FUN WITH A CRANE

MARTIN CLEEVE built it for his young son-or so hetells us. The machine may inspire other adults to model this kind of subject

THERE are few mechanically-minded people who will not pause to watch a crane in operation. The graceful upward sweep, the slewing of the load to bring it over the exact position, the obvious skill of the driver upon whose experience the safety of the load and those beneath depends, the silky response of the mechanism to the controls: in this scene there is pleasure.

When I wanted to make something mechanical for a young son, without devoting undue time or cash to the project, my thoughts turned to a crane. I made the first assembly almost entirely from Meccano, using the workshop to fashion extra parts, for some of which Meccano could not have been strong or adaptable enough. The machine did not respond easily to the controls, and its operation was not as smooth as I wished.

But in making the assembly, I had solved the problems of gearing ratios, winding-drum dimensions and disposition of the parts. The mechanism, crude though it was, created interest, and I decided to tidy it all up, using more carefully machined components. regrouping the control levers into a neat lever-frame, and making a jib which looked real.

To avoid electrical complications, I wanted only one electric motor. I chose a derrick crane because it lent itself to a fixed mechanism and control-frame. It was also the simplest to make as it did not involve the lattice-work tower and large roller-race track needed for the hammer-head crane.

With a conventional lattice-work jib, stays based upon some full-sized machine, and the whole operating mechanism fixed below the baseboard instead of above it as in my model, the effect would be charming indeed. I may add that some derrick cranes have a simple wooden beam or pole for jib.

The crane is not mobile, but this is compensated for by the long jib-about 44 in., commanding quite a large operating area.

For general-convenience, the whole is mounted upon a cheap wooden kitchen table with a top measuring 30 in. x I8 in., surfaced by a sheet of hardboard. The driving motor is fixed on a platform underneath the table, and a drive is taken through a slot cut in the table top, as in the photograph (Fig. 1).

Range of movements

Five control levers can take up, basically, 14 different positions, but although the total number of possible combinations of 5 from 14 is 2002 (see the football pool tables). The used number is 32, or, allowing for the combinations at four different speeds, 128. The mechanism and controls are arranged, as in full-sized practice. so that various crane movementscan be carried out independently or simultaneouslv. Herein urobablv lies the secret of the fascination of crane oeeratine!

Assuming that you are facing the five levers in the control frame (Figs. 1 and 2), the left-hand lever is for the four-speed control and the next is for the jib control with three positions-centre off, forward for jib lowering, and right back for jib raising. The third is the hoisting lever, with three positions-off, and speeds one and two (additional to the main four-speed control). Then we have the hoist brake lever and the swivel or slewing lever, with three positions, centre off and forward to swivel to the left, and back to swivel to the right.

Full-sized cranes are often powered by a separate reversible electric motor for each movement; hoist, luff and slew. Although a similar method of three-motor powering would appear to simplify greatly the mechanism of a model, it would have the disadvantage of being rather costly, and the simplification would be largely offset by the electrical gear for reversing and speed control. In addition a transformer and rectifier would be needed for the direct current supplied to variable speed motors. Some crane mechanisms involve the use of two motors and an ingenious arrangement of epicyclic gearing, but we can reproduce the motions of a crane without these advanced designs, which would in any event be beyond the scope of most of us.

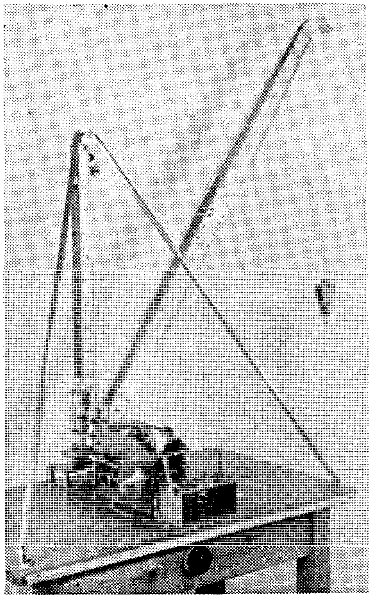
The mechanism is driven from one small induction motor-originally a fan motor-working from the a.c. mains. It has a constant speed of about 1,400 r.p.m. and a full load output of about l/l00 h.p., which is ample. The drives are taken from it by the gearing shown in Fig. 3 where, for illustration, the gears have been spread out to form a kind of schematic diagram. The sets of relative speeds are those which have proved the most satisfactory for the elegant operation of a crane of this size. Except for certain gears which 1 made myself for the sake of appearance, or because it was more convenient, all the gears are of Meccano, or of Meccano size. These, or Bond's No 40P gears, could be used throughout at a modest cost.

With mechanisms of this small size and loading, there is no need for clutches or similar complications: the gears can be slid in or out of mesh while they are running under load, either to change speed or to reverse- as by the contrate gears at the top and bottom of the drawing.

Of course, it is unwise to reverse the jib in slewing at full speed, but the direction can be very smoothly carried out by first dropping to the lowest speed with the appropriate control lever,. and then reaccclcrating in th e opposit edirection. Even here the gears do not protest; what is undesirable is the slovenly appearance of the driving when the jib is jerked into reverse.

To demonstrate the crane in action and to gain driving experience I used a number of card boxes, weighted and bound with fairly stiff wire terminating in a loop at the top. By this means loads can be hooked on and transferred to various positions, or regrouped, while the driver stays in his seat. There is also a hook attachment with two chains which can be used as a sling. By manipulating the controls, you can make the sling pick up two open-hooked blocks, or one longer block with two hooks spaced at about 6 in. apart. All these operations call for many hours' practice at the controls if they are to be carried out smoothly, efficiently and quickly.

I know that there is room for improvement in the crane loads Wire-. bound card boxes would look crude at an exhibition. Perhaps model wooden crates would be better. I



This jib, 3 ft 8 in. long, was built of four pieces of aluminium, cut from a sheet and tapered and_flanged. All the movements are controlled by the levers

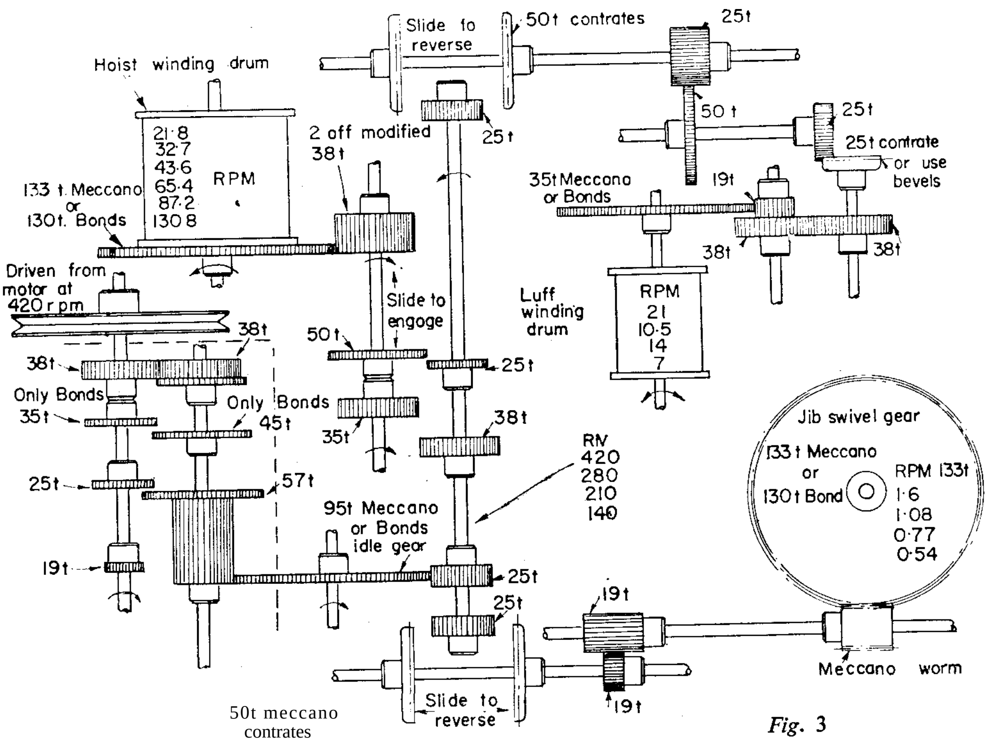


Fig. 3

daresay that readers can offer sound practical suggestions, although one's chief interest lies in learning to drive the machine without taking one's eye off the load, to transfer the loads without setting up a violent swinging, and to form neat groups with a minimum of resetting movements, using the controls by feel alone. Two hands can be used at the lever frame. An experienced driver can give an impressive performance, but the novice may take as long as 15 minutes to engage the hook on one load alone! Children learn to drive far more quickly than adults. ❑

FOR YOUR BOOKSHELF

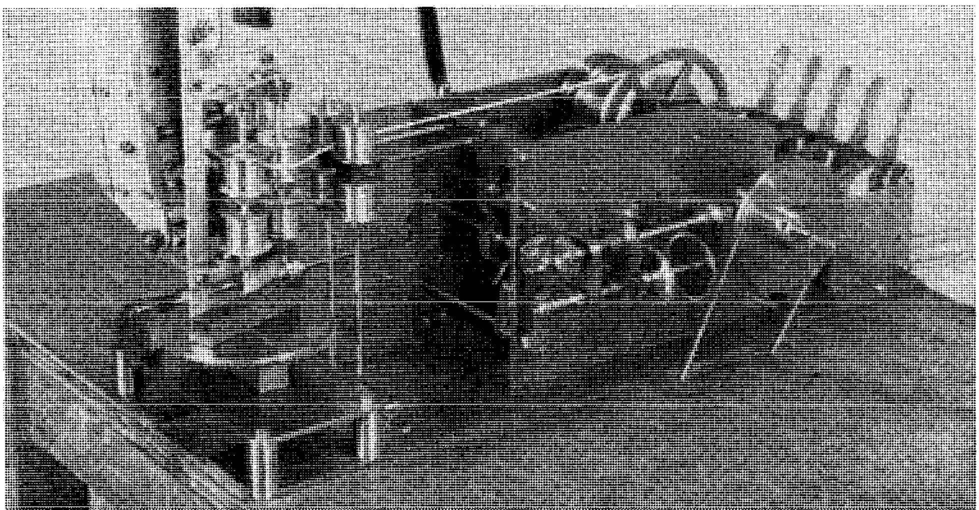
Model Railways Handbook. *Percival Marshall and Co. Ltd. Price 3s. 6d.*

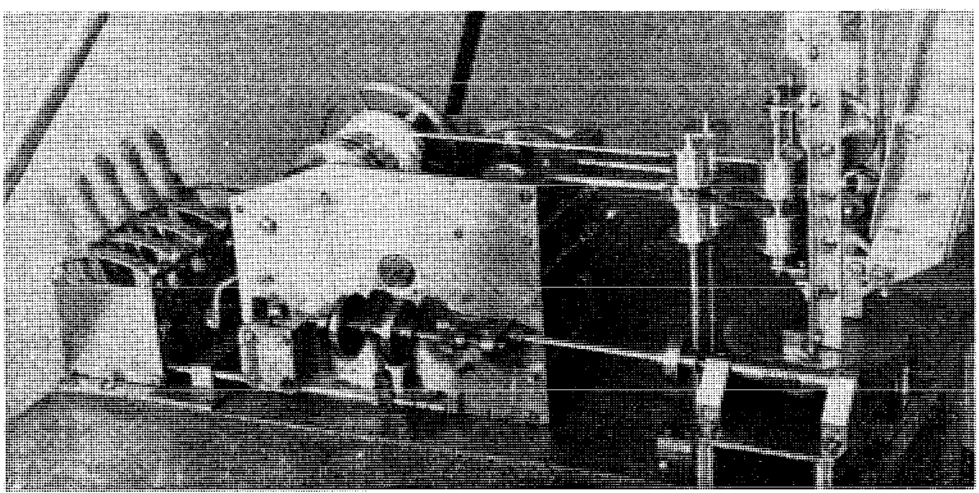
MANY readers of this magazine are also interested in the smaller gauges of model railways. This latest edition of the popular *Model Railways Handbook* has been completely revised by the staff of *Model Railway News.*

The section on the BRMSB standard relating to track, gauges, scales, loading gauges, wheels and so on, is full of valuable information. The data are set out clearly and concisely and concern all gauges from TT up to IF.

There are sections dealing with most aspects of the hobby and illustrations of some of the finest layouts.

A brief history of railway modelling opens the book and within the remainder of its 95 pages you will find chapters on TT gauge, the various systems available for 00, the all-important feature of electrification, with regard to all gauges and scales, and a list of items introduced by the trade within the past twelve months.-R.O.





Top, Fig. 1: This picture shows the luffing gear and the eight jockey rollers to guide the hoist and luff cables in slewing. Above, Fig. 2: On the other side are the swivel gearing and the lever control frame

FUN WITH A CRANE

MARTIN CLEEVE gives a fuller description of the model derrick he designed and which many readers admired

THE brief introduction to my derrick crane (18 January 1962) aroused considerable interest, so I venture to offer more complete details.

Those wishing to build the more elaborate hammer-head type of crane will find that my gearbox and fixed-point control can be adapted with slight modification. By passing the hoist and luffing cords up through the centre of rotation and limiting the head slewing movement to a few degrees short of a full turn, the cords will not become tangled.

The accompanying list of gears may be read in conjunctjon with the gear layout drawing, Fig. 1. The key numbers and letters do not refer to the numbers of teeth, because many gears have the same number of teeth and identification on later drawings would be difficult.

LIST OF GEARS

No of teeth	Face width, in.	Key numbers on schematic drawing	Meccano parts No	Total required
19	1/4	GI5. G34	26	2
15	1/4	G7	2bc	I
19	3/8	GI6	26b	I
25	1/4	G5. GI2, GII, G2I. G25, G30	25	6
25	1/8	G9, G28, G23	25a	3
25	3/8	G9	25b	I
38	1/4	G I, G2, G 19. G20, G32, G33	31	6
50	1/16	G6, G22. G29	27	3
60	1/16	G8	27d	I
95	1/16	GI0 G35'	27c	2
133	1/16	G 18, G24*	27b	2
25	Contrate	G3I	29	I
50	Contrate	G13. GI4, G26. G27	28	4
—	Worm	G17	32	I
—	Ratchet wheel	R36 (not shown)	148	I
Teeth	**Face width**	**Key No**	**Bonds only**	**Total required**
35	3/16	G3 (No 40 diametral pitch)	—	I
45	3/16	G4 (" " . . ")		I

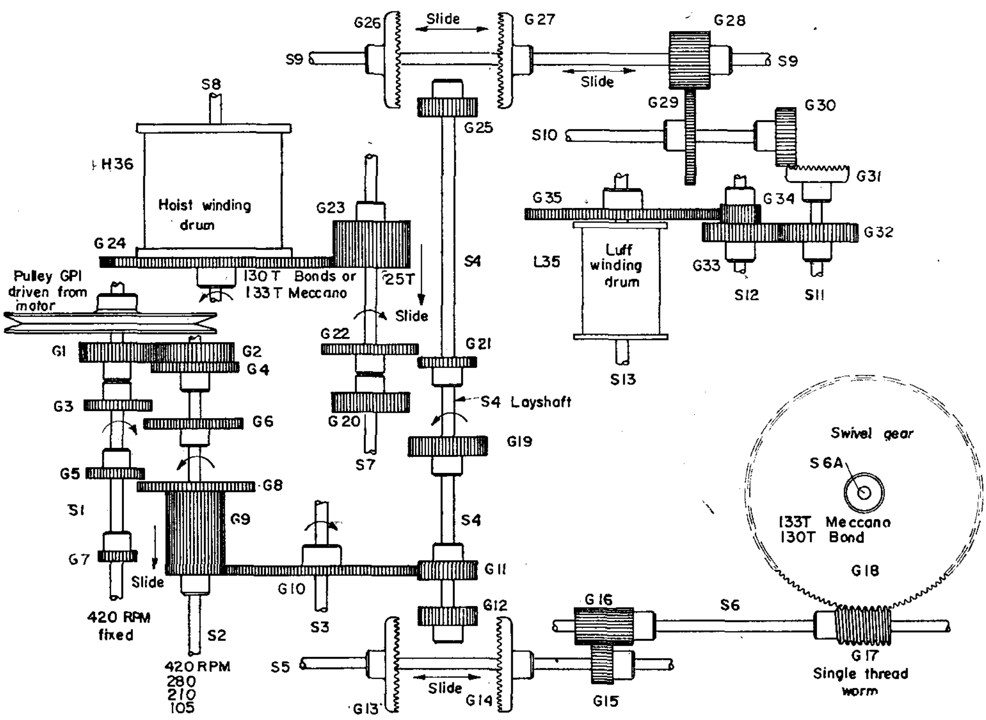


Fig. 1: Schematic arrangement of gears and key to their identities

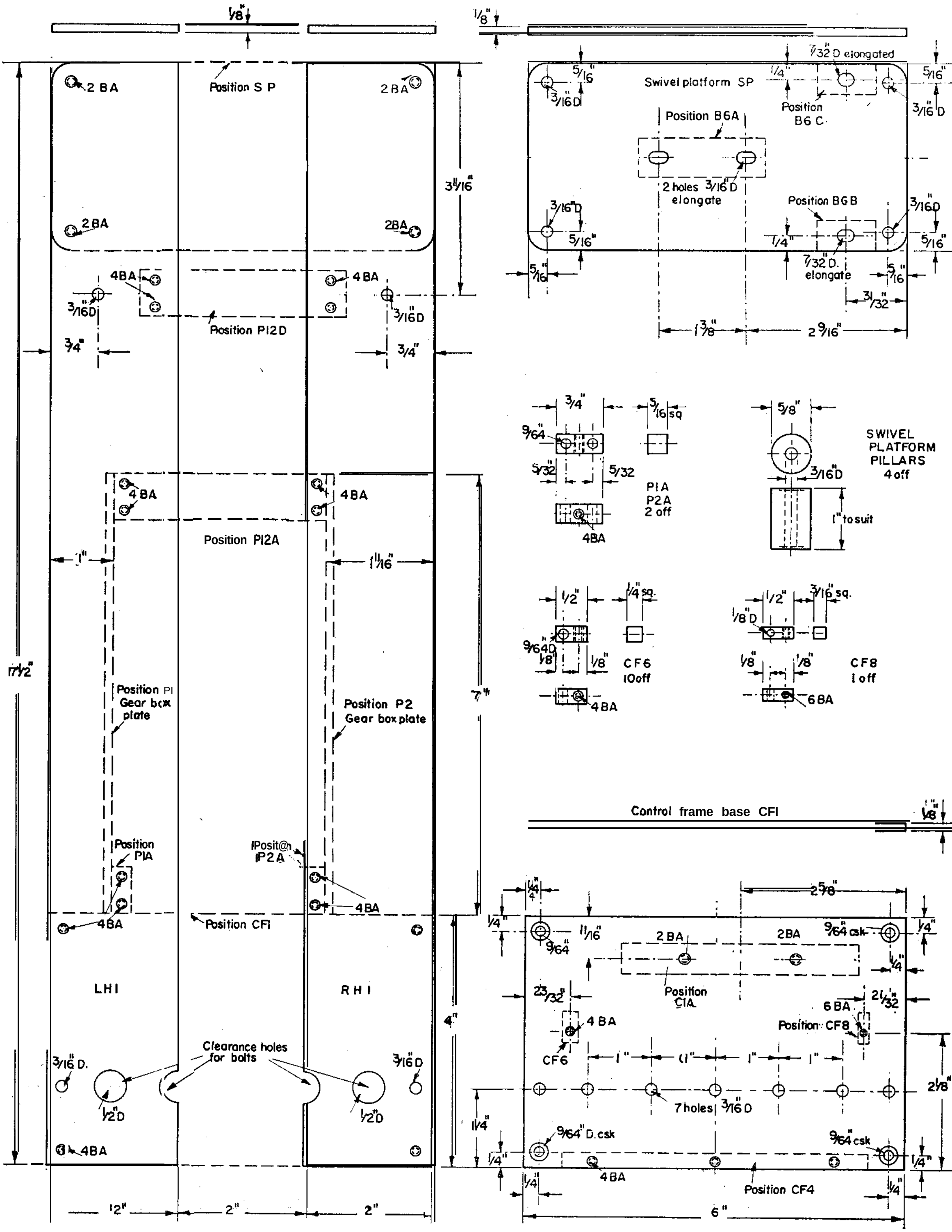


Fig. 2: General arrangement of the base

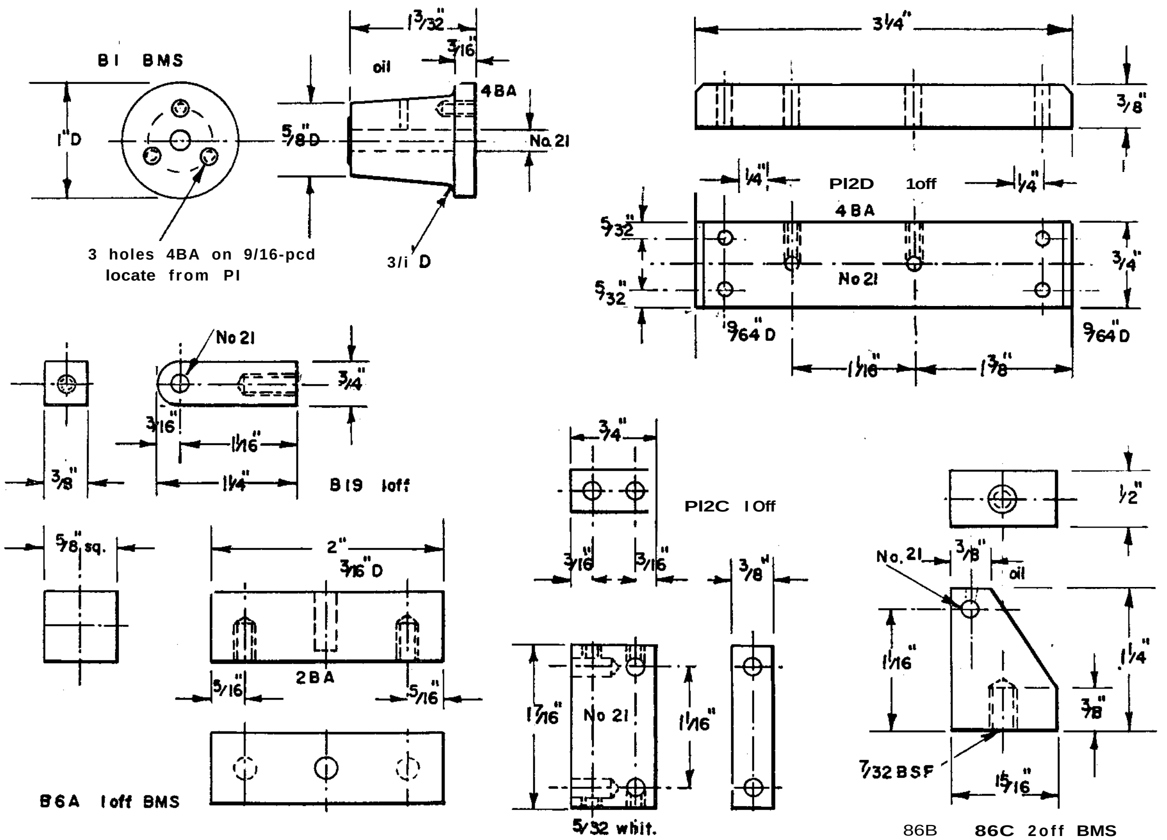


Fig. 3: Some of the components associated with Fig. 2

If you wish to cut spokes in the hoist and luff winding gears, use Bond's 130 t., 40 d.p. for gear G24, and Bond's 95 t., 40 d.p. for gear G35. If bevel gears are preferred in place of G30 and G31, use Meccano No 30.

The shaft diameter for Meccano gears is not 5/32 in., as commonly supposed, but averages around 0.159 in., so use Meccano axles or silver steel, No 20 gauge (0.161 in. dia.).

When making collars, pulleys, gear blanks and so on, to fit Meccano rod, a good average fit may be obtained by first drilling No 23, and then following up with No 21. Drilling of this kind should be done with the work revolving in the lathe chuck,. with the drill feeding from the tallstock.

To ensure accurate running, Bond's gears should be opened out in the bore with a slender boring tool in the lathe. If bearing holes that have to be drilled No 21 prove too tight, work a shaft backwards and forwards with a twisting movement, and some oil. This is less risky than drilling the next size up.

In all drawings, the key letters and numbers will always refer to the same component, base piece, bracket, lever, gear and so on. Where holes are shown without dimensional positions, it is intended that these should be located by using the mating component as a drilling jig, clamping in position and " spotting " through. Where a hole is threaded, initially drill both components tapping size.

All steel plates are from standard sections 2 in x 1/8in 3 in. x 1/8in and so on.

Basically, the construction is simple. The drawings may appear complicated, but drawings sometimes do. Drawing the items two or three times to show positions, and plan and side elevations, often makes the simplest piece of apparatus look as complicated as a battleship.

Fig. 2 gives details of the base: the foundation for the entire mechanism. Two strips of 2in. X 1/8 in. bright steel are spaced 2 in. apart and, initially, held by the control frame base, CF1, bottom right, and the jig swivel platform, top right.

The control frame base is fitted directly on to the main base strips, but the swivel platform is mounted upon four interposed pillars, SPP (also shown in Fig. 2) together with the small gearbox plate fixing pieces. Plates at the right may be drilled as shown and the hole positions transferred to the base strips at the left. The uses for remaining holes will become apparent as we progress.

My gearbox plates are of 1/8 in. thick brass, but as some readers may have plate material differing in thickness, but otherwise suitable, I have shown the positions on the base strips by referring to the *inside* of the plates. Duralumin would serve very well.

The jib swivel nlatform. SP. carries two worm shaft bearers, B6B and B6C, for shaft S6 (see Fig. 1 for shaft numbers). These and other base fittings will be found on the drawing, Fig. 3.

To be continued

Continued from April 4, page 424
By MARTIN CLEEVE

ALL WILL FALL TOGETHER

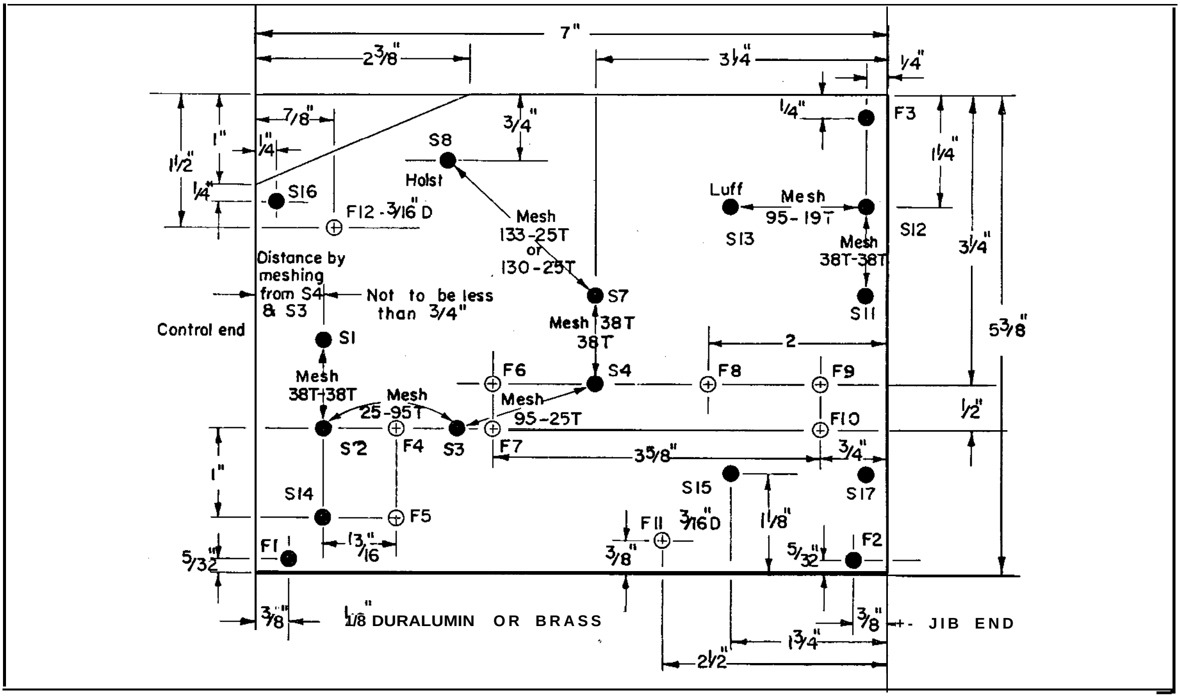


Fig. 5: Drilling of the gearbox plates. In Fig. 6 (below) drilling of the left-hand plate is shown

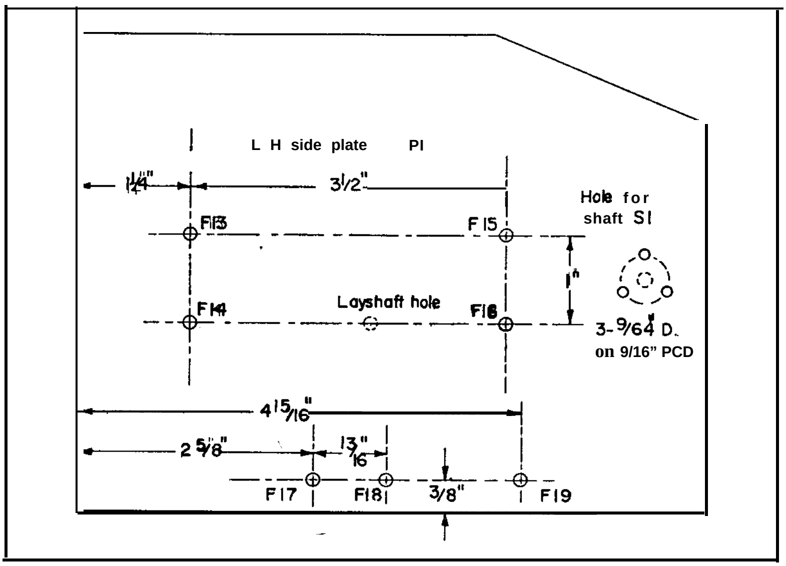


FIG. 4 takes us a step further. The upper drawing gives a side elevation and shows where the control lever frame will be positioned, how the stretcher P12D holds support rods for the hoist and luffing cord jockey pulleys, and how the jib swivel platform is raised up on the pillars SPP.

Do not be alarmed because many parts do not carry dimensional positions. All will fall together on assembly.

In Fig. 4, for example, the gearbox plate carries two bearers (for outside shafts) B67 and B910. When we come to drill the plates (from another drawing) the holes will be there as *F* for fix, followed by the hole numbers, and you will see that B67 is fixed and positioned by two holes, F6 and F7, and B910 by F9

Fig. 5 shows to what size and shape the two plates should be cut. Holes through which revolving or

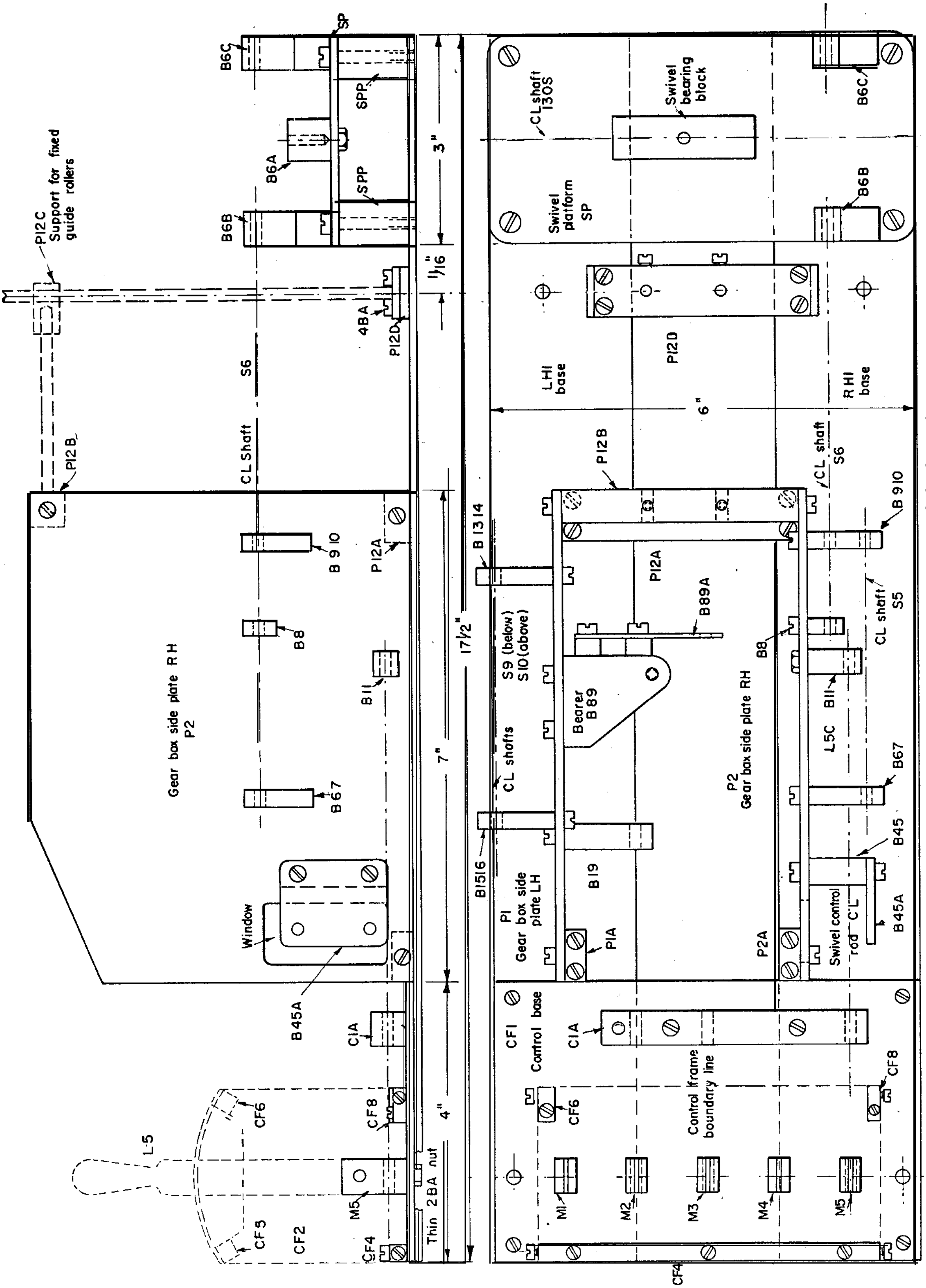


Fig. 4: This is the base, with the gearbox plate and the lever frame

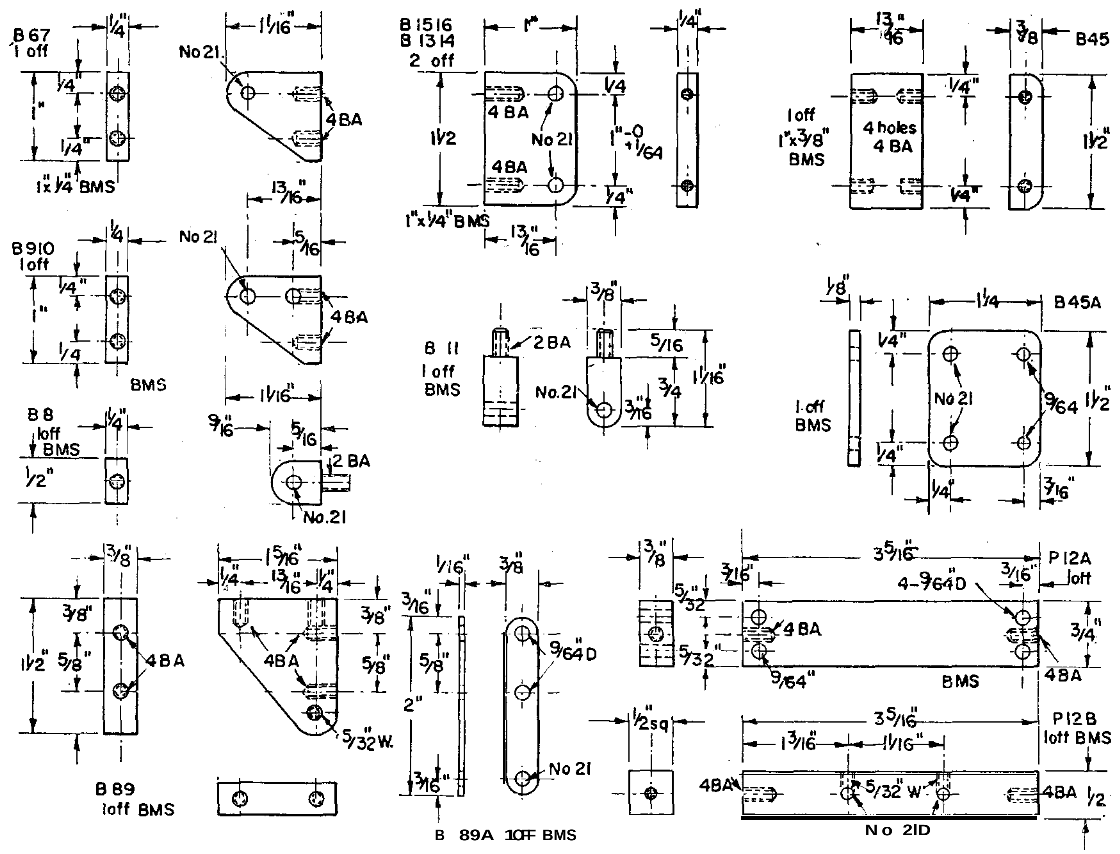


Fig. 7: Gearbox fittings, bearing pieces and other parts

sliding shafts pass are marked with the key letter and number for that particular shaft. Those for fixing only are prefixed F. Where the dimensional position of a bearing hole is marked with a single dimension only, you are intended to find the position in the " other direction " by meshing the gears and spot-drilling through the boss. This will help you greatly to avoid mistakes.

The holes shown in black should be drilled through both plates while they are fixed together. Holes not blacked-in are to be drilled only on the plate in question.

If you have any doubt whether a hole for gear-meshing can be drilled in exactly the correct place, carry out the operation first on an odd piece of 1/8 in. mild steel strip, afterwards using this as a drilling jig. When two or more gears are to mesh on spindles at a fixed centre distance, it is as well to try the meshing of all pairs first on a crude set-up, with the object of finding the best average centre-distance.

Note that the hoist-drum shaft hole S8 is positioned on a horizontal line 3/4 in. from the top of the plates: the hole may be moved along this datum line to suit the meshing of either a 133-tooth Meccano gear, or a Bond's 130-tooth brass gear with a 25-tooth gear (G23) on shaft S7.

You may drill in both plates, regardless of gear meshing questions, holes Fl, F2, F3, S15, S16, S17, and, marking the positions with even more care, S4 and S12. It is from these two bearing holes that the positions of all the remaining geared spindles which cross from plate to plate are found. Shaft holes (S) are No 21 drill size, and fixing holes are No 4 BA clearing, except F12, which is 3/16 in.

Fig. 6 shows the left-hand plate. In marking out the hole positions shown here, take extra care not to become confused with holes that will be there already from the drilling of both plates together.

* ***To be continued***

AND ALL FREE !

Sir.-I would like to say how amazed I often am at the range and complexity of the Readers' Queries which you handle.

Your full reply to J.S. on November 29 is a classic example. I can appreciate the specialist knowledge required to design that transformer. And all free !

St Andrews Road, Bridport, Dorset. A. M. SELLICK.

Continued from April 18, page 493

HOW TO ARRANGE THE GEARS

By MARTIN CLEEVE

Fig. 8 shows the relative positions of as many gears as possible, viewed from the right-hand side. At the bottom left-hand will be seen a cut-away portion of the side plate, marked "Window." It is cut to make room for the sliding needed on shaft S2, which carries five gears for the four-speed control. The cut-away part is moved outwards by a spacer, as 'may be seen in Fig. 4, bottom left, just to the right of the control frame base.

It is easy enough to show the gearing outside the plates. But it would not be of much help to draw the inside arrangement all on one sheet, for the resulting diagram would appear as an unintelligible jumble of gears hidden by gears. I shall, therefore, start with what you can see when you look over the control lever frame. Then I shall work back to the four-speed control gears, the hoist gearing, and the luffing gearing.

Fig. 9 shows the four-speed gearing. Shaft S1 is driven at constant speed from the motor (not shown). Shaft S2, below, carries four gears; sliding the shaft in steps to the left brings the gears, which diminish in size, successively into engagement with the gears above, which increase.

The wide gear G9 drives gear G10 behind. This transfers the various speeds to the layshaft S4 (Fig. I) from which all the crane's movements are taken. During speed changes, the face of G9 moves across that of G10. To accommodate the gears within the box width of 3-5/16 in. the face widths of some of them must be adjusted as in Fig. 9. The four-speed gear lever may be used with reckless abandon. As a help, springs B are interposed between the shaft S14, which is coupled directly to the lever and the loose boss and hanger C1D, which transfers the sliding action to shaft S2.

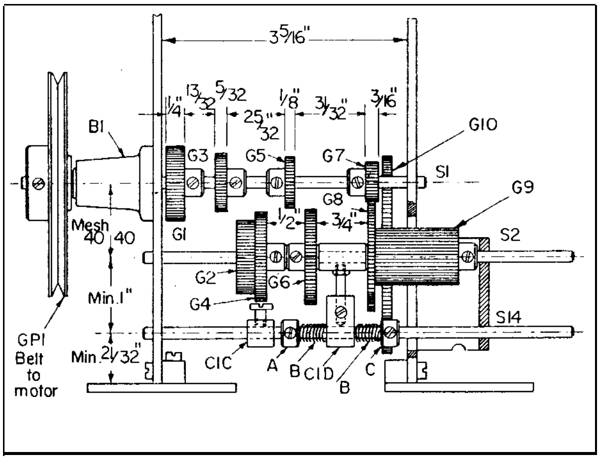


Fig. 9: Master four-speed control gearing, with every part in its correct position. Gears G2 1/4 *in. thick, G4 and G6 5/32 in. Springs B: each uses about seven turns of 21 s.w.g. Collar CZC is bell-cranked to a control lever*

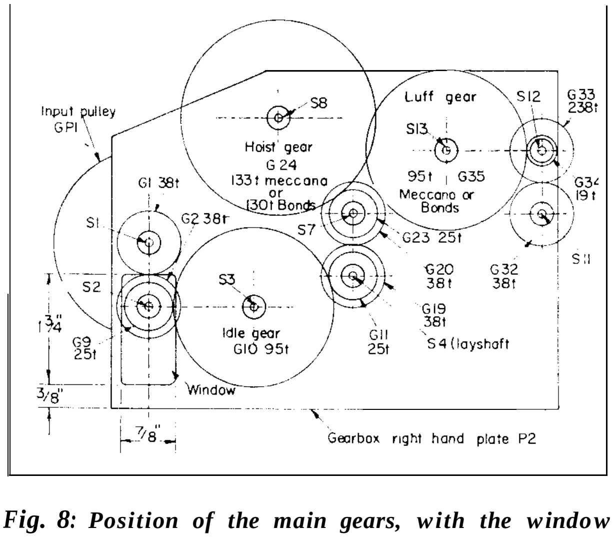


Fig. 8: Position of the main gears, with the window

Gear G2 has its boss machined away, and is eoupled to gear G4 either by soldering or with two countersunk head screws. Gear G8 is soldered to gear G9, whose width is made up from two Meccano gears of 1/2 in. plus 3/4 in. face width, the boss of one being thinned to receive G8, which is bored to about 3/8in. to suit.

To add to the novelty of using the mechanism, the hoist arrangement has two speeds besides the four given already by the main speed control. You will see from Fig. 10 when shaft S7 slides axially to the right gear G22 will engage with gear G21 and then the two will disengage and gear G20 will engage with gear G19. Layshaft S4 is driven all the time from gear G10 (Fig. g), engaging with G11 here.

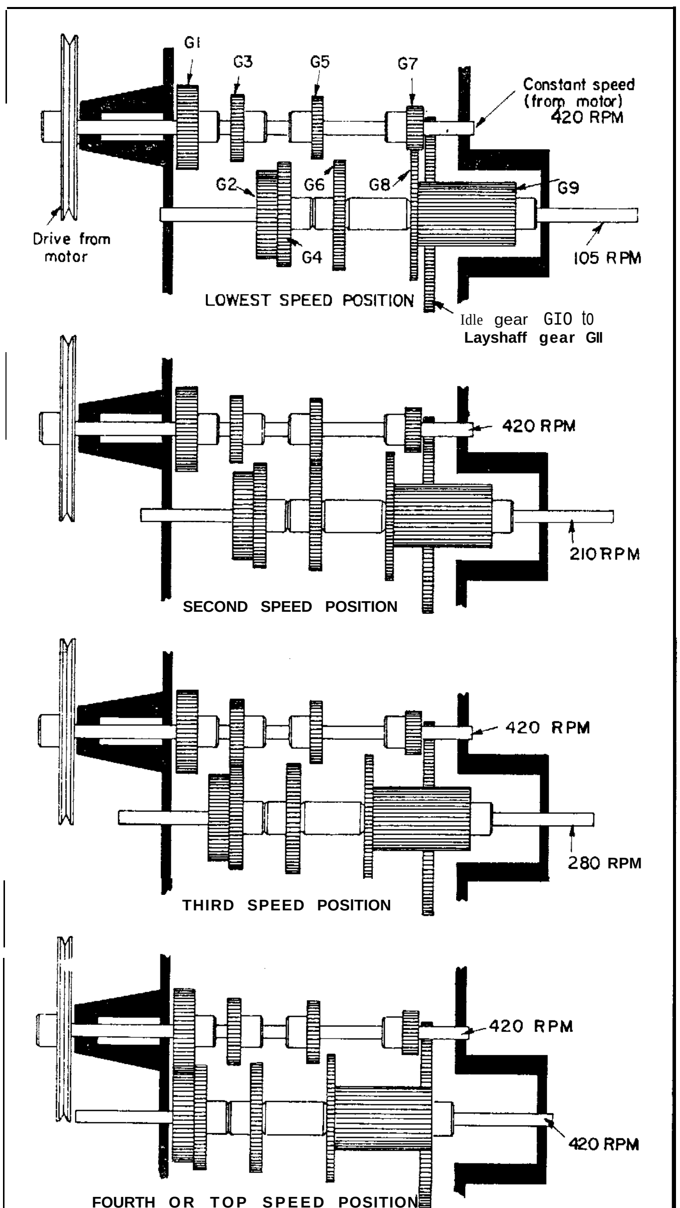
The drive is shown in the disengaged position, but the load or hook weight is prevented from rotating the winding drum by the ratchet wheel R36. Pawls tied to brake drum P36 hold the ratchet wheel, with the result that the drum can unwind only when a brake band around P36 is loosened by release of the brake lever. P36 is loose on the shaft S8. Movement of shaft S7 is controlled by shaft S15 at the bottom of the drawing. The two shafts are connected by rod R and sleeve S15A, which is tied to S15 and the boss or sleeve S15B. The sleeve is free on S7, but is positioned by two collars, one on either side.

Fig.11 gives particulars of the hoist and brake drums. I made the hoist drum by force-fitting two flanged steel plates, F, suitably machined, into a 1-1/2in. length of 1-7/8 in. dia. brass tube which had been faced each end in the lathe. After fitting the flanges, I took a light cut over the brass tube to provide dead true running.

Ratchet wheel R36 is held to the right drum flange by three No 6 BA countersunk head screws entering tapped holes in the flange. Note the direction in which the ratchet teeth must face (Fig.11, extreme left). To get the teeth this way round, the boss has to be machined away. Drill the oblique hole CH when the drum is completed. Countersink the outside: the hoist cord passes through and the countersink holds the retaining knot.

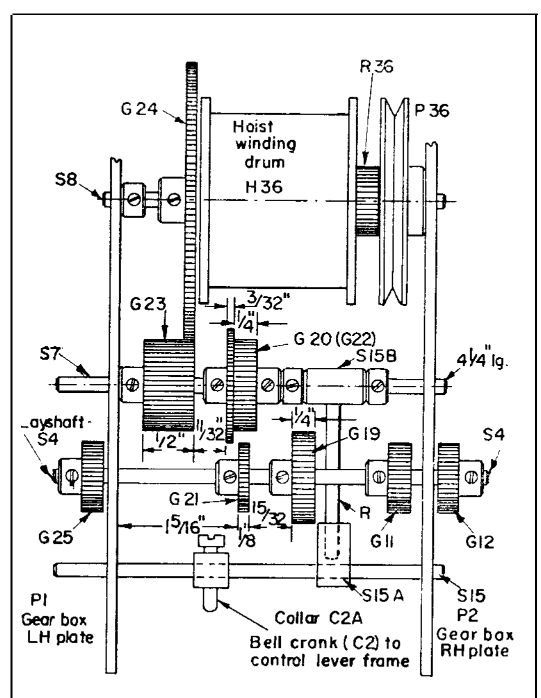
The screw S, fitted to the outside of the left flange, is to take a drive from one of the spokes, or a corresponding hole, in gear G24.

Details of the hoist brake arrangement will be found in Fig. 12. I designed it, not with the idea of obtaining enormous mechanical advantage, but to allow the control



As the transmission is light, the gears are slid into mesh under load

Fig. 10: Gearing of the hoist



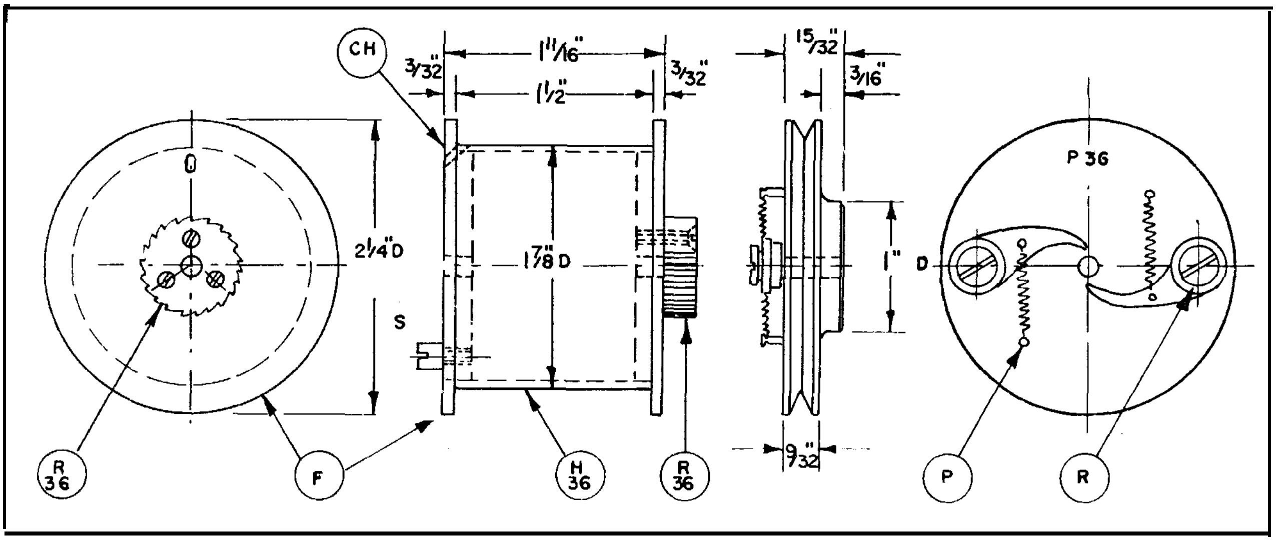


Fig. 11: Hoist and brake drums

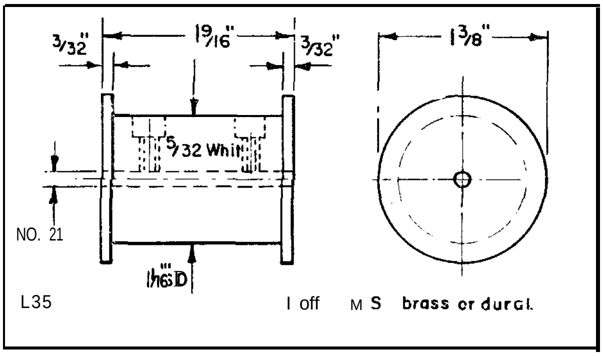


Fig. 11A: Luff winding drum

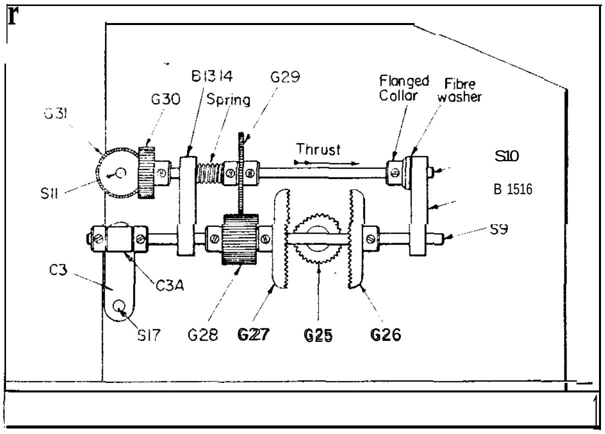


Fig. 13: ***Luff reversing gears and the frictional holding arrangement***

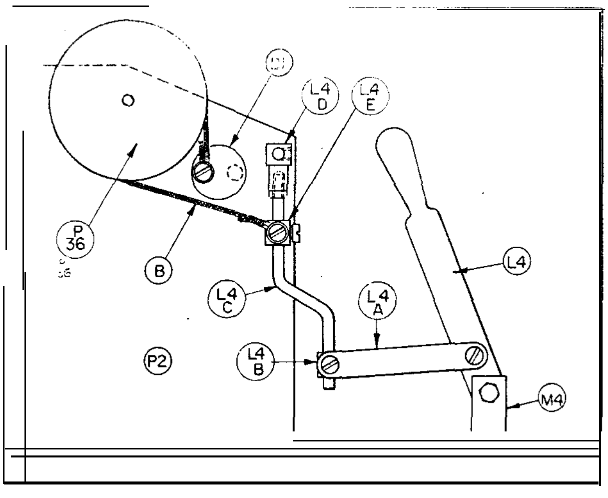


Fig. 12: Hoist brake lever and connections. L4A, 2-1/6 in. centres. Cranked rod L4C is offset 3/4 in.

lever to move through the same length of arc as the other levers and at the same time be capable of tine adjustments in braking intensity.

Cranked rod L4C is pivoted about shaft SI 6 bridging the gearbox side plates (see hole S 16, Fig. 5), and movement is prevented by the usual collars and grub screw. L4C is threaded at its upper end and is lock-nutted to the adaptor L4D. The lower end of L4C is linked to the hand-lever by the collar and screw L4B and strip L4A. Two brake-band adjustment points are provided for tensioning and to take up stretch : L4B may be moved up and down L4C, and BI may be revolved about its fixing screw, shown in broken outline.

As the main adjusting point, hole F12 (Fig. 5) is also very useful when new brake bands are fitted, as it is difficult to prepare them to the exact length. Brake tension should be adjusted so that in the full-on position a load of about 2 lb., falling fast, can be arrested. Make the brake bands from whiskerless white string, not less than about 1/16 in. dia. Loop and bind the ends: knots take up too much room.

** To be continued*

Continued from May 15, page 61

Gears for luffing and swivelling

By Martin Cleeve

THE ONLY luffing gears inside the box are G32, G33, G34 and G35. Figs I and 8 show the internal arrangement and we may turn to Fig. 13 to see how a reversible and neutral drive is taken from layshaft gear G25, through contrates G26 and G27, and wide gear G28 to shaft S10 and gear G29 and thence into the gearbox through contrate G3 I. Movement of shaft S9, to engage the contrates G27 and G28, is controlled from crank C3 pivoted on shaft S17. This shaft is rocked by a further crank inside the gearbox and rodded to the lever frame, as will be seen an another drawing (Fig. '17) in due course.

When the gears are in the position shown in Fig. **13, the** weight of the crane jib and the pull on the luff winding drum, unless some special provision is made, will be more than enough to drive all the gearing and let down the jib. This is prevented by the simple frictional arrangement mounted on shaft S10. A fairly strong compression spring is positioned on the shaft between bearer B1314 and gear G29. The spring gives an endwise thrust in the direction of the arrow, thus causing the flanged collar and interposed fibre washer to press against bearer B1516. As shaft S10 has a mechanical disadvantage of 5 to I, the amount of friction needed to hold does not have to be very great, and the driving motor will not notice it. The friction device is, strongly recommended in preference to a self-locking worm drive.

The arrangement of the swivel gearing is seen in Fig. 14. We have the-usual reversing contrates G13 and G14 with the wide gear G16 as compensation for the axial movement of shaft S5. Rod L5C is supported at BII, C1A, and M5, and is made to move axially by the piece L5B which is coupled to the control lever as shown. Rod L5C carries the adapter L5D and the rod R which is screwed and lock-nutted into the loose sleeve between the contrate gears.

Fig. 15 shows the chief lever control frame parts, and Fig. 16 the frame assembly. At the left will be seen the way in which the levers are positioned by a spring and bearing ball assembled inside the component SB. The positions of the locating holes in the strips NI and N5 may be marked on assembly, except for the luffing and slaving levers, which are in neutral at top dead centre and in forward or reverse at their limits of travel.

Strips NI and N5 should be bent before the notch holes are drilled. For a uniform bend, a fairly long strip (3/8 in. x 1/16 in. mild steel) should be pulled around a radius slightly smaller than the 2 1/4 in. rod required.

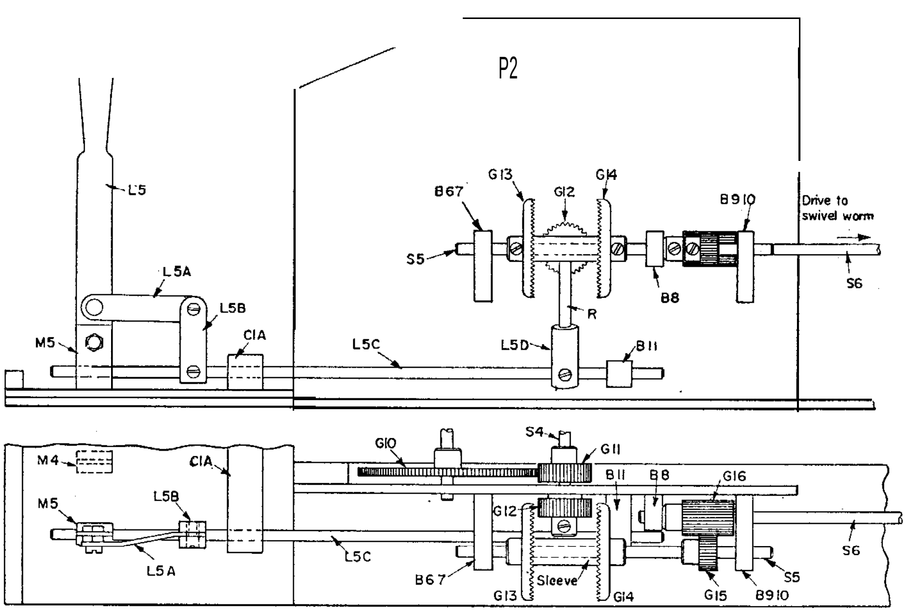


Fig. 14: ***gearing is connected to control lever***

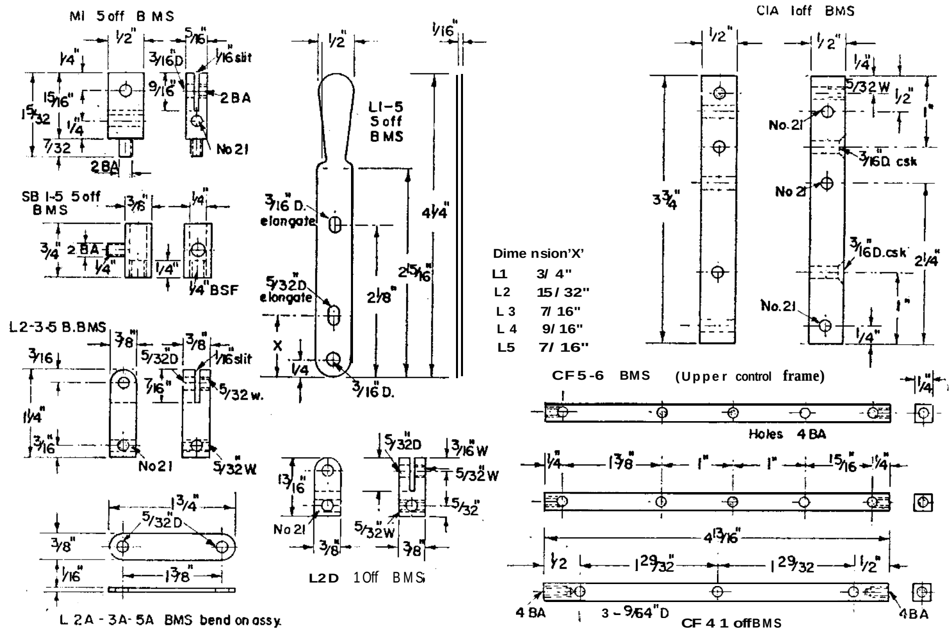
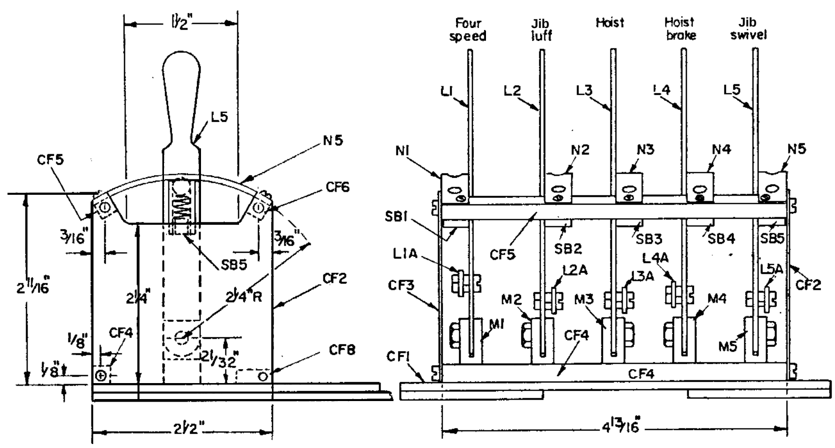
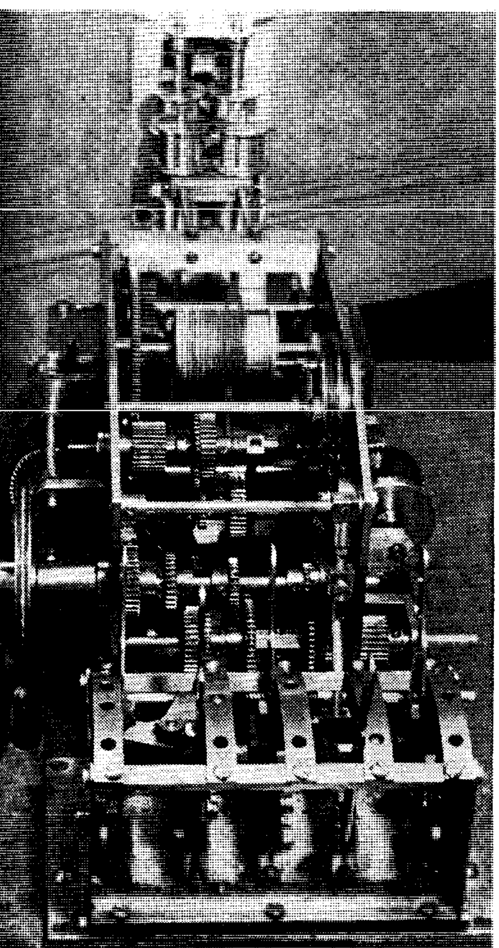


Fig. 15: Chief control lever and the parts of the frame





*Above, Fig. 16: Frame for five-*lever ***control***

Left: Looking over ***the frame***

Make the spring ball holding pieces from an approximate length of 5/8in. of 3/4in. x 3/8in. section bright steel. Chuck it sideways and machine the spigot for No 2 BA thread, leaving the body 3/8in. square and 3/4in. tall. You can best make the holes for the ball, spring and adjusting screw by drilling right through tapping size for 1/4 in. BSF, following with a 1/4 in. drill to the 1/2 in. depth required, and threading 1/4 BSF. When these holders are fitted to the levers, the upper ends exposing the ball should almost rub on the undersides of the notched strips, and so a slight radius should be filed in the direction of lever travel. For final adjustment, use the elongated hole in the lever itself.

Suitable springs may be made from eight to ten turns of 19 s.w.g. spring wire (0.040 in. wire dia.). In setting the tension to give the levers a comfortable feel, you will need to experiment; note that the tension will be close

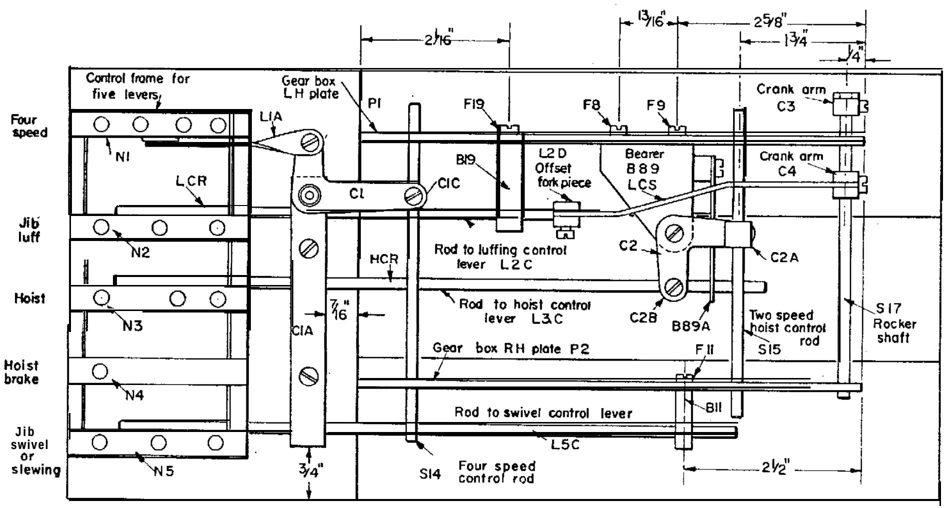


Fig. 17: ***General arrangement of control rodding and crank layout***

to the correct point when the ball shows one half of its diameter above the top of the holder.

Fig. 17 shows the control rods and cranks and Fig. 18 gives further details of some of the components. In Fig. 17 the levers and their mountings have been omitted to prevent confusion, but all the control rods. and the one twisted link L1A, are shown passing into the lever frame (except the hoist brake lever-Fig. 12). If you refer to the collar and screw C1C in Fig. g, and then look for C1C in Fig. 17 you will see that bell crank C1 is mounted on C1A, and is joined to the four-speed control lever by the twisted link L1A. Details of crank CI, and the way in which it is mounted on C1A, will be found at A in Fig. 18.

Swivel column construction

The general arrangement drawings (Fig. 20) show the salient features of the jib swivel column. The angle material may be 1/2 x 1/2 x 1/16in. aluminium angle. Basically, there are two angles to a side. They are 25 in. in length from the swivel gear G18 to the top of the column, where they are joined by the angle J7. The main uprights are strengthened by a further angle J2, bolted to the back of each, and reaching from the top of the column downwards to a length of 19 in., as may be seen in the centre drawing. The inner double-width flat formed by the back-to-back fixing is braced by a strip of I in. x 1/16 in. steel, J3, 16 in. long.

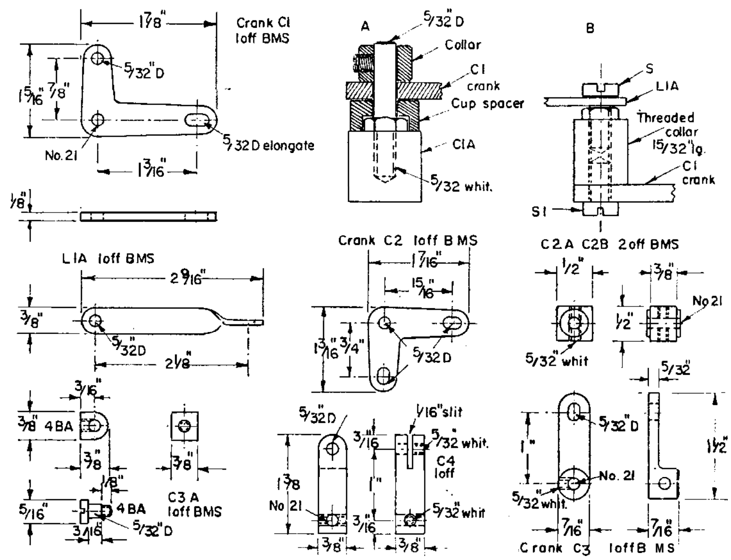


Fig. ı8: ***Cranks and fittings***

How a difference in height between C1 and L1A is dealt with can be seen at Fig. 18B. Fig. 18A and B are drawn to twice the scale of the remainder.

For the luffing control find shaft S17 in Fig. 13.Look for the same shaft on Fig. 17, at the right-hand end, and you will see that there is a crank arm C4 coupled by an offset strip LCS to an offsetting fork piece L2D, fixed to the rod LCR and passing to the luff control lever. C4 will be found in Fig. 18, L2D in Fig. 15 and B19 in Fig. 3.

To understand the hoist control, find shaft S15 at bottom of Fig. 10, and note the collar C2A. In Fig. 17 you will see that C2A is joined by a bell crank C2 to the rod HCR leading to the control lever. Crank C2 Will be found in Fig. 18, and a mounting piece for the crank is shown in Fig. 7, B89. Strip B89A is screwed to the side of B89 as in Fig. 17; it acts as a steady for that end of the rod HCR.

* *To be continued*

Be sure to make it work elegantly

By Martin Cleeve

THE two main uprights of the jib swivel column J1 are fixed to the swivel gear by a short length of 1/2 in. square bright steel, J4. Two screws, passing up through the gear and entering tapped holes, hold it to the swivel gear. You will see the details in Fig. 21.

At the top of the column the cross-brace angle J17 is fitted between the back-to-back angles J1 and J2. If aluminium angle is being used for the uprights, they may be squeezed up in the vice to close the gap as in the centre drawing, Fig. 20.

Trunnions J12 near the base of the column can be made up, or Meccano part No 126a may be used. The drawing shows the holes 'at the apex reamed 3/16 in. These are the holes about which the jib is hinged. So that the jib shall follow the motion of the column without slackness, the hinge pin is a fairly tight fit in J12 and in the corresponding jib hinge holes. As a further aid to rigidity at the jib hinge-point, the spacer J18 is fixed between the two trunnions. Adjust the spacer length on assembly.

The jib swivel column is held in the vertical position by two stay rods passing from the top of the column to the corners of the table; see the pictures of 18 January 1962. I used 1/2 in. dia. mild steel and shaped the ends by milling as in Fig. 22. Getting a satisfactory fitting at the top of the column was one of the biggest difficulties in the whole assembly, 'and so I have included Fig. 22A t make the method quite clear. If you prefer to use tubular stays and to flatten the ends by squashing in the vice, increase the lengths of the stays slightly and omit the bent pieces J24 and J25, Fig. 22A. The lower end of each stay rod is fixed to a shaped angle piece, J21 and J22, Fig. 29, each being held to the table by two wood screws.

To find the exact fixing positions for anchors J21 and J22 on the table, refer to a plumb-line dropped down the centre of the swivel column from which pulleys have been removed temporarily.

Construction of the **jib**

Fig. 23 shows the jib. The whole is made from sheet aluminium 1/16 in. thick. Basically it is constructed from four main tapered channel pieces, spaced and tapered also in the plan view, by simple cross-bracing parts. To avoid the difficulty of obtaining a double-tapered flange effect on one long piece, we make the jib from four pieces, each side pair being joined by the fishplate J30.

The flanges look well when they are not more than 3/8 in. in depth. To prepare the sheet aluminium for bending you will require for the jib hinge end two pieces with a width of 1-3/8 in. plus 3/4 in. at the hinge end, and widening to 2 in. plus 3/4 in. at the central point marked X-X on Fig. 23. For the outer halves, you will need two pieces, 2 in. plus 3/4 in. at X-X tapering to 1-1/4 in. plus Pin. at the extreme end. You may like to add a little more to the blank widths, say 1/8 in., and to remove the excess after bending. Having found that one of those little all-steel woodworking planes could be easily used for aluminium I produced very accurate flanges with it. Sheet aluminium should not be cut with tin snips because they bend the material too much: snap off along a deeply scribed line and finish the edge with the plane. Form the flanges by clamping them between two lengths of stout angle iron held in the vice, with additional clamps at the extreme ends. Bend the work over according to the inside flange dimensions. Aluminium will take a sharp corner, and this looks more satisfactory. Bending and clamping mar the bright finish, but the appearance of the whole is improved if it is given a matt surface by being rubbed over with medium emerycloth.

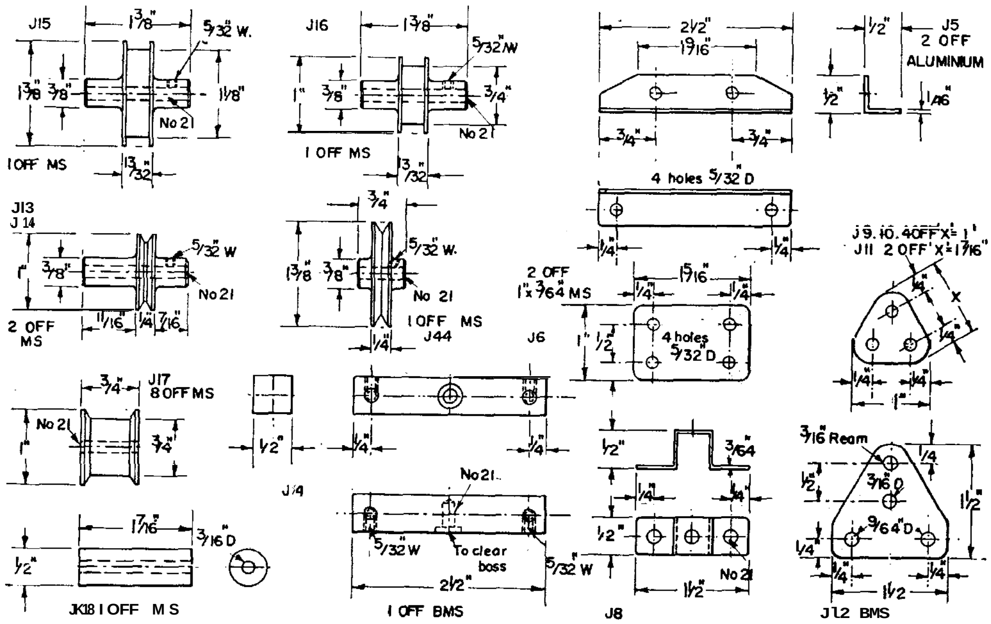
Central fishplates

Those who look a little askance at the work of flanging the flat sheet may like to consider building it up from flat tapered pieces edged with, say, 3/8 in. X 1/16 in. angles, bolted on.

Fig. 24 shows details of the jib central fishplates. Mark them out and fit them carefully to make sure that the two halves of the jib remain symmetrical about the centre line. Some of the holes take ordinary bolts and nuts, and some are used to fix the spacer pieces, J36 to J39. See also Fig. 24.

The jib hinge adaptors, J32 and the jib hoist end plates J31 should also be a good fit between the jib flanges.

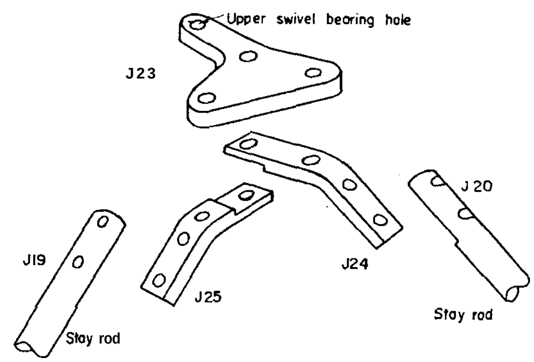
To use the correct shape for the jib end plate, J31, I had to make several trials. The details are shown in Fig. 25. Use two pieces of 1/16in. aluminium sheet, about 6-1/2in. x 4-1/2 in. Near the top on the 6 in. length of one, mark out the slightly tapered part to fit between the flanges. Mark a vertical line Y at right angles to the centre line X coincident with the point at which the jib members terminate. Mark a point in corner A, 1/16 in. above line A, and a similar point 1/16 in. below point B to indicate what will form the small corners, so that the curved part of the fitment shall blend with the outsides of the jib members.

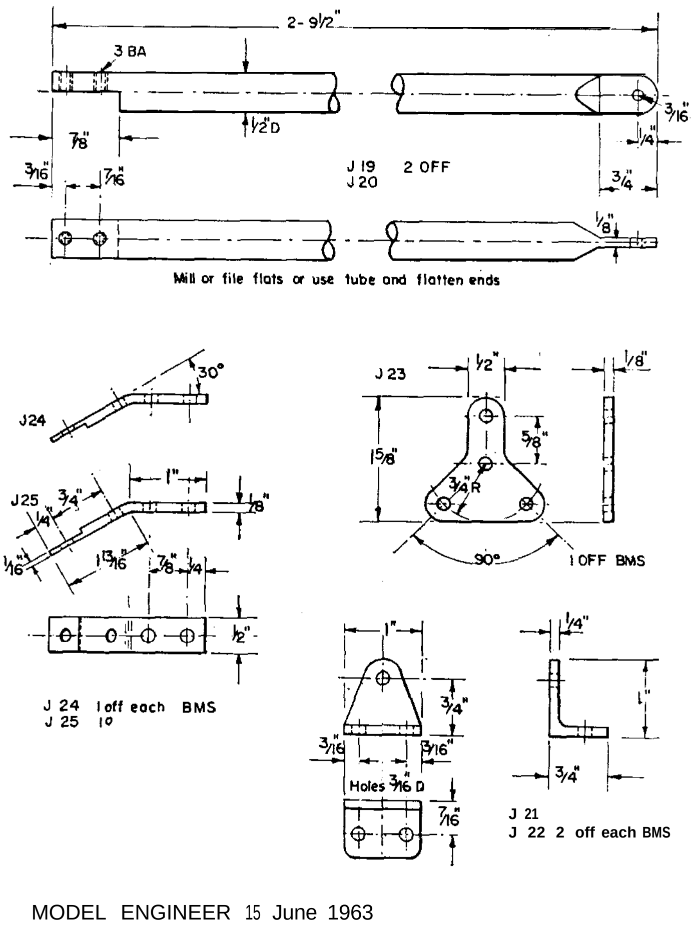


Above, Fig. 21: Fittings of chief jib swivel-column

Right, Fig. 22A: Upper stay-rod fittings; exploded

Below, Fig. 22: Swivel-column stays and anchor pieces

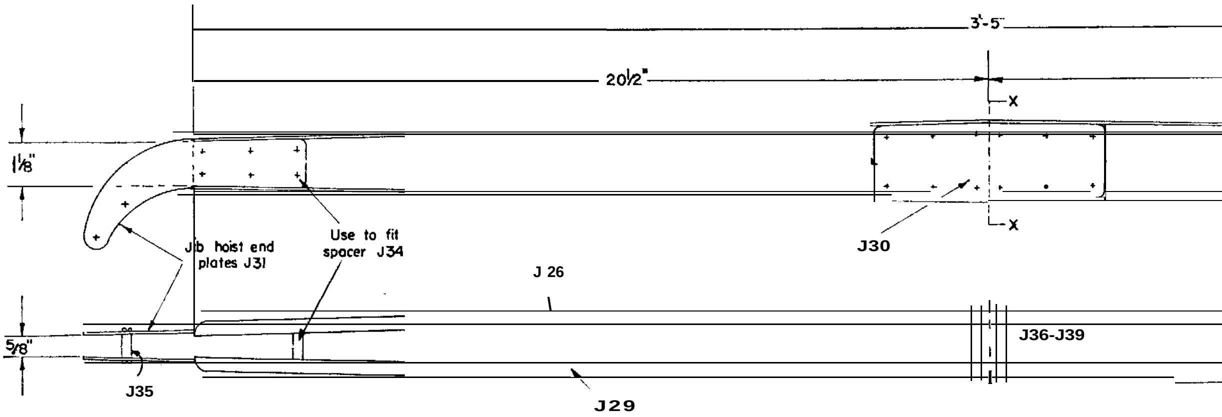




Set the dividers to a radius of 2-7/8 in., and by trial, find point P about which the outer arc C can be scribed. Centrepop P and scribe C. Now set the dividers to a radius of 2-1/2 in., and, by trial, find point 0 for scribing arc D. Using the centrepop P as a reference, measure up line Y for distance of 3/8 in., and through this point scribe line Z, parallel to the horizontal centre line X. At the centre point on Z between the two scribed arcs, centre pop and scribe a radius of about 11/32 in. to blend with the curves. Set the dividers to 1-1/8 in. radius, and mark off arc F and centre pop for a hole 1/4 in. up from the underside. Rough the work out with tin snips and file it to size. Mark the second plate from the first and drill both together.

The holes on radius F are for fixing the spacer J35, and the hole on the centre line Z is for the jib hoist pulley (see Fig. 21) component 544.

Details of the hoist pulley sleeve are shown in Fig. 26. The pulley J42 should be of sufficient diameter just to clear the spacers J41. Then if the block is allowed to fall and rest on its side, the hoist cable cannot escape over the pulley edges and on rehoisting will fall back into the groove. Trouble with the hoist cables coming off the various pulleys is very rare.



J43 is an additional weight to give sufficient pull for gravity lowering when there is no load on the hook. Mild steel will serve here.

Plaited picture cord, about 1/16in. diameter is the very best for the hoist and luffing cables. If ordinary twisted string is used, especially for the hoist cable, it will tend to set the pulley sheave into a violent spin at the least provocation.

The hoist cable requires seven yards, and the luffing cable three yards. Hang the hoist sheave with the hook open-side outwards.

You can use the same picture cord as a driving belt from the motor to the mechanism. Join it by threading each end into a short piece of spring. If you are using a constant-speed induction motor (as I recommend) it will probably run at 1,400 r.p.m., and if the gearbox input pulley GPI has a groove diameter of 2-3/4 in., a suitable groove diameter for the motor pulley will be about 8/10ths in. The motor needs a horse-power of about 1/150th. The smallest steam engine would also serve very well.

The motor is fixed upon a platform underneath the crane table. I merely bridged the legs at each end with a short length of "bed angle" iron, cut a board of sufficient length to rest on these angles, and fixed the motor to the board. Some means must be included for belt tensioning. To save the bother of cutting slots in the angles, the platform is fixed by carriage bolts and wing nuts, gripping the edges of the angles only.

Careless driving may easily damage the mechanism: the jib will swivel through an arc of about 200 degrees, greater movement being prevented by the stay rods. As there is a speed reduction of about one thousand to one between the motor and the swivel gear itself, the torque behind the gear is very great, and so extreme care must be taken not to allow the jib to come into contact with the stays or jockey rollers at the base of the swivel column. If it does the column will be twisted.

Take care, too, not to over-luff in the fully jib-raised position: here the leverage at the jib hinge end is considerable, and if the jib is luffed in close enough it is capable of bending the swivel column. When the jib is slewed to its extreme left or right, the jockey rollers move in such a way that the jib cable is tightened slightly-

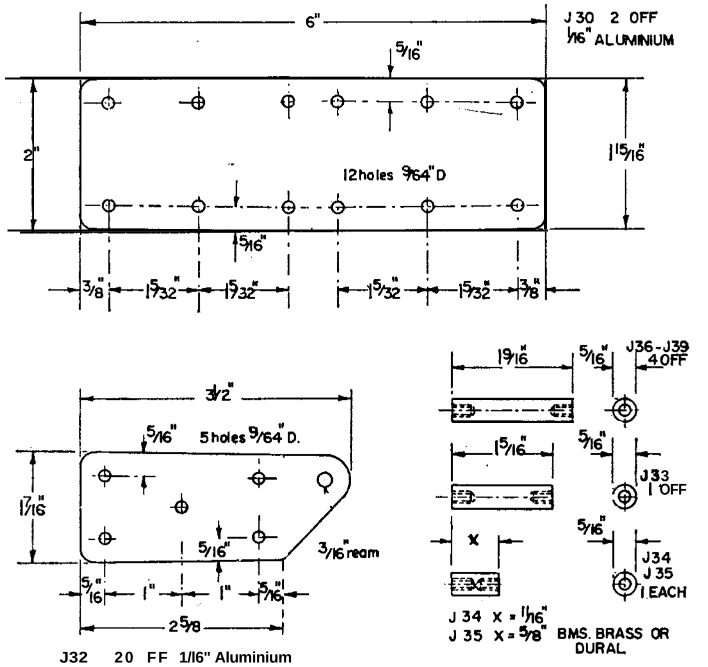
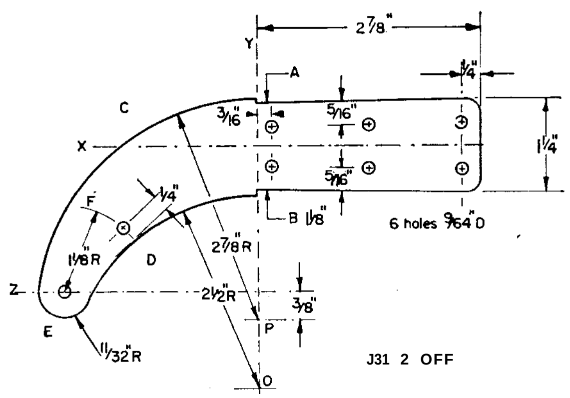
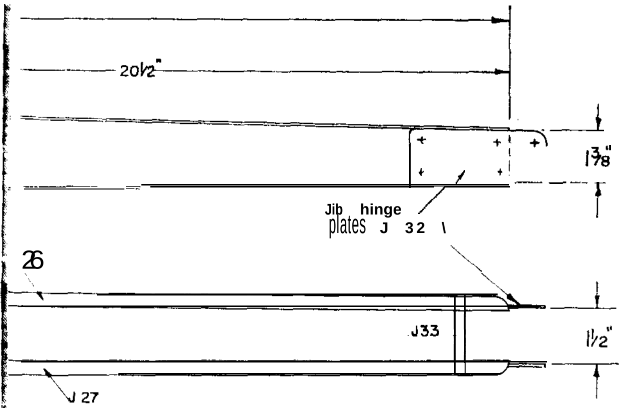


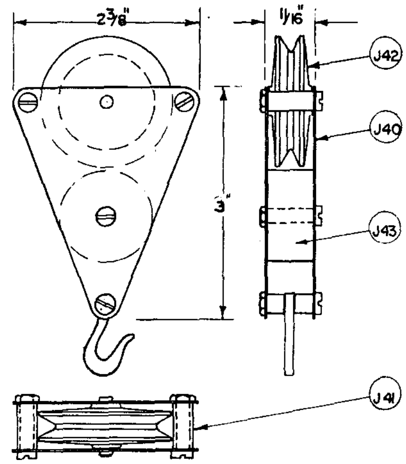
Fig. 24: *'jib fishplates, hinge plates and spacers*

Below, Fig, 25: ***Jib extension plates; marking out***





Left, Fig. 23: This is *the jib*



Right, Fig. 26: Hoist pulley sleeve

as may be seen by experiment. Therefore, if the jib is near its fully raised point and you intend to slew a little more to the right or left, you should let out a short length of luffing cable so as not to strain the mechanism.

Another point for which to watch is that when the hook is raised and the jib lowered the two do not meet.

For elegant operation, the dewing gears should never be engaged or disengaged unless the four-speed control lever is in the lowest or bottom-speed position, especially when the jib is much extended. Thus, at the onset of a slewing movement, you may use the four-speed lever to accelerate the jib to full speed and to decelerate it before stopping it. In this way, too, a minimum of strain is placed upon the jib hinges and gearing, and the load is carried steadily.

A small slewing movement to adjust the hook position or move it only an inch or so may be made by two (or more) sharp successive operations or " jabs " at the lever. The first engagement will cause the hook to swing over the desired point, and the second will swing the jib over the hook (if it is done at the correct moment) thus preventing a continued oscillation.

Similarly, if the load or hook has been set into a violent swing owing to a faulty operation, such as by the disengaging of the slew when it is moving at top speed, the four-speed should first be placed in the " slow " position; then by careful timing, the jib may be swung vertically over the hook just as it reaches a point of maximum oscillation.

In altering the speed with the gear-change lever, the drop from full to slow and vice versa may be made in one continuous, rapid movement: the retarding effect on the jib, if you are slewing, is just as effective. Again, if a load is being raised and luffed in or out at the same time, and you want to engage or disengage the slew alone, the four-speed may be dropped, the slew engaged (or disengaged) and the speed restored to full in a time too short to be noticed by an audience.

The luffing and hoist gears may be engaged regardless of any pre-selected speed, but when a load has been raised, slewed, and luffed in at the same time, it is as well that you slow all movements with the speed control on approaching the desired dumping point; then slew, hoist or luff may be disengaged in any order dictated by circumstances, the speed being left in low ready for re-engaging any necessary movement for the final close positioning of the load.

In lowering the jib to cause a load to move outwards radially, the load will normally go down at about one-half the speed of the jib: but you will find that when you engage the first hoist speed, the hook will remain almost stationary in a vertical direction while the jib is moving down, and the load will therefore be held to a horizontal radial path. *

● ***This serial began on April 4 (page 422). Other instalments were published on April* 18 *(page* 491) *and May 15 (page* 59).**

Steam in the civil war..

***Continued from page* 121**

winter, and on rainy days at home he learnt shorthand and studied astronomy. He was badly short-sighted and at first could not see a star of less than the third magnitude. After gaining a teacher's certificate, he used his money to buy from Amasa Holcomb of Massachusetts. the mirror and eye-piece for a ten-foot reflector. His observatory was a step ladder and the post on which he had mounted the telescope, at a level spot above the farmhouse. Photography was another of his interests, and only lack of capital turned him from making it his career. After teaching at Ravenna in Ohio, he helped to edit and publish the ***School-day Visitor*** in Cleveland. At nineteen he was teaching in Southern Illinois, reading law in his spare time, and making himself known as an abolitionist. Then he took a school for the winter in Beaver Country, Pennsylvania, and soon afterwards wrote home to say that he had made up his mind to become a soldier.

He was the most interesting of the twenty-three who met on the Wartrace road, to wait for James J. Andrews, as thunder-clouds gathered in the sky on a stormy April evening.

*** To be continued***