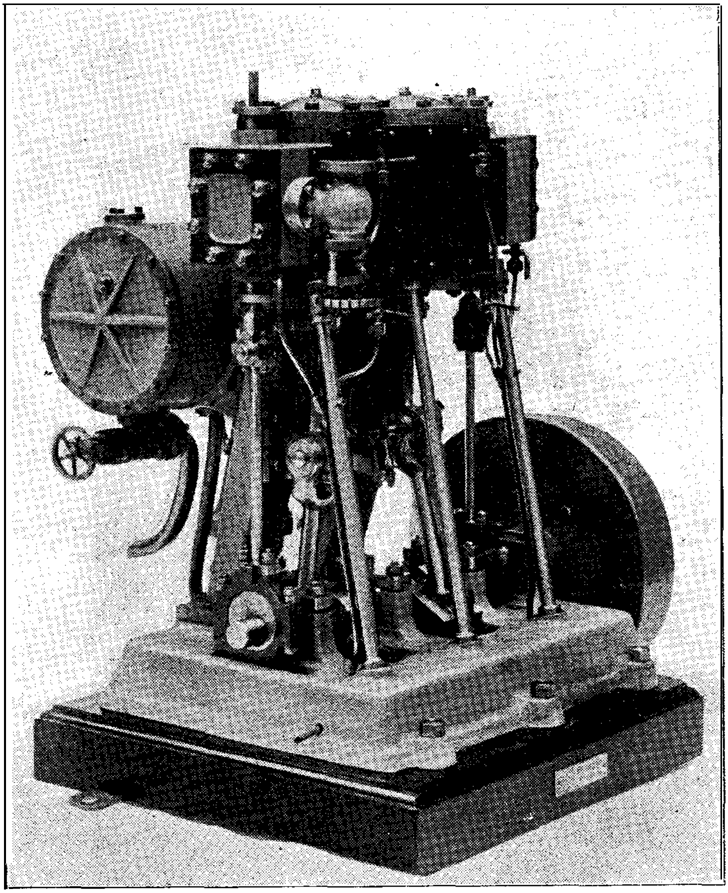
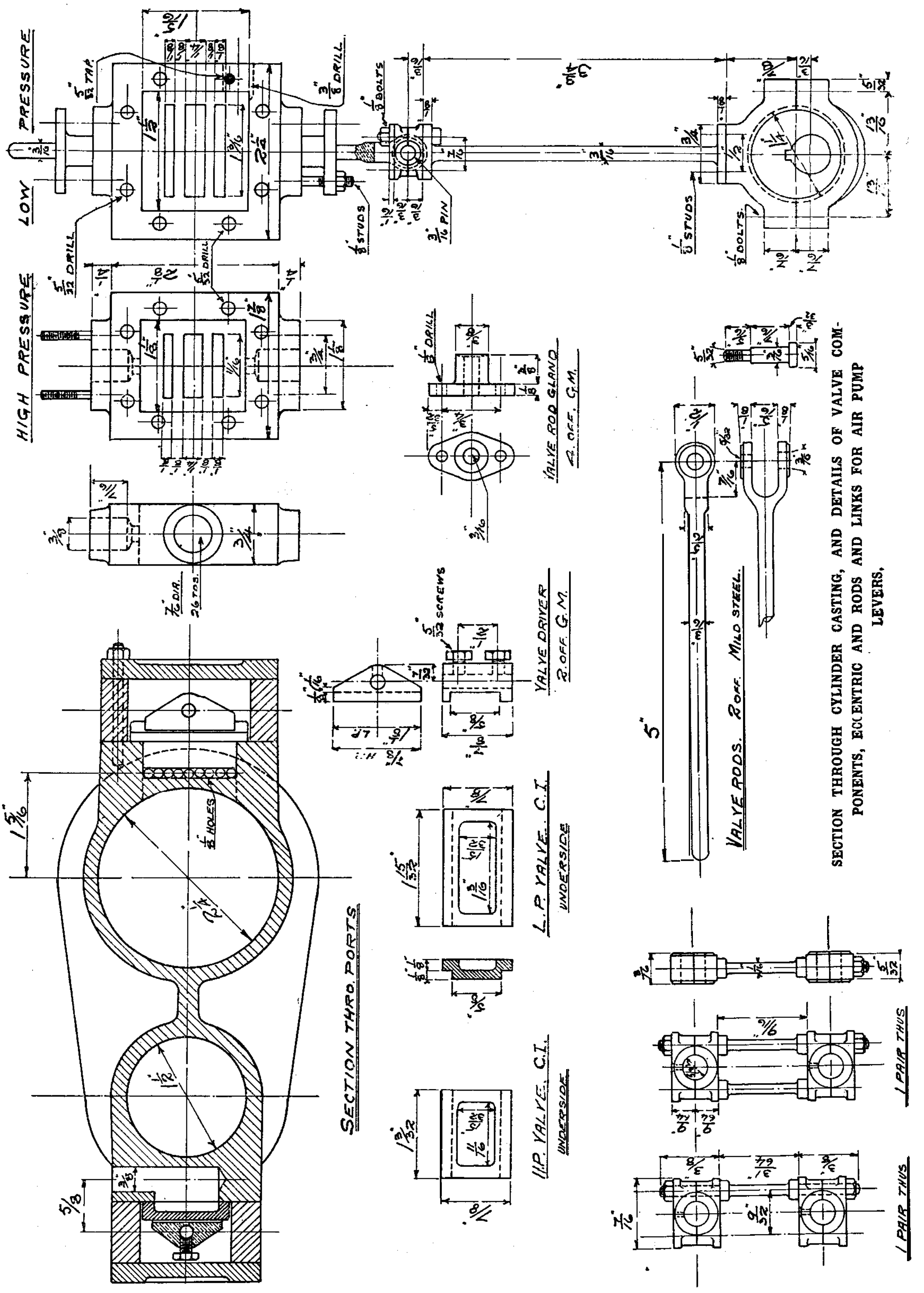


Fig. I.-The Completed Model Compound Condensing Engine.

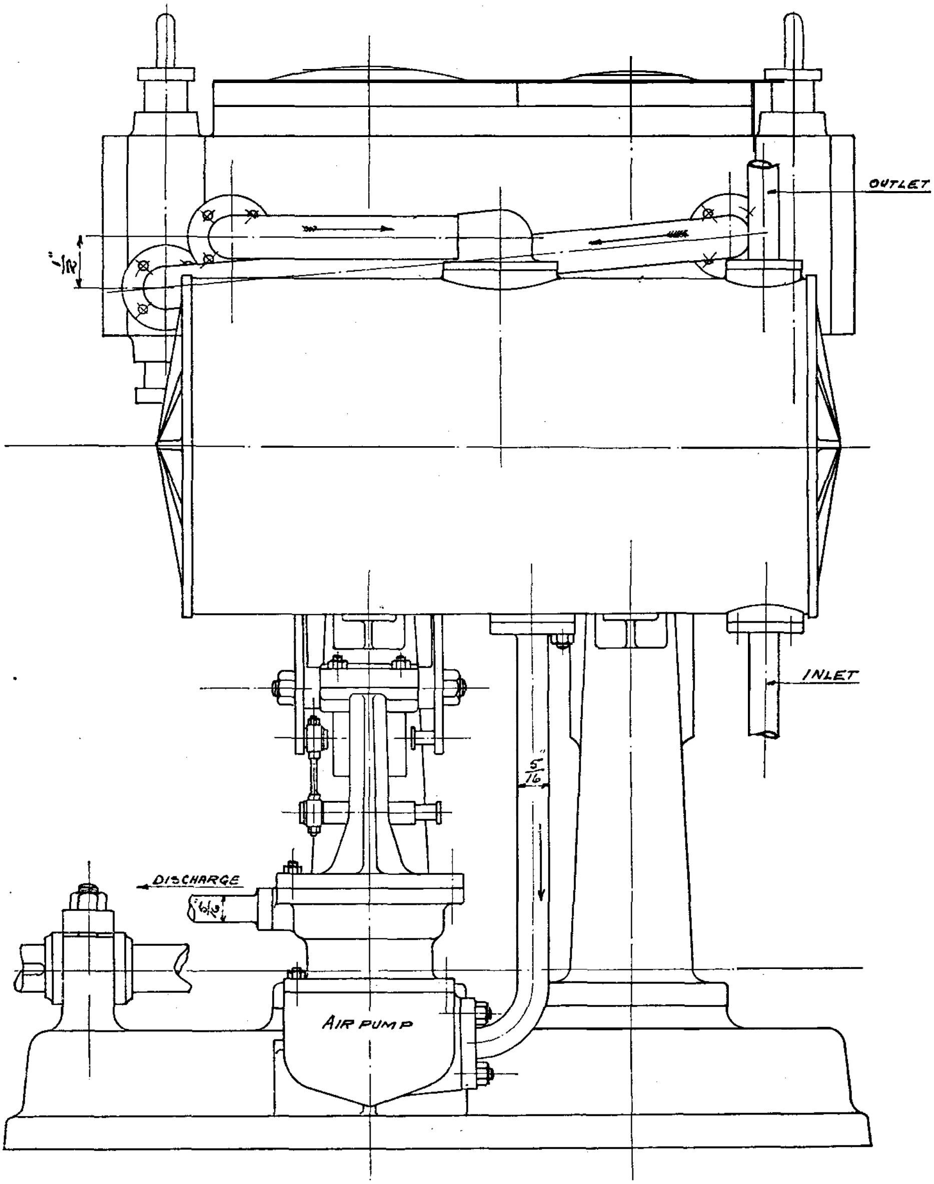
He then went to sea for a year or two, and I heard nothing further of the compound until 1909, when he had given up model work altogether. I was at his home one evening lookmg over a quantity of odds and ends, and we came across the pieces and patterns of the compound, when he asked me if I would like to take them over and finish the job; needless to say, I



SECTION THROUGH CYLINDER CASTING, AND DETAILS OF VALVE COMPONENTS, ECCENTRIC AND RODS AND LINKS FOR AIR PUMP LEVERS.

jumped at the opportunity and took the lot home.
The first thing I did was to examine everything thoroughly and scrap the following parts: all cylinder covers, both steam chests and covers, and piston rods, procuring new castings and boxes. Pistons are of magnalium, and in two parts, with a **single cast-iron** ring 1/4-in. wide between them.

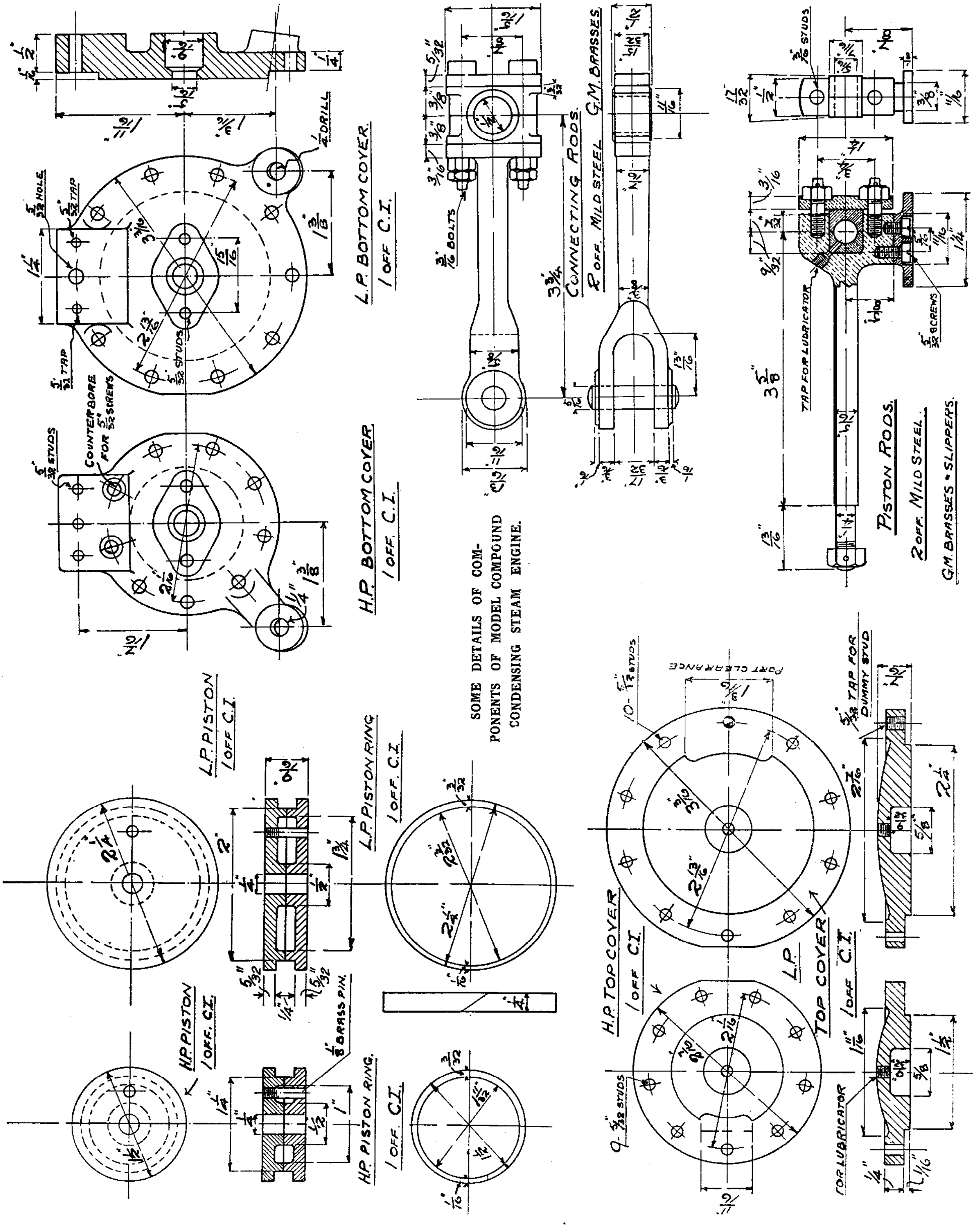
The rings were turned from a bush casting held in the chuck, and were first bored to a



Elevation (Condaaser Side) of_Model Compound Condensing Engine.

forgings for these; then I Prepared a new set of drawings, as the old ones had disappeared. The cylinders were lapped out, ports trimmed up and one or two incorrect stud holes plugged; the new chests and covers were faced up in the lathe and bored for rods and double stuffing

size which would give the correct diameter when split and closed, then the outside was rough-turned to I-32nd in. over finished size, after shifting the bush in the chuck to give the required eccentricity. The next operation was to part the ring off the bush, and face the sides



SOME DETAILS OF COMPONENTS OF MODEL COMPOUND CONDENSING STEAM ENGINE.

to correct fit between the flanges of the piston; then the ring was split at 45 degs. at its thinnest gart and the joint carefully filed to close fit. A jig was then prepared (see nest issue for sketch). A spigot was turned on a piece of material A to fit the bore of the ring when closed, its width being slightly less than that of the ring, a thick washer B made and attached by setscrew C. A clip of thin springy material D was made, placed

labour well paid, as the rings are absolutely steamtight.

The piston rods were made from forgings, machined to dimensions shown on drawing, and fitted with G.M. split brasses. Connecting rods are also made from forgings, the G.M. brasses being machined on ali faces in the lathe to ensure accuracy, the exterior being finished on a mandrel after all parts were bolted together.

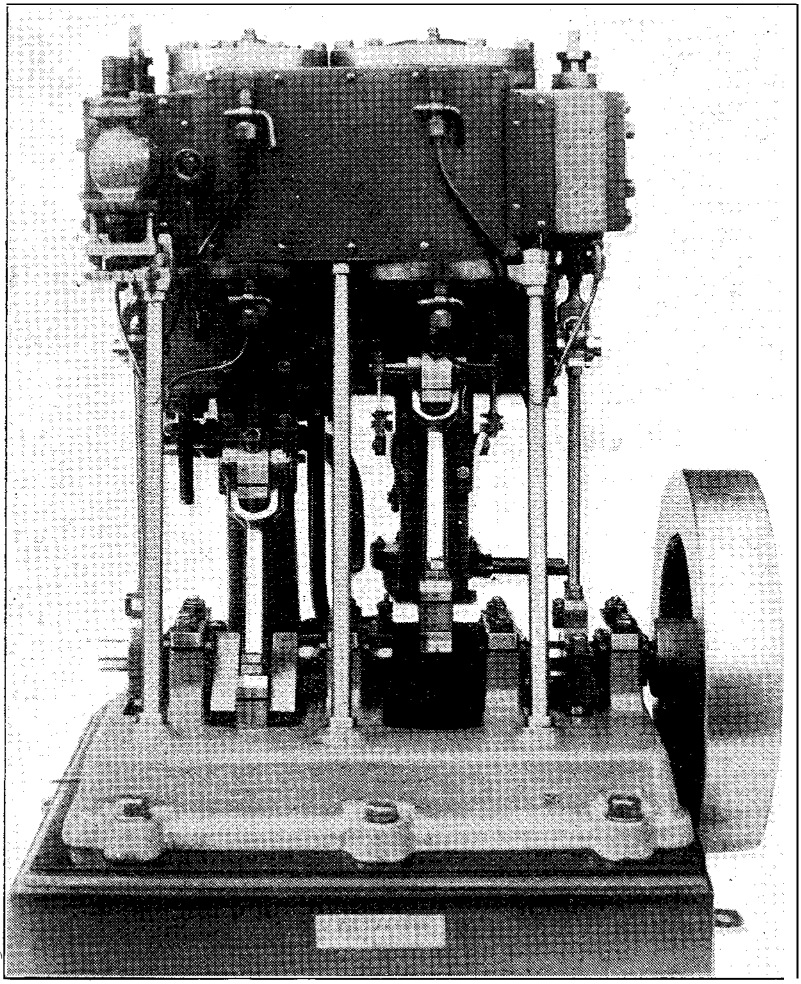


Fig. 2.-Front View of Model Compcund Condensing Engine.

over the ring and tightened up by the bolt, so as to draw the split in the ring quite close ; finally, setscrew C tightened up and the ring turned to exactlv fit the cylinder. Of course, the spigot on A is set slightly eccentric to suit the ring and when released the ring opened out, and on the first insertion in the cylinder there was a good bearing equallv all round the outer surface. The above may seem a very elaborate method of making a simple article, but it is

Crosshead pins are driven in and secured by a small screw each ; the low pressure pin is extended to form journals for the air pump links.

The crankshaft forging was turned up in the usual way, with centre plates attached by set-screws for turning the pins ; it is drilled through with a 3-32nd-in. hole for lubrication from main bearings to crank-pins as shown on drawings, and a 1/8-in. keyway was end-miiled in the lathe, with shaft bolted on slide-rest. The bed plate calls for no special comment, except that the holes for the sloping columns were drilled with the aid of a wood block, which was cut to the correct angle on the drawing. This job, by the way, was carried out in the workshop at the earlier M.E. Exhibitions, as were the flywheel and the planing of the back columns.

The valves were certainly unorthodox, but give a maximum of length with a minimum of steam chest, without any tipping action in the driving. They are of cast-iron and were milled out of a piece of broken hydraulic cylinder. Eccentrics are of mild steel, secured by gib head keys in sunk keyways, those in the shaft being milled in the lathe, and those in the sheaves cut with a 1/8-in. wide parting tool set sideways in a boring bar, whilst the sheave was held in the chuck. The top ends of the eccentric rods are fitted with split brasses, embracing a 3-16th-in. diameter pin, and they were faced on sides in the lathe after being bolted to rods.

There is a small by-pass starting valve fitted, consisting of a 3-32nd-in. diameter needle valve and hand-wheel, which opens a I-16th-in. diameter drilled port leading from the H.P. steam chest to the H.P. exhaust port, and thence to the eduction pipe to the L.P. steam chest, thus passing sufficient steam to start the engine, should the H.P. crank be on the dead centre.

A 1/16-in. clear way screw down steam stop valve is also fitted. details of which are shown on p. 14-15. Thi body casting for this was obtained from Messrs. Stuart. Turner, and the hand-wheei was turned from mild steel, five spokes cut out with drill and file, and notches on square rim cut in the lathe, using change wheel as division plate. Cylinders are lagged with thin blue lagging steel secured with 1-16th-in. round-head steel screws A good tip for fitting this, if of an awkward shape, is to cut out a temporary sheet in thin tin, bend into place, cut all necessary corners, etc., then flatten the whole piece out and use it as a template to cult the lagging sheet. I found it very successful.

Top and bottom cylinders and both steam chests are fitted with drain cocks, which are connected by unions to 3-32nd-in. diameter copper pipes, three of which, from the high pressure end, meet in a small junction piece fixed to the back of one column, and thence by a single 1/8-in. diameter pipe down the column to the underside of the bedplate; the three from the low pressure end being similarly arranged and meeting the common pipe, thence out of the side of the bedplate. These details are clearly shown in one of the photographs appearing with these notes, and in another which will be reproduced next week. The condenser, of which detail drawings will also be given in the January 10 issue, is of brass tube, 3 1/2 ins. diameter, and No. 16 gauge.

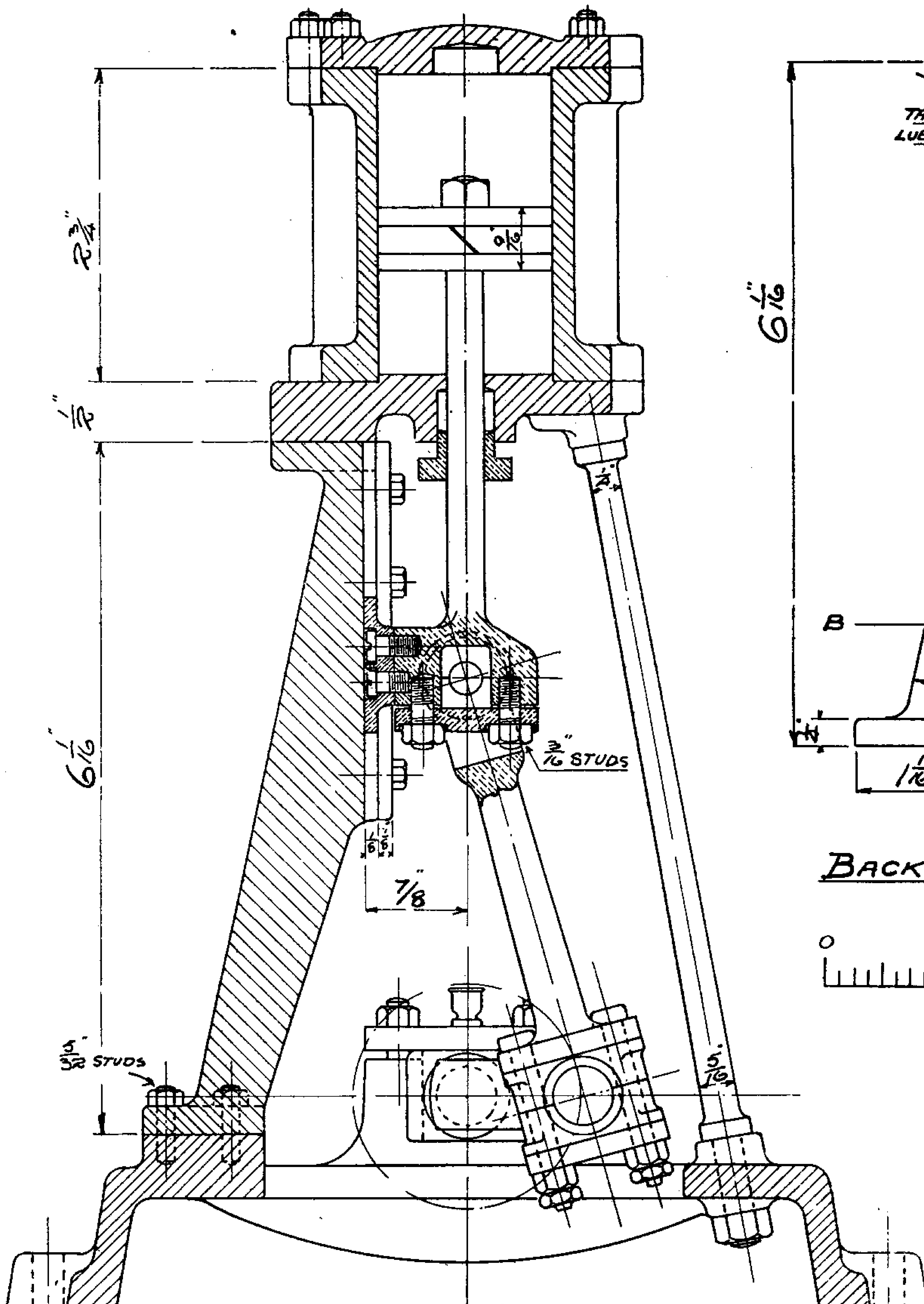
(To be continued.)

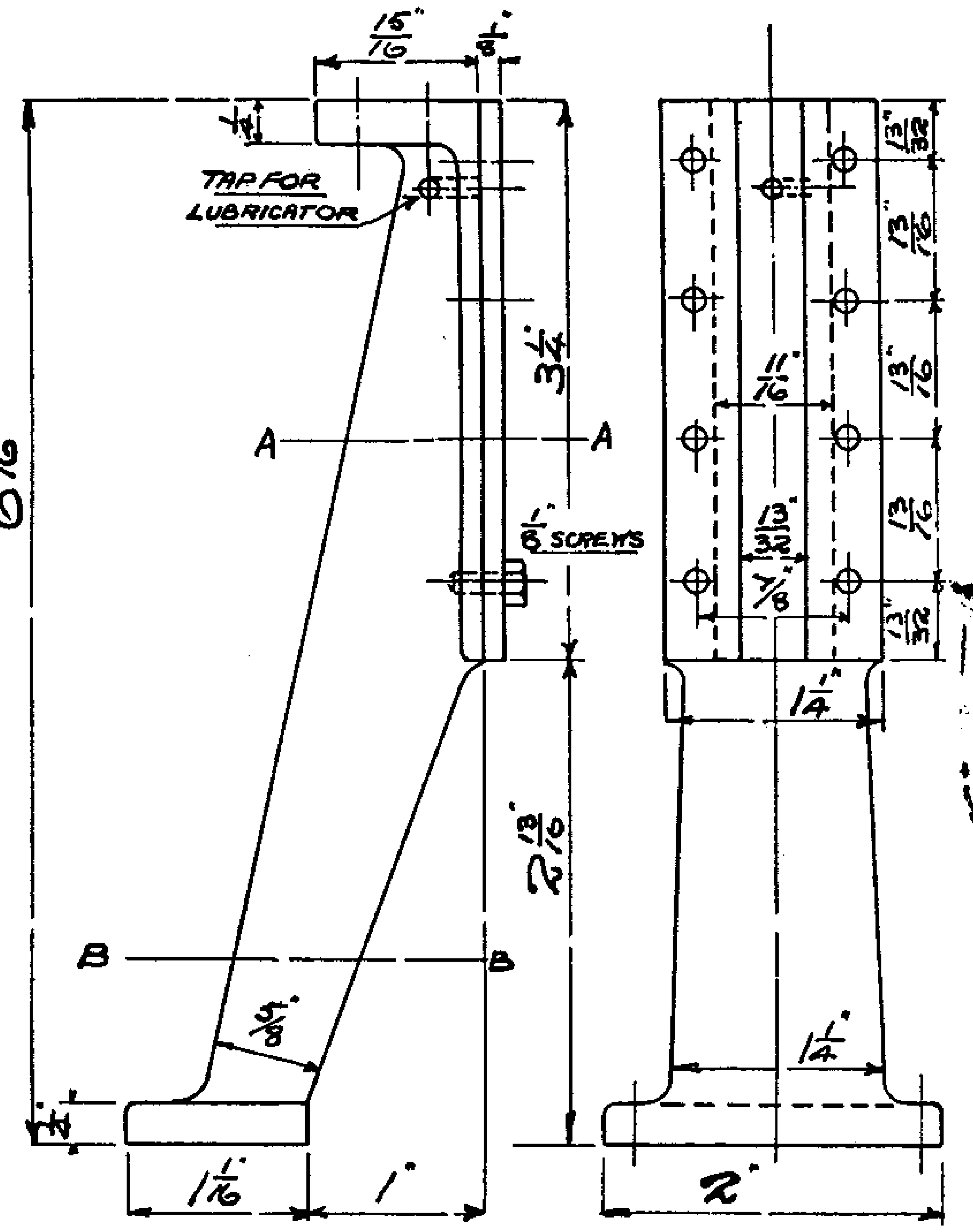
Model Engineers and their or

Mr. J. C. Crebbin.

MUCH water has flowed under the bridges since the publication of the issue of the MODEL ENGINEER for July, 1899. In its pages is a short article by James C. Cretbin, entitled " Some Models I Have Made," illustrated by photographs of a single-driver model locomotive of Great Western type, and which he terms his No. 3. The portrait accompanying the article is the presentment of a young man, but he had already been recognised as worthy to be a vice. president of the (then) Society of Model Engineers. He occupied this position from October, 1898, to November, 1901, and has been member of the committee from December, 1913, to November, 1915; again elected in December, 1921, and has been elected chairman at the last A.G.M. He has assisted with his locomotive, the now celebrated " Cosmo Bonsor, " at every one of the six MODEL ENGINFER Exhibitions, giving pleasure to thousands of people and demonstrating what a wonderful thing a model locomotive can be. This unique and welcome record has been acknowledged by the presentation, from the organisers, of a MODEL ENGINEER silver medal of honour, one of the first two such medals which have ever been given.

Last March we received a letter from abroad, in which the writer asked us to publish accounts of celebrities in the mode1 engineering world. Amongst others, he mentioned Mr. J. C. Crebbin, and remarked, " I, for one, am very interested, and continually wondering what his ordinary every-day occupation is. For all I know he may be president of a railway or greaser on a Thames steamboat. But whatever he is, I will lay that he knows his job." If we were going to write Mr. Crebbin into a story *for* a cinema film, we should entitle it " Big Heart," for this is his main characteristic -whether as a model engineer or in his dealings with other men. He was sent to Australia when ten years of age, owing to reasons of health, in a five-masted clipper sailing ship, and berthed with the bo'sun, carpenter and the donkeyman. He knew no one on board the ship. He remained in Australia until he was 14, then returned to London and went to school at Owen's College, Islington, where he surprised everyone by making a cylinder frictional electric machine with a gin bottle. The hair for the rubber was given to him by a carman from a horse's tail. He passed the Science and Art Examinations in Physics, Mathematics and Chemistry, but terms himself the biggest duffer at languages who ever existed. He obtained

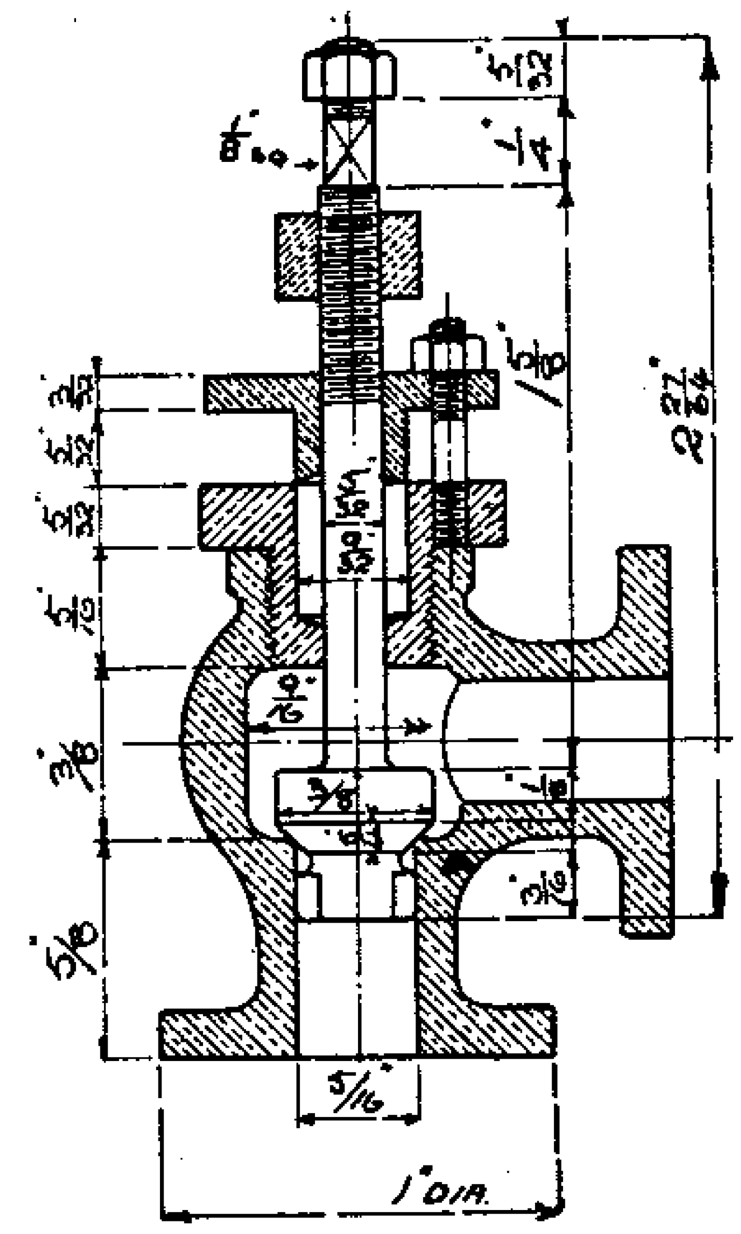


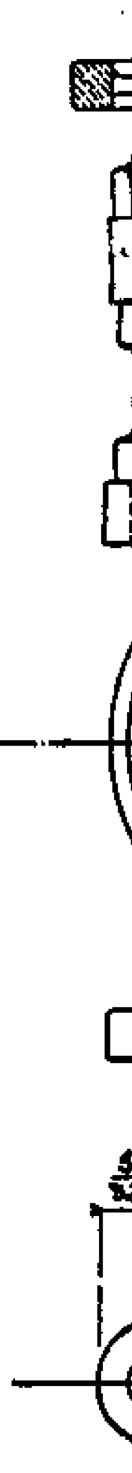


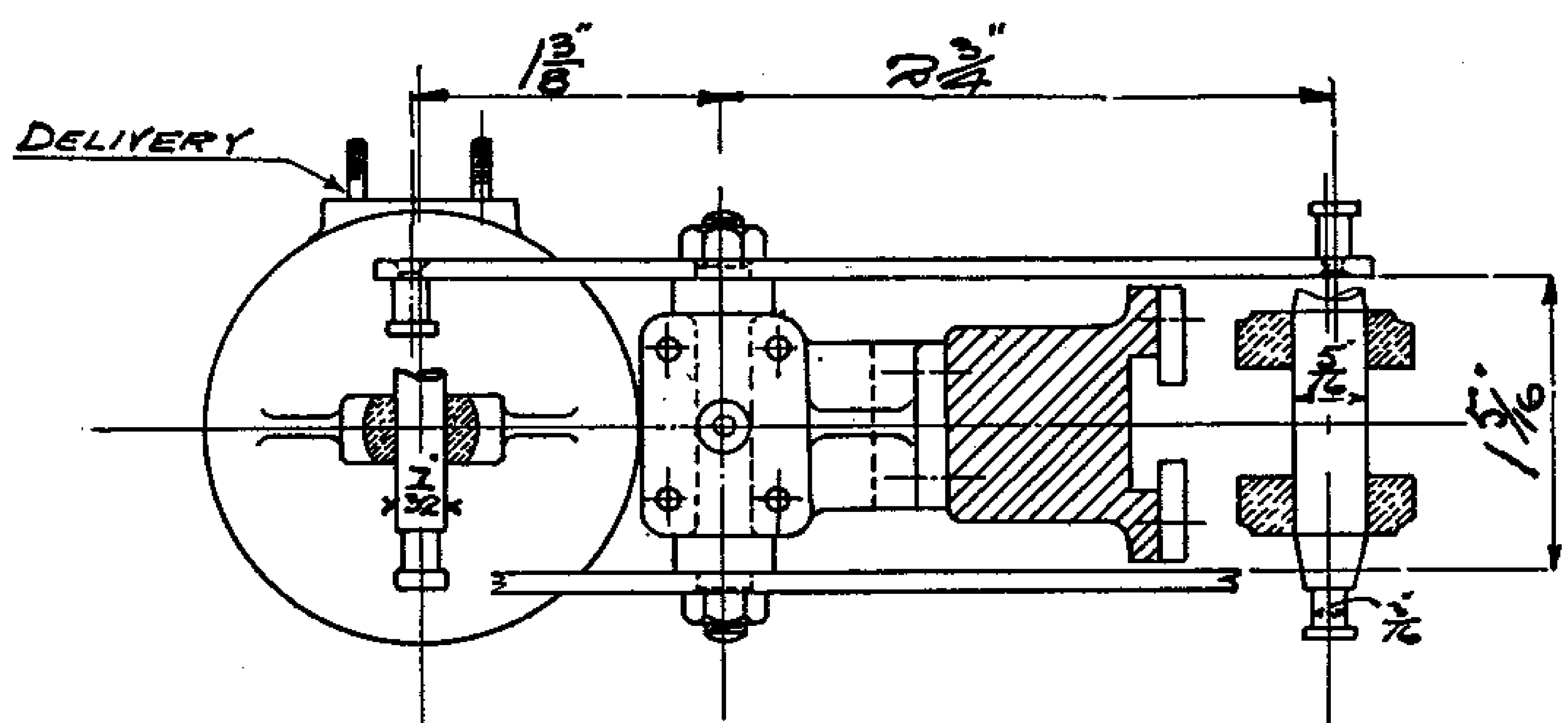
BACK COLUMNS, 2 OFF, CAST IRON.

MILD STEEL GUIDE PLATES.

SCALE FOR ELEV TIONS AND PLANS OF



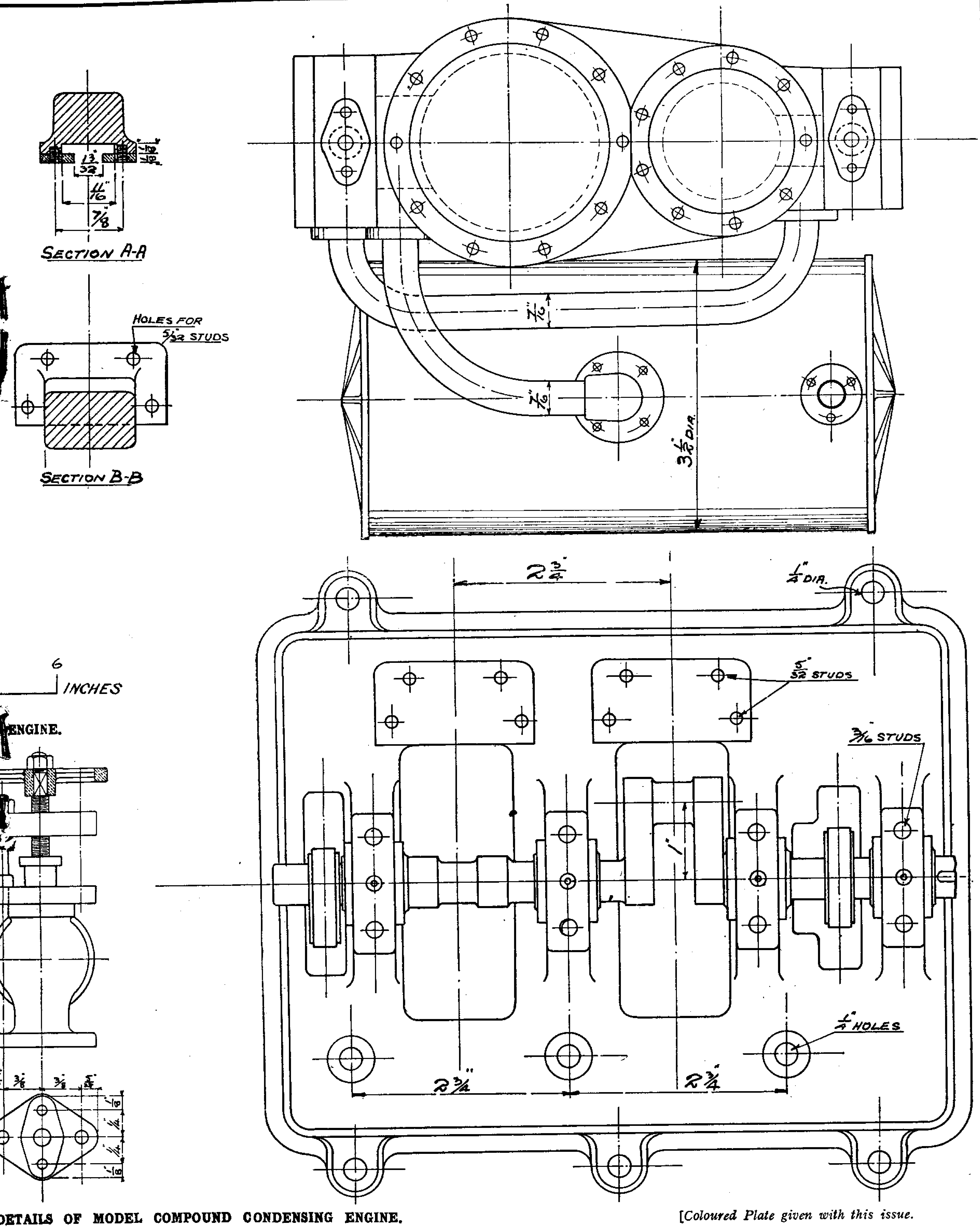




ARRANGEMENT OF PUMP LEVERS

For description see page 5 and]

SECTIONAL ELEVATION, PLANS, AND SOME D



DETAILS OF MODEL COMPOUND CONDENSING ENGINE.

[*Coloured Plate given with this issue.*

indefatigable labour on behalf of the Club he has reached the presidential chair, a position which he has now adorned for some years. He has often been on duty at the Lake side adjudicating at the races, etc., against doctor's orders, and his services at these events are always highlv valued and his judgments respected. Very often I have seen him shoulder responsibilities when all others fail and many times this has occurred when he has not been physically fit. He is a bluff old diamond who looks as if he had just stepped off the bridge of a P. and O. liner, and being one of the boys himself he understands their failings and good points as no other can. It would not be too

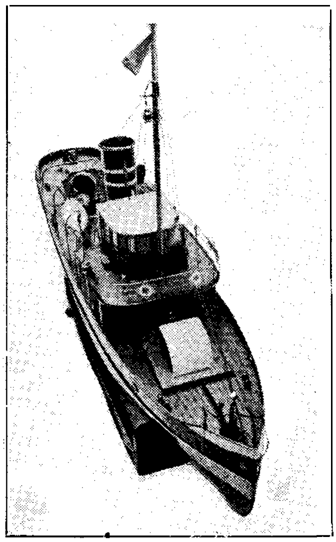


Fig. S.-Another Deck View o! "Danube II."

fulsome to say that We love him. It has been a principle with him to set the boys a good example by owning the best boats he could get. and Danube II. is a fitting unit in the Pierson fleet.

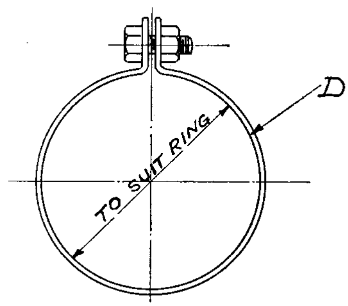
THE City of York has had a most unfortunate experience in adapting two Diesel engines from a German submarine for use in its electric light plant. These engines were purchased in 1920, the cost being little more than half that of a corresponding steam plant, but the engines have proved most unsatisfactory in use, the cost of renewals having been very great, and strong -complaints have been received of the excessive vibration when running. The experience at York has been similar in these respects to that of another borough in the South of England, and it is reported that the Electric Lighting Committee has decided to scrap the engines.

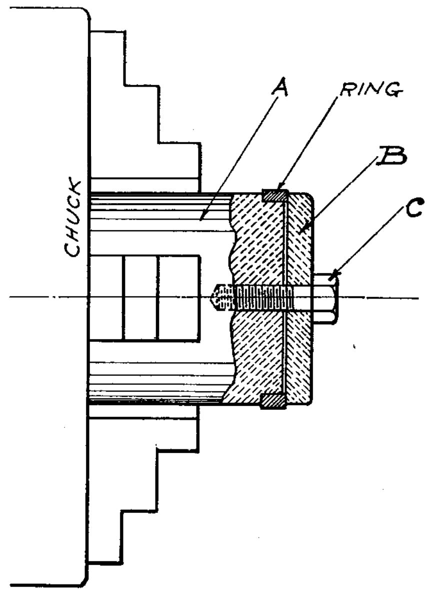
A Model Compound Condensing Engine.

By C. S. BARRETT.

(*Concluded from page* 10.)

The condenser is constructed of a piece of 3-1/2in. diameter I6-gauge brass tube, with the tube plates (16 G) turned to fit and sweated in, 5/8 in. from the end of the barrel, after drilling them a good fit for the 86 1/4in. diameter thin

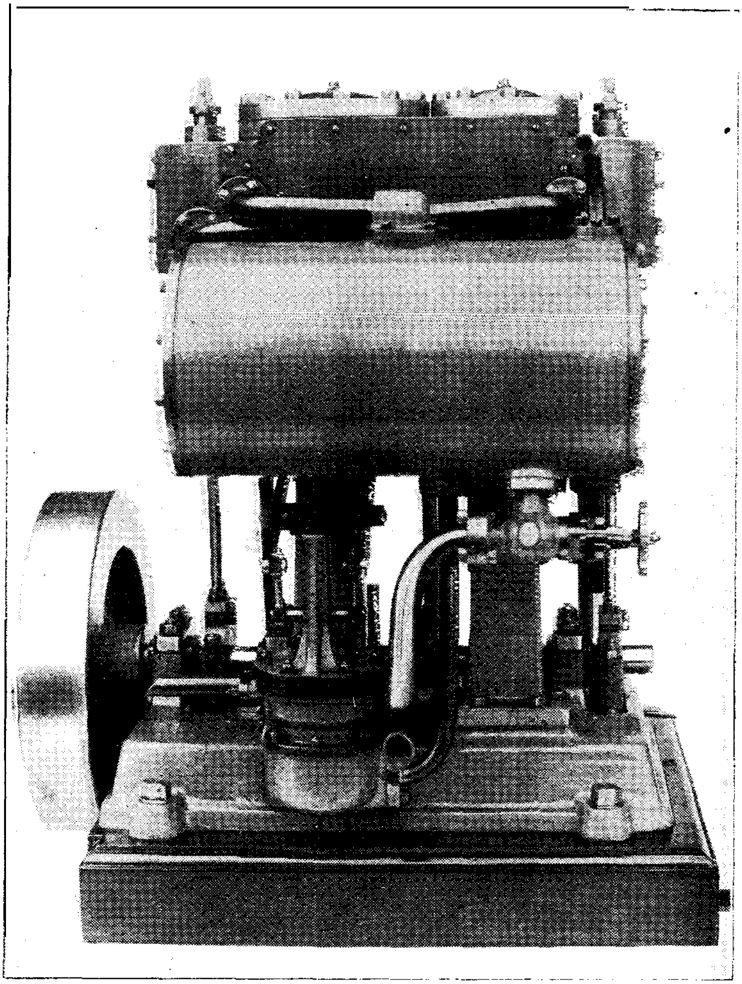




Showing Method of Machining the Piston Rings.

brass tubes, the thinner the better. The 1/4in. tubes are then cut off all exactly the same length; a good method of doing this, provided a hollow mandrel lathe is available, is as follows : Hold the length of tube in a self-centring chuck and adjust the poppet (with preferably a drilling pad on the end of the barrel) so that the required length is outside the chuck jaws, leaving enough to allow the slide-rest to come close to them. Then mount a parting tool made of a thin saw blade on edge in the slide-rest, and adjust lengthways so as to cut off the exact length ; run lathe at high speed and part through. Release chuck, push tube up to poppet, tighten chuck and repeat, and provided neither the slide-rest nor the poppet is moved, the n-hole batch of tubes can be cut off dead to length in less time than it takes to write the description.

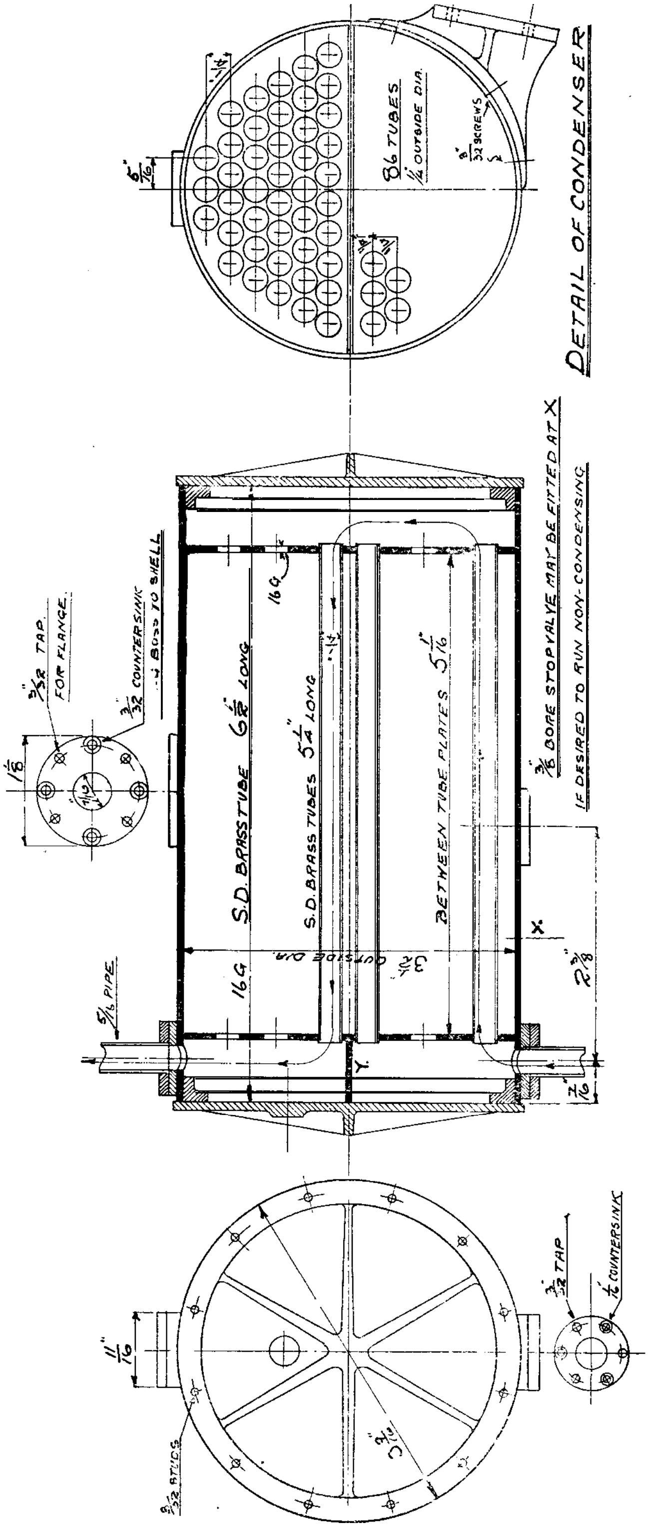
the tubes are as thin as they should be. A division plate of 1-16th-in. brass is now fitted, as shown at Y on drawing, to ensure the flow of circulating water passing through the bottom half of the tubes, and back through the top half. *Then* the cast angle ends are turned a good fit in the barrel, a few brass screws put in radialiy, the rings sweated in, and the ends of the barrel with the rings faced in the lathe to ensure a flat



Back View of the Model Compound Condensing Engine.

The next operation is to reader the tubes watertight; this may be done by sweating if preferred, but mine were expanded in with an expander of the three-roller type, as shown in sketch on p. 40. If this tool is carefully made and the rollers are free to move slightly radiaily, it is surprising how quickly the tubes can be rendered absolutely watertight, as it requires only a few turns with the thumb and finger, if

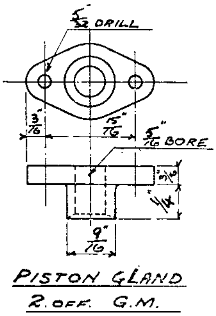
joint for the covers. The latter are a straightforward turning job, and are secured to the barrel by 12 3-32nd-in. studs tapped into rhe angle rings, an oiled brown paper joint being inserted when finally assembling. The following facings are attached by countersunk screws with paint and paper joints, as shown on the drawings : Inlet from L.P. exhaust with cast elbow piece, outlet to air pump, circulating water



Sectional and End Elevations of the Condenser for Model Compound Engine.

inlet, and circulating water outlet. An extra facing may be fitted at the bottom of the condenser if desired to lake a 3/8n. clear bore stop valve similar to the main stop valve, so that the engine map be run non-condensing.

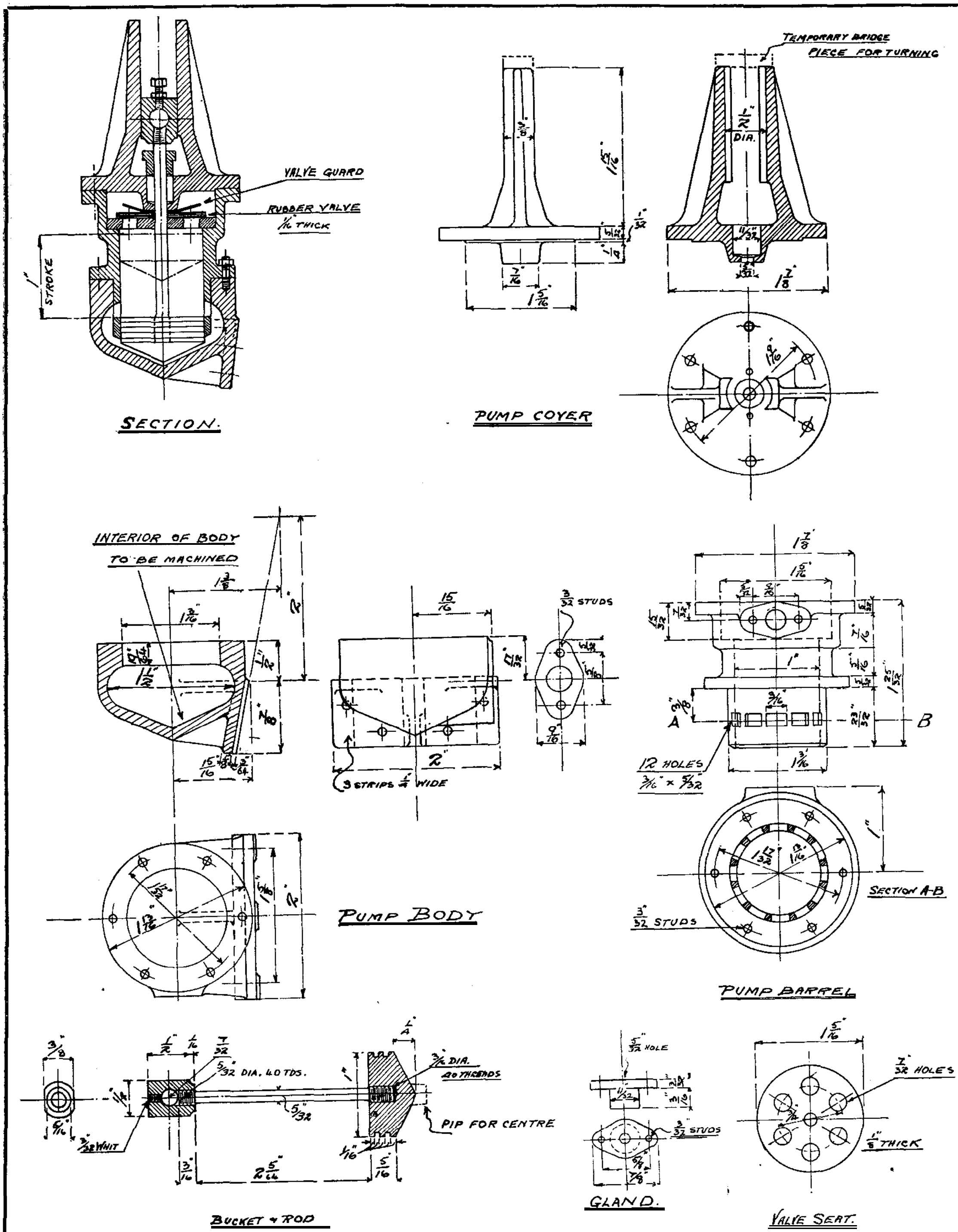
The air pump is of the Edwards type, 1-in. bore, I-in. stroke, and has only one valve, the delivery. On the down stroke a vacuum is created on the top of the piston or bucket until it nears the bottom of its stroke, when the ports open and air passes from chamber in the body to the top of the bucket; at the same time, the conical bottom of the bucket hits the water in the chamber, without shock and projects it round the curved sides, through the ports on to the top of the bucket, which, rising, closes the ports and takes the air and water through the delivery valve to the discharge, at



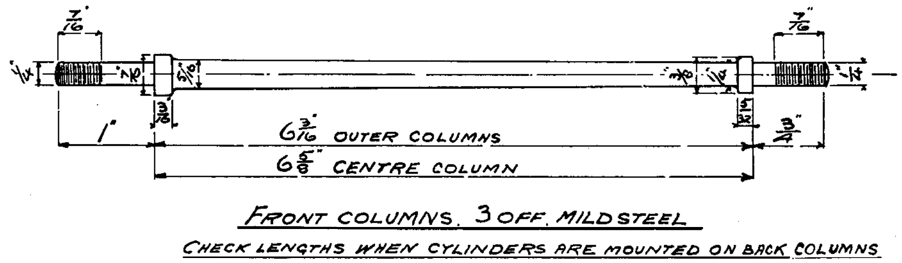
Elevation and Plan of Piston Rod Gland.

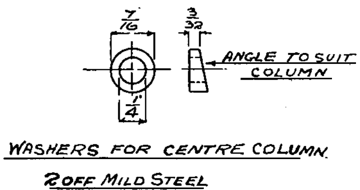
the same time drawing further quantities of air and water from the condenser.

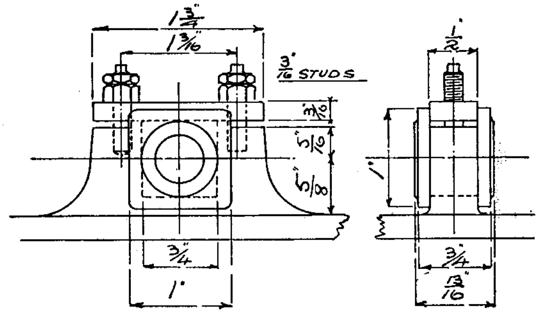
The principal points at which care is necessary are the machining of the interior of the body to a smooth and even curve, and the accurate machining of the top cover with its bored guide; the rest is straightforward lathe work. The bucket is not packed, two or more water grooves are turned in it, and it must be a good fit in the barrel. The pump is attached to the side of the bedplate by four 1/8-i,n. steel studs (care being taken to ensure that it is vertical), and it is driven by a pair of side levers from the L.P. cosshead pin ; the bearing bracket for these is fixed to rear column by four 3-32nd-in. studs. The four connecting links are each fitted with split gun-metal brasses, working on 5-32nd-in. diameter pins, and held together with



DETAILS OF EDWARDS AIR PUMP FOR MODEL COMPOUND CONDENSING ENGINE.

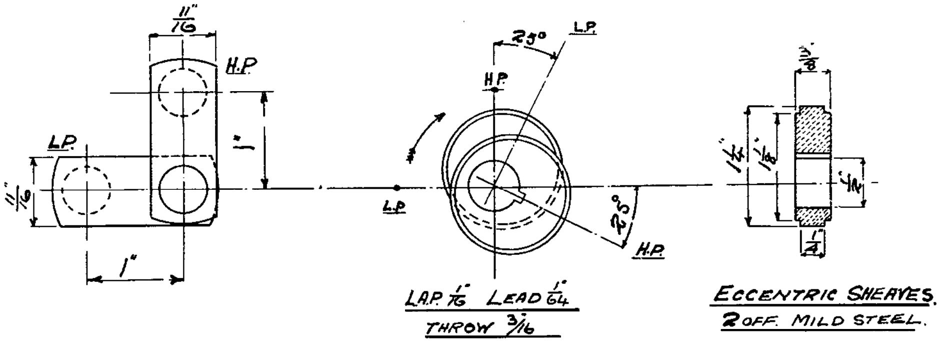


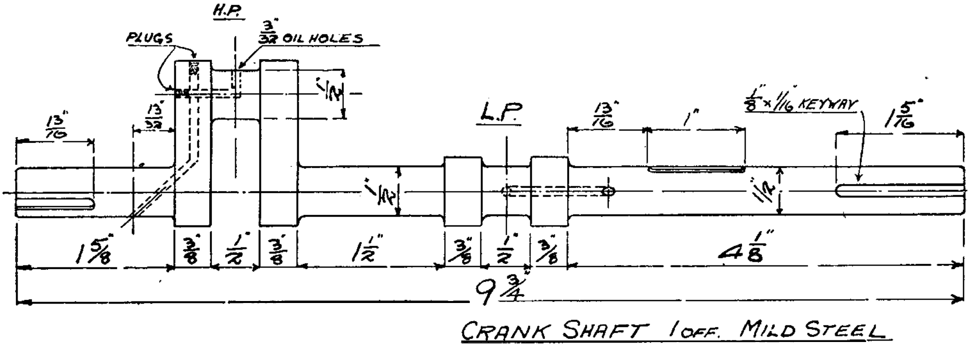




Main Bearing 4 OFF

Brasses G.M. Caps M.S.

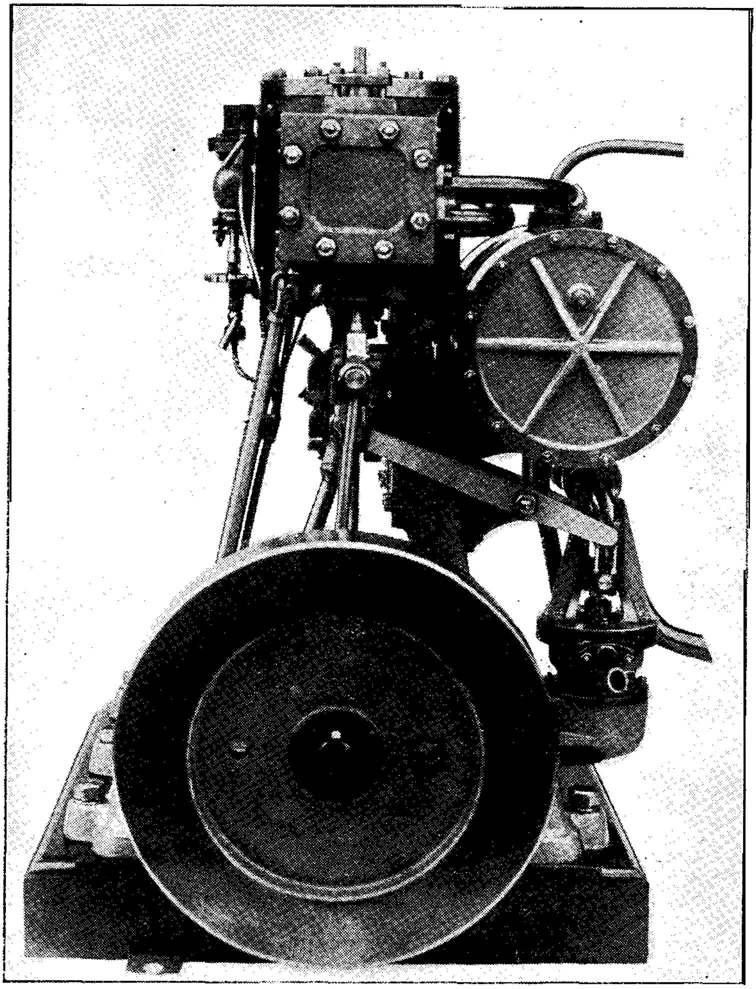




THE FRONT COLUMNS, MAIN BEARINGS, ECCENTRIC SHEAVES AND CRANKSHAFT FOR MODEL COMPOUND CONDENSING ENGINE.

1-16th-in. diameter columns or distance pieces. These little bearings had their sides faced in the lathe, after being fitted with the distance pieces.

Up to the time of writing the engine has had but one test run, and that under rather adverse conditions. It was coupled up to a vertical multi-tubular boiler fired with anthracite and fitted with slide crank steam feed pump, while the condenser circulating water was taken from the main tap by means of the garden hose, and the condensate passed into the household bucket. When 50 lbs. pressure showed on the gauge, all drains were opened, and the starting and main steam valves eased, when I was surprised at the quantity of water which passed from the drains before the engine moved away gently. On opening out the main steam valve the speed rose to a somewhat alarming figure, without any load, and priming commenced. The dynamometer brake mas then rigged on the flywheel and a few test runs taken, with the results shown below. It is, at first glance, curious that the revolutions and power should fall off above 60 lbs. pressure, but this was entirely due to priming, as I had my hands too full to keep a steady pressure and water level. There are so many things to be attended to, viz., firing, feed pump, brake adjustment, stop valve, revolution counter and watch. The help that I anticipated did not materialise, as the morning started wet and the run was out of doors. However, the test results show some very good figures, and I hope at higher pressure to obtain better; nearly half-horsepower at 60 lbs. pressure is good for so small an engine.



Low Pressure End View of the Model Compound Condensing Engine.

The following are the results of the tests :—

(1)	490	revs.	3	lbs.	brake pull,	Boiler	pressure 45	Lbs.	=.210	b.h.p.
(2)	920	,,,	3	al	„	8,	55	„	“.354	„
(3)	1040	?>	3	„	„	.I	60	,/	“ 4 4 5	„
(4)	960	,I	3	I,	I,	1.	3	„	=.411	,>
(5)	950						70	„	=.407	„

Total time under steam 1-1/2 hours.
Evaporation, 16 lbs. of water (approx.).
Condensate, 13.25 lbs. of water.

It was impossible to run long tests, as the fly-wheel overheated, so time was allowed between each to allow it to cool.

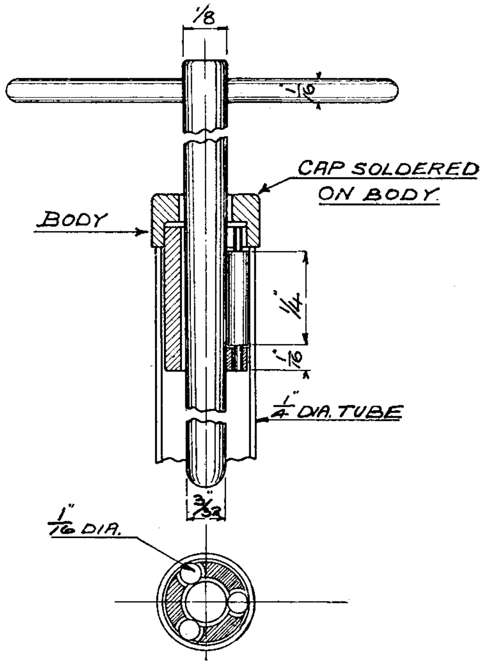
The effect of the condenser was very marked; if the engine was throttled down to just tick over, while the circulating water was cut off (condenser by-pass being, of course, opened), then the water turned on again, and the by-pass closed, revolutions were immediately doubled, although the difference in speed was not so marked at higher speeds. It was necessary to use a considerable quantity of circulating water **to** keep the condenser cool.

A sketch is given below of the brake gear used. The brake blocks A were of hardwood attached by screws to the bars B, which bars were drilled to take the 1/4-in. screwed rods C and D, the rod C being provided with lock nuts inside the bars as shown, and D extended to take the hook bolt E. Rough adjustment is made with the lock nuts on rod C, and the brake pressure regulated while the engine is running by the wing nuts on rod D, the pull an the spring balance F being adjusted by wing nut G.

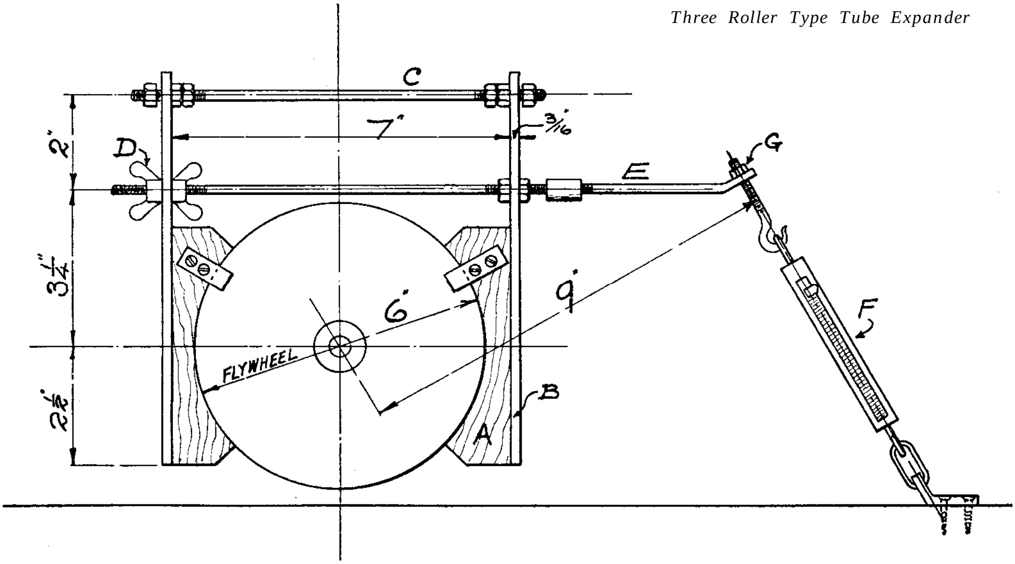
The b.h.p. is arrived at as follows.-First

P = spring balance in pounds, L = length of lever in feet, and R = revolutions per minute.

Taking test (3) we get by substitution :



Three Roller Type Tube Expander



The Brake Gear Used for Testing the Engine.

measure exactly the distance radially between the flywheel centre and the centre of the spring balance hook; in the present instance it is g ins.

The formula is : $\frac{PxLx2xR}{33,000}$ where

$\frac{3 \times 9 \times 44 \times 1,040}{12 x 7 x 33,000}$, and this fraction worked out gives .445 b.h.p.

Care must be taken to measure length L radially from wheel centre, and to see that the line of balance is at right angles to this line. The sketch will make this clear.

The photographic reproductions give a good idea of the appearance of the engine, and show a good deal of the exterior details.

The whole job has been an exceedingly interesting one throughout, and its performance well repays the time and labour spent an it; it grained a silver medal at the 1922 Exhibition.

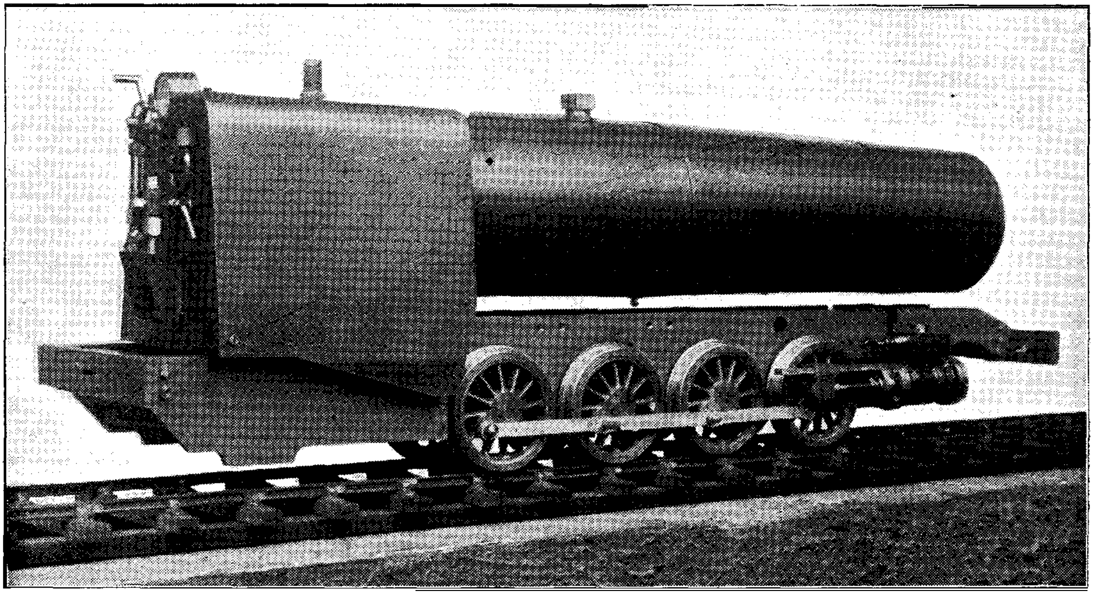
Should anyone be desirous of building a similar model, sets of castings will shortly be available.

A Large Spirit-Fired 2-1/2-in, Gauge Experimental Locomotive.

By HENRY GREENLY.

DURING the height of the discussion on solid firing and the hauling of heavy loads by 2-1/2-in. gauge locomotives, I was asked by Mr. W. J. Bassett Lowke to suggest a design for a " hauling model " for the 1924 MODEL ENGINEER Exhibition, which by the time these notes will appear will be in progress. Whether the model will acquit itself in the manner the writer's paper calculations would show to be possible of accomplishment, and what will be freak performanccs on the short Exhibition track.

To obtain a high drawbar pull what is required is weight; ADHESIVE: weight I may repeat. Scale cylinders, scale pressures, scale drawbar pulls, scale everything else, is subservient. What is required to gain the plaudits of the observer is to obtain within the prescribed loading gauge limits the adhesive weight of an inch-scale locomotive, and having appropriated



The 2-8-2 Experimental 2-1/2-in. Gauge Three-Cylinder Locomotive in Course of Construction.

the nature of the mutual recriminations of builders and designer, cannot at the moment be foretold. The final test, for good or ill, will be its presence and work at the Exhibition.

Naturally, as the new goods locomotive for Eskdale was paramount in the writer's mind at the time of Mr. Bassett Lowke's request, the design that was considered best for the service there, where the maximum hauling capacity has to be maintained over a seven-mile non-stop run -to time-was thought to be sufficient for the avoirdupois in this illegitimate manner, the next portion of the problem is utilising it. Having arbitrarily fixed the steam pressure-a convenient one based on practical experience, say, anything between 50 and 80 lbs. per square inch -the size of the cylinders can then be discussed.

The weight on the coupled wheels of the model as designed was estimated at about 28 to 30 lbs.* On a dry rail the maximum coefficient

* A scale tonnage (with coefficient taken at 5) of 140 to 150 model tons.