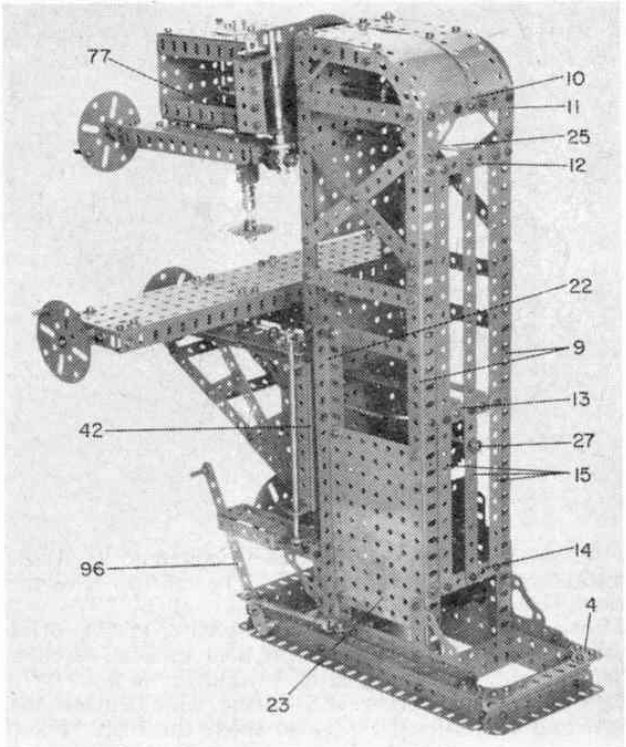
UNIVERSAL MILLING MACHINE

by Spanner

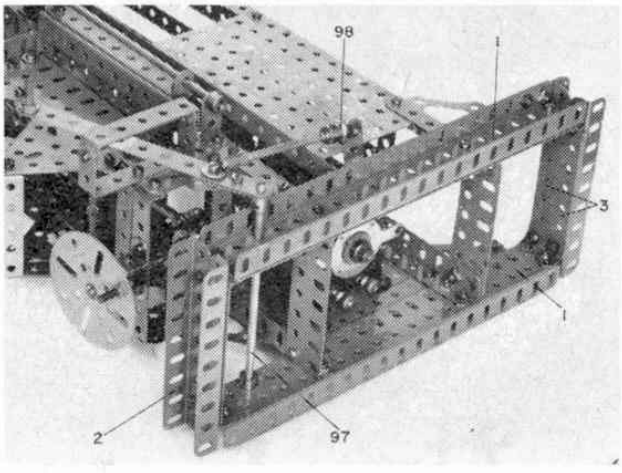
An intriguing model for the mechanically-minded Meccano model enthusiast.



A rear general view of the Universal Milling Machine in which the open construction of the column is clearly shown. This is a fully working model and best constructed by the more experienced Meccano enthusiast.

ALL OF us have our own personal likes and dislikes connected with virtually everything we do and Meccano modelling is certainly no exception. I have often claimed—rightly, I think—that the most popular subjects for Meccano modellers are road vehicles, cranes and bridges, but these are not the only well-liked subjects. On the contrary, there is another highly-popular category which unfortunately tends to receive rather less publicity than the first three and this is, quite simply, machinery.

Machine models, in fact, have a very wide following, perhaps because there is something deeply satisfying in producing a Meccano version of something, such as a lathe or bench drill, that reproduces most of the movements of the original, although the finished model need not actually perform the *work* of the prototype. In this article, we feature one of the best examples of this type of model I have seen. Based on a Universal Milling Machine and powered by an E15R Electric Motor is incorporates a driven spindle in a universal head that can be swung to any position in one plane without affecting the drive, as well as including a worktable with fully-adjustable height-, traverse- and cross-feeds.



An underside view of the base of the model showing the construction of the built-up channel girders as well as the linkage to the E15R Motor switch.

Construction is not really so complicated as it may appear from the accompanying pictures. The base of the Machine is built up from two 9½ × 1 × ½ in. channel girders 1, each obtained from two 9½ in. Angle Girders joined flange to flange by a 9½ in. Flat Girder. Two 4½ × 1 × ½ in. channel girders 2 are then each produced from two 4½ in. Angle Girders joined, in this case, by a 3½ in. Flat Girder, the securing Bolts also holding in place two 4½ × 2½ in. Double Angle Strips 3 which are used to connect girders 1 to girders 2. In addition, one girder 2 is secured to girders 1 by two 1 in. Corner Brackets 4 bolted as shown between the upper flanges of the girders.

In the case of the main body or column of the model, it is best to build this up separately and attach it to the base when completed. Two 18½ in. Angle Girders 5 are joined together at the top by a 3½ in. Angle Girder 6 and, at the bottom, by a 3½ in. Flat Girder, two 5½ × 3½ in. Flat Plates 7 and 8 also being bolted to the Girders in the positions shown.

Two 17 in. compound angle girders 9 are next each produced from one 12½ in and one 5½ in. Angle Girder, the compound girders being joined at the top by a 3½ in. Strip 10, strengthened by 1½ in. Corner Brackets 11. Further 3½ in. Strips 12, 13 and 14 are bolted between girders 9 in the positions shown, these Strips themselves being joined by three 12½ in. compound strips 15, the lower ends of girders 9 being connected by a 3½ in. Flat Girder as in the case of Girders 5. Each compound strip 15 consists of a 7½ in. Strip extended by a 5½ in. Strip.

A close-up view of the column showing the drive to the universal head which, along with the table and its saddle, have been removed for this picture.

Girders 5 are now secured to compound girders 9 by a 3 in. Angle Girder 16, extended by a 2½ in. Stepped Curved Strip, two crossed 5½ in. Strips 17 and four 4½ in. Strips 18, 19, 20 and 21. Strips 20 and 21 are joined by a 9½ in. Angle Girder 22 which, at one side, is connected to girder 9 by a 5½ × 3½ in. Flat Plate 23 and, at the other side, is connected to corresponding girder 9 by a 3½ × 2½ in. Flat Plate 24. A 4½ × ½ in. Double Angle Strip 25 is bolted between Strip 12 and Flat Plate 7, while two similar Double Angle Strips are bolted between Strip 13 and Flat Plate 8. A Double Bent Strip 26 is fixed to the centre of the latter Double Angle Strips.

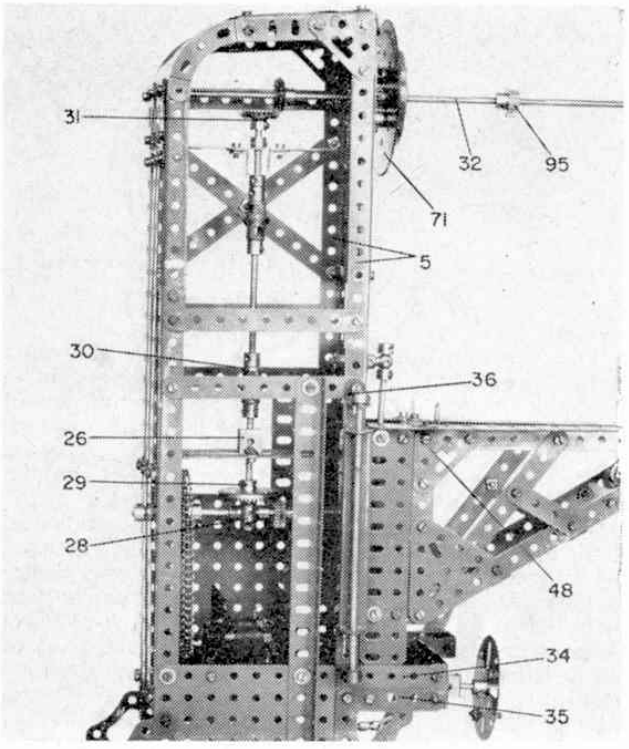
An E15R Electric Motor is now bolted to Flat Plate 24 and a ¾ in. Sprocket Wheel on its output shaft is connected by Chain to a 2 in. Sprocket Wheel on a 5 in. Rod 27 held by Collars in centre compound strip 15 and Flat Plate 8. Also mounted on the Rod are a ¾ in. Pinion and a Coupling 28, the latter loose on the Rod but held in position by Collars. Note that the Rod passes through the centre transverse bore of the Coupling. Journalled in the longitudinal bore of the Coupling and in Double Bent Strip 26 is a 2½ in. Rod that carries a 1½ in. Contrate Wheel 29 towards its lower end and a Universal Coupling 30 at its upper end. Fixed in this Universal Coupling is a 3 in. Rod, on the other end of which a second Universal Coupling is secured. The other side of this Universal is mounted on a 2 in. Rod held by Collars in Double Angle Strip 25 and in a Double Bent Strip bolted to the underside of the Double Angle Strip. A ⅞ in. Bevel Gear 31, fixed on the upper end of the Rod, engages with a second ⅞ in. Bevel Gear on an 11½ in. Rod 32 journalled in Strip 10 and Flat Plate 7. This Rod will later transfer the drive to the universal milling head.

A 1 × ½ in. Angle Bracket 33, overlayed by a 2½ in. Flat Girder 34 and a Corner Gusset 35, are now bolted to Angle Girders 5 at each side, a second 1 × ½ in. Angle Bracket 36 being bolted further up the same Girders. Flat Girders 34 are joined by two 3½ × ½ in. Double Angle Strips 37, a Washer being added to each securing Bolt for spacing purposes. At one side, the securing Bolt helps to hold in place as shown a 2½ × 1 in. Double Angle Strip, between the lugs of which two 2½ × ½ in. Double Angle Strips 38 are bolted in such a way that they form a " gate " for the start/stop lever, to be fitted later.

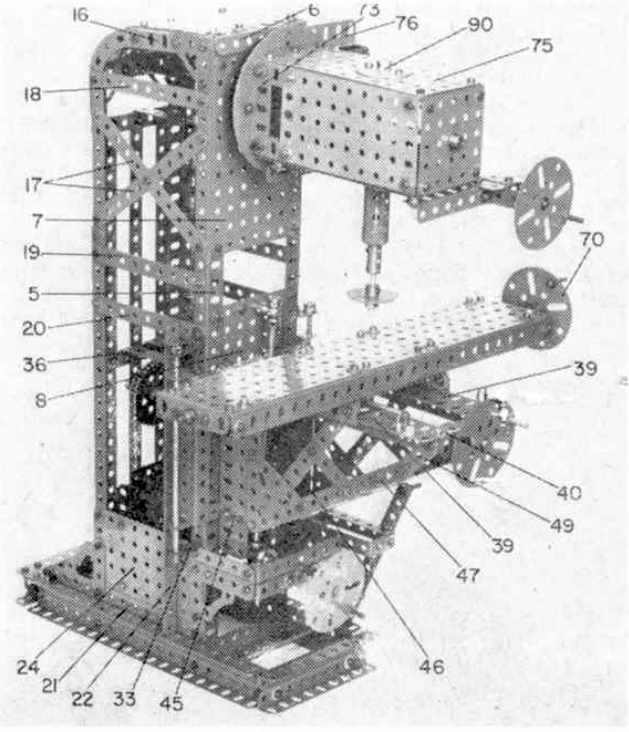
In producing the vertically-moving section or " bed " of the model two T-section girders 39, each built up from two 7½ in. Angle Girders bolted " back to back," are joined at one end by a 2½ in. Angle Girder 40 and at the other end by a 2½ × 1½ in. Double Angle Strip fixed to the back of a 4½ × ½ in. Double Angle Strip 41. Bolted to each lug of the latter Double Angle Strip are two 4½ in. Angle Girders 42, arranged to form a U-section girder, the securing Bolt also fixing another 4½ × ½ in. Double Angle Strip 43 to the back of the U-section girder.

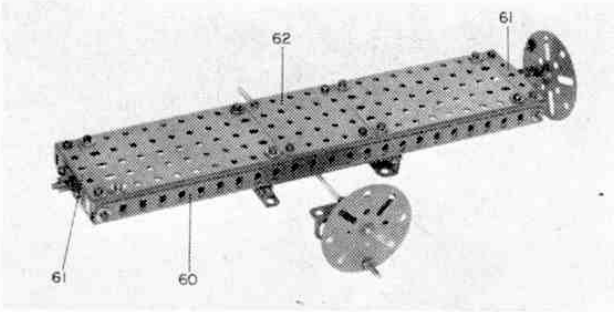
Fixed between the lower ends of the U-section girders at each side is a further 4½ × ½ in. Double Angle Strip 44, to which another 2½ × 1½ in. Double Angle Strip is secured. A 2½ × 1½ in. Flanged Plate is bolted between the lugs of this last Double Angle Strip, the securing Bolts at each side also holding in place a 5½ in. Flat Girder 45, a 2½ in. Triangular Plate, a 5½ in. Strip 46 and a 6½ in. compound strip 47, obtained from one

Machine models have a very wide following among Meccano hobbyists. This particular example is a Universal Milling Machine which performs nearly all the actions of its full-size counterpart.



5½ in. and one 2½ in. Strip. The Triangular Plate is extended upwards by a 2½ in. Strip which is bolted, along with a 1½ in. Corner Bracket 48, to T-section girders 39. Flat Girder 45 and Strip 46 are also bolted direct to the girder, while compound strip 47 is extended by a 2 in. Slotted Strip 49 fixed to the end of the girder. A 2 in. Strip is fixed between Strips 46 and 47 for bracing purposes, then strips 47 at each side are joined by three 2½ × ½ in. Double Angle Strips. A Threaded Crank 50 is bolted to the top of the 2½ × 1½ in. Flanged Plate mentioned above.





A view of the worktable and saddle as they appear when removed from the model.

The assembly can now be mounted on the main body of the machine which is simply done by positioning U-section girders 42 on Girders 5 so that the lugs of each Double Angle Strips 43 fall in line with the protruding lugs of Angle Brackets 33 and 36. A 6½ in. Rod 51 acting as a slide is then slipped right through all these lugs, to be held in place by Collars.

Movement of the bed is controlled by a handwheel (built-up from a Face Plate 52 to which a Threaded Pin is fixed), mounted on a 3 in. Rod held by a Collar in lower Double Angle Strip 37 and a Double Bent Strip bolted to this Double Angle Strip. A ½ in. Bevel Gear 53 is also fixed on the Rod, the inside end of which is inserted, loose, part way into the longitudinal bore of a Coupling. Loose in the centre transverse bore of the same Coupling is a 6 in. Screwed Rod 54 extended, via a Threaded Coupling 55, by a 2½ in. Rod free to turn, but held by Collars in the head of a Handrail Coupling 56 on a 1 in. Rod fixed in the boss of a Double Arm Crank bolted to Flat Plate 8. A Nut locked against Threaded Coupling 55 holds the Screwed Rod in place in the Coupling. *Note that the Screwed Rod passes through the boss of Threaded Crank* 50.

Fixed on the Screwed Rod just above the Coupling is another ½ in. Bevel Gear 57, meshing with Bevel 53, then the Rod is held by a Collar in a 3½ × ½ in. Double Angle Strip 58, secured between Flat Girders 34 with Washers on the shanks of the securing Bolts again being used as spacers. A couple of " stops " for this section of the model are supplied by 1 × ½ in. Reversed Angle Brackets 59 bolted to Flat Plate 8 so that they project one each side of the Screwed Rod.

Coming now to the worktable and the " saddle " on which it is mounted, two U-section Girders, each produced from two 12½ in. Angle Girders 60, are connected by two 2½ in. Angle Girders 61, one at each end, two 4½ × 2½ in. Flat Plates and a 2½ × 2½ in. Flat Plate 62, the last centrally placed.

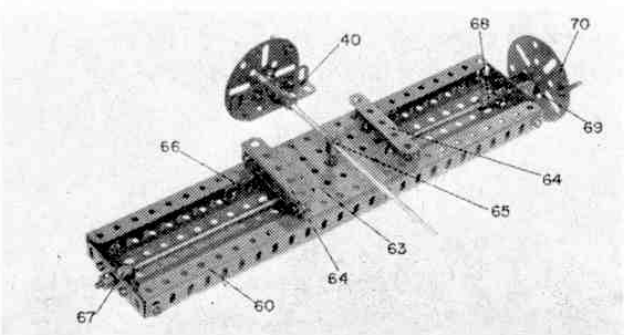
A Threaded Boss is now locked by a Nut on the end of a 1 in. Screwed Rod, care being taken to ensure that the Rod does not foul the transverse bores of the Boss. The Screwed Rod is then fixed by Nuts in a 3½ × 2½ in. Flanged Plate 63, to each flange of which a 2½ in. Angle Girder 64 is secured, Washers on the shanks of the securing Bolts spacing the Girders a short distance from the flanges. Note that the Threaded Boss is situated above the Flanged Plate and should not be confused with a second Threaded Boss 65 now locked by a Nut on the lower end of the Screwed Rod, care again being taken to ensure that the transverse bores are not fouled.

Two 3½ in. Angle Girders are fixed to Flanged Plate 63, through the second row of holes from each side, the horizontal flanges of the Girders pointing inwards. Bolted to the back of the vertical flange of each of these Girders is a 5½ in. Angle Girder 66 and note that use is made of the elongated holes in this latter Girder, thus enabling a gap to be left between its horizontal flange and the top of Flanged Plate 63. Sliding in this gap are the horizontal flanges of lower Girders 60 to give table traverse movement. Screw control for the movement is again included, this time being supplied by an 11½ in. Screwed Rod passed through the transverse bore of the upper Threaded Boss, previously mentioned, and extended, at one end, by an Adaptor for Screwed Rod 67 and, at the other end, by a 1½ in. Rod fixed in a Threaded Coupling 68. The Adaptor is held by a Collar in a 1½ in. Strip bolted to one Angle Girder 61, while the 1½ in. Rod is journalled in a Double Bent Strip 69 and a second 1½ in. Strip bolted to other Angle Girder 61. Incidentally, the 1½ in. Strips are necessary as they are used to cover the elongated holes in Girders 61 which themselves allow the height of the Strips to be adjusted. A handwheel, supplied by a Face Plate 70 and Threaded Pin, is mounted on the end of the Rod.

The " saddle," supplied by Flanged Plate 63 and Angle Girders 64 is slid on to T-section girders 39, after which stops are provided by four Angle Brackets bolted to the girders. Movement is controlled by a Face Plate with Threaded Pin fixed on a 1 in. Rod connected by a Threaded Coupling to a 6 in. Screwed Rod passed through the transverse bore of Threaded Boss 65 and journalled in an Angle Bracket fixed to a 3½ in. Strip bolted between T-girders 39. The 1 in. Rod is journalled in a 1½ in. Strip bolted to Angle Girder 40.

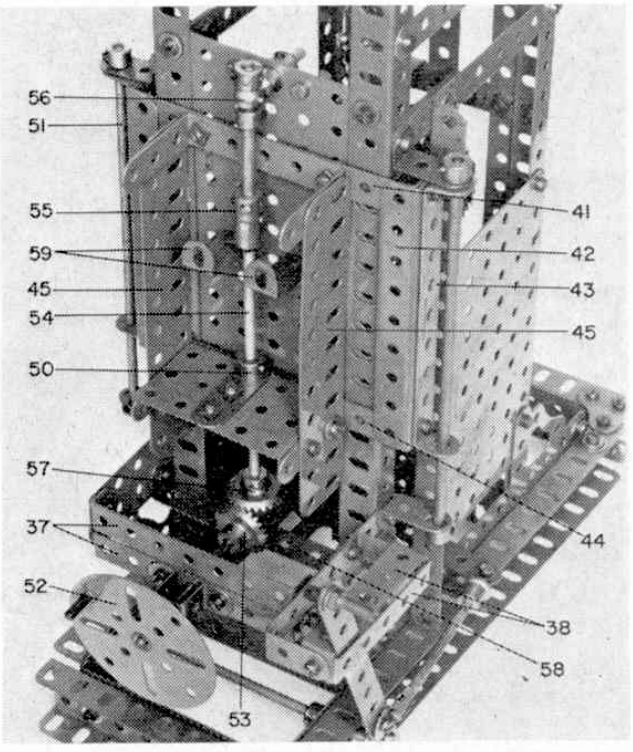
We come at last to the universal head, with which particular care should be taken. First, however, a Wheel Flange and a 3½ in. Gear Wheel 71 are tightly fixed by two ¾ in. Bolts to Flat Plate 7, but are spaced from the Plate by two Collars on the shank of the securing Bolts. Note that Rod 32 projects, free, through the boss of Gear 71 and that the flange of the Wheel Flange points outwards. The head, itself, is built up from a 4 in. Circular Plate 72, to one side of which a 2½ × 2½ in. Flat Plate is bolted. Fixed to the other side of the Circular Plate are two 2½ in. Angle Girders 73, to each of which two 5½ in. Angle Girders 74 are bolted, one to each end. The ends of the two upper Girders 74 are joined by a 2½ in. Angle Girder, the securing Bolts helping to fix a 5½ × 2½ in. Flat Plate 75 to the same Girders. A 3 in. Angle Girder 76 is bolted to the inside end of the Plate, projecting three holes sideways, as shown.

The ends of lower Girders 74 are also joined by a 2½ in. Angle Girder 77 only, this time, ⅜ in. Bolts are used as they not only help to fix another 5½ × 2½ in. Flat Plate 78 to lower Girder 74, but also secure a 3½ in.



In this underside view of the worktable and saddle, the method of obtaining traverse- and cross-feed is clearly shown.

A close-up view of the drive for adjusting the height of the bed. The bed, itself, has been removed to aid description.



Angle Girder 79 in position, this Girder being separated from the Plate by three Washers on the shank of each Bolt. A second, similarly-spaced 3½ in. Angle Girder 80 is fixed half an inch from the other end of Plate 78, both Girders projecting a distance of two holes past the Plate. These projecting sections are connected by a 5½ in. Flat Girder and a 5½ in. Angle Girder 81. Bolted between earlier-mentioned 2½ in. Girders is a 2½ × 2½ in. Flat Plate 82.

At one side Girders 74 are joined by a 4½ × 2½ in. Flat Plate, while Girders 74 at the opposite side are joined by a 2½ in. Strip, to which a Girder Bracket 83 is bolted. This Girder Bracket is extended by a 1½ in. Flat Girder, to which a second Girder Bracket 84 is bolted at right angles. Fixed to this Girder Bracket are two 1 × 1 in. Angle Brackets, in which is mounted a 3½ in. Rod, carrying a Worm Gear 85 and a ¾ in. Contrate Wheel 86. The lower end of the Rod is inserted, free, part-way into the longitudinal bore of a Coupling 87, in the centre transverse bore of which an 8 in. Rod 88, free to turn in the bore, is held by a Collar and a ¾ in. Pinion. The Pinion meshes with Contrate 86, while the Rod, itself, is journalled in Angle Girders 79 and 80 and in a 1 × ½ in. Reversed Angle Bracket 89 bolted to Girder 79. A Face Plate carrying a Threaded Pin is fixed on the end of Rod 88 to serve as yet another handwheel.

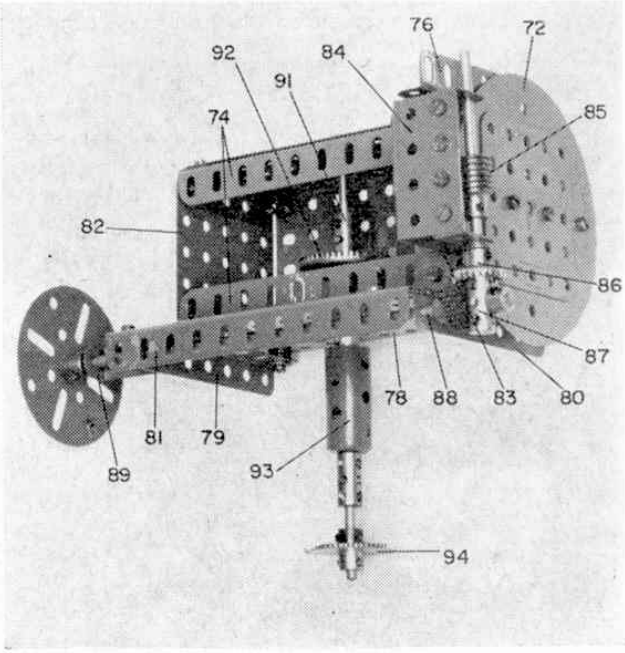
A ½ in. Rod is now fixed in the boss of an 8-hole Bush Wheel 90, bolted to the top of Flat Plate 75, then a Coupling 91 is secured to the end of this Rod in such a position that its centre transverse bore remains clear and coincides exactly with the centre holes in Circular Plate 72 and Flat Plate 82. Loose in the lower part of the longitudinal bore of the Coupling is a 5 in. Rod on which a 1½ in. Contrate Wheel 92 is fixed, the Rod being journalled free in the boss of another 8-hole Bush Wheel bolted to the underside of Flat Plate 78 and held in place by a Collar above the Plate. Also mounted lower down the Rod are a Sleeve Piece 93, carrying two Chimney Adaptors, a Coupling, a Collar and a 50-teeth Gear Wheel 94, the last representing the milling tool. The finished head is then mounted, along with a ¾ in. Pinion 95, on Rod 32 which passes through the centre of Circular Plate 72, the central transverse bore of Coupling 91 and the centre hole of Flat Plate 82, after which a Collar is added to the Rod to hold the unit in place. Pinion 95 meshes with Contrate 92, while Worm 85 engages with Gear Wheel 71.

Last, but by no means least, a stop/start lever for the Motor is supplied by a 5½ in. Strip 96, inserted in the gap between Double Angle Strips 38 and bolted to a Crank mounted on a 5 in. Rod 97 held by Collars in channel girders 1. Lock-nutted through the third hole of the Strip is a Rod and Strip Connecter that carries a 3 in. Rod, on the opposite end of which an end Bearing 98 is fixed. Pivotally attached to this End Bearing is a 2½ in. Strip which is bolted tightly to the centre arm of the Motor switch.

PARTS REQUIRED

3—1b	2—16	3—52a	4—103d
12—2	3—16a	1—53	2—103f
8—2a	2—16b	4—53c	1—103h
3—3	1—17	2—55a	4—108
7—5	3—18a	28—59	4—109
2—6	2—18b	1—62	2—111
3—6a	2—24	1—62a	6—111c
2—7a	3—25	1—62b	5—115
6—8	1—27b	5—63	3—124
6—8a	2—28	2—63c	6—133
4—8b	1—29	2—64	2—133a
10—9	4—30	2—70	1—136a
8—9a	1—32	3—72	1—137
4—9b	304—37a	2—76	2—140
3—9c	280—37b	1—78	1—146a
9—9d	80—38	2—59a	2—161
7—12	4—45	1—82	1—163
2—12a	1—46	2—90a	2—164
4—12b	2—47	1—94	1—166
1—13	5—48a	1—95	1—137a
1—13a	7—48b	1—96a	1—189
2—14	7—48c	3—103	1—192
2—15	1—51	2—103a	1—212

1—E15R Electric Motor.



The universal milling head removed from the model. Note that, when in place, Contrate 92 meshes with Pinion 95 on Rod 32.