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Meccano Planing Machine

A Model Machine Tool

TOOLS have played a very important part in the history of civilisation. Before he learnt to use them, man was little better than the animals, but as soon as he realised that a bar of wood wielded by his powerful muscles was more effective both for peaceful and warlike operations than his bare hands, the slow process of civilisation had commenced. To-day his skill both in devising and using tools is such that he can fashion iron and steel to any shape that he desires: with their aid he can tunnel through the largest mountains, build canals, and produce machines with which to travel with great rapidity over the surface of the ground or beneath it, over or beneath the sea, or in the air.

Tools, like everything else, had small beginnings. The earliest tools were of the simplest character and were few in number, principal among them being the knife, the chisel, and the axe. These, with the primitive hammer, formed the stock-in-trade of the first mechanics.

Then came the introduction of the saw, which was considered of so great importance that its "inventor" was honoured with a place among the gods in the mythology of the Greeks! Another very ancient tool was the file, which was used to sharpen weapons and implements. This is referred to in the Bible.

Such continued to be the chief tools in use down almost to our own period. The smith was at first the principal tool maker, but special branches of trade gradually were established, devoted to tool making.

Even at the time of James Watt nearly all the work on his engines had to be done by hand and we find him complaining to his partner of the failure of his engines through bad workmanship. Yet better work could not be had. First-rate workmen in machinery did not as yet exist; they were only in process of education, and the few tools used were of a very imperfect kind.

Nowadays the position is very different. The perfection of modern machine tools is such that the utmost possible precision is secured and the engineer can calculate on a

SPECIAL FEATURES

Vertically-adjustable Tool Slide operated by Rack and Pinion gear; Traversing Tool Box operated by Screw Gear; Quick-return device incorporated in Table Mechanism.

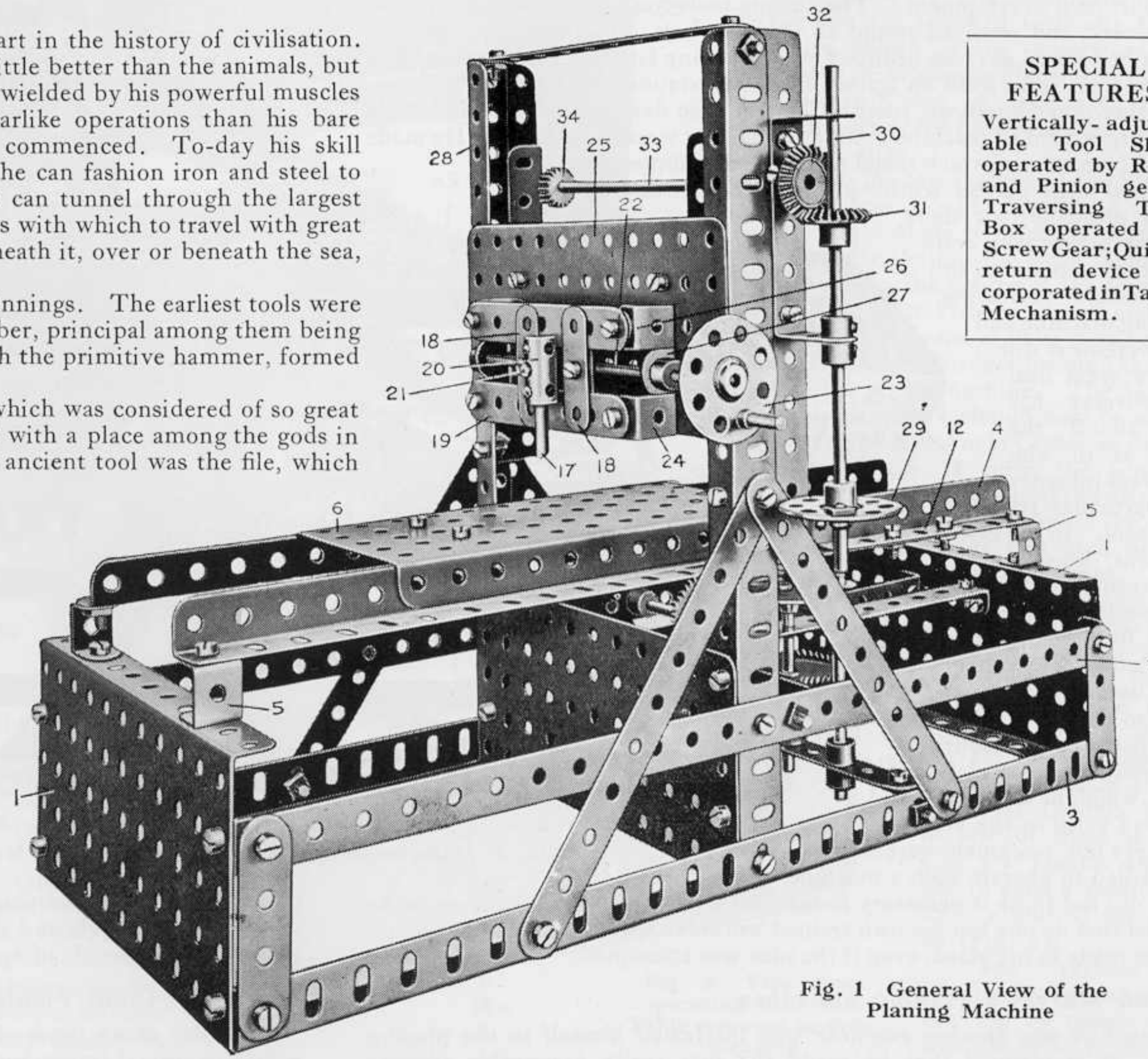

Fig. 1 General View of the Planing Machine

degree of exactitude that does not admit of a deviation beyond the thousandth part of an inch. In some machines inaccuracies would mean disaster.

Bramah's Planing Machine

One of the most important machine tools is the Planing Machine. In a patent specification taken out in 1802 by Joseph Bramah, the famous engineer, a machine was described as a tool for producing smooth, straight and parallel surfaces on wood and various other materials. This record is the earliest in which a planing machine is mentioned, although several earlier inventions had led up to its final development. The cutting tools were fixed on frames driven by machinery, and revolved round an upright shaft. In another pattern the shaft was horizontal as in an ordinary wood-turning lathe, while in yet another design the tools were fixed on frames sliding in stationary grooves.

Another noted engineer, Joseph Clement, also devoted considerable study to the improvement of machine tools, such as they were in his time. He made a machine by means of which metal plates of large dimensions were planed with perfect truth—a great accomplishment!

It is probable that there were many others who contributed their experience and labours toward perfecting the planing machine and to whom credit is due. Indeed, a great deal of controversy has centred round the question as to who was the real inventor of this particular type of machine tool. In the case of Clement, however, it may be recorded that he had a machine specially designed for planing the bars of lathes and other work in use for some years previous to 1820. The success of this instrument encouraged him to produce a more elaborate machine, which he completed and set to work early in the year 1825.

As very few workmen were sufficiently skilled to operate such a machine Clement did not think it necessary to take out a patent for his invention, as he considered that no one but his own trained workmen would be able to operate a machine made to his plans, even if the idea was attempted.

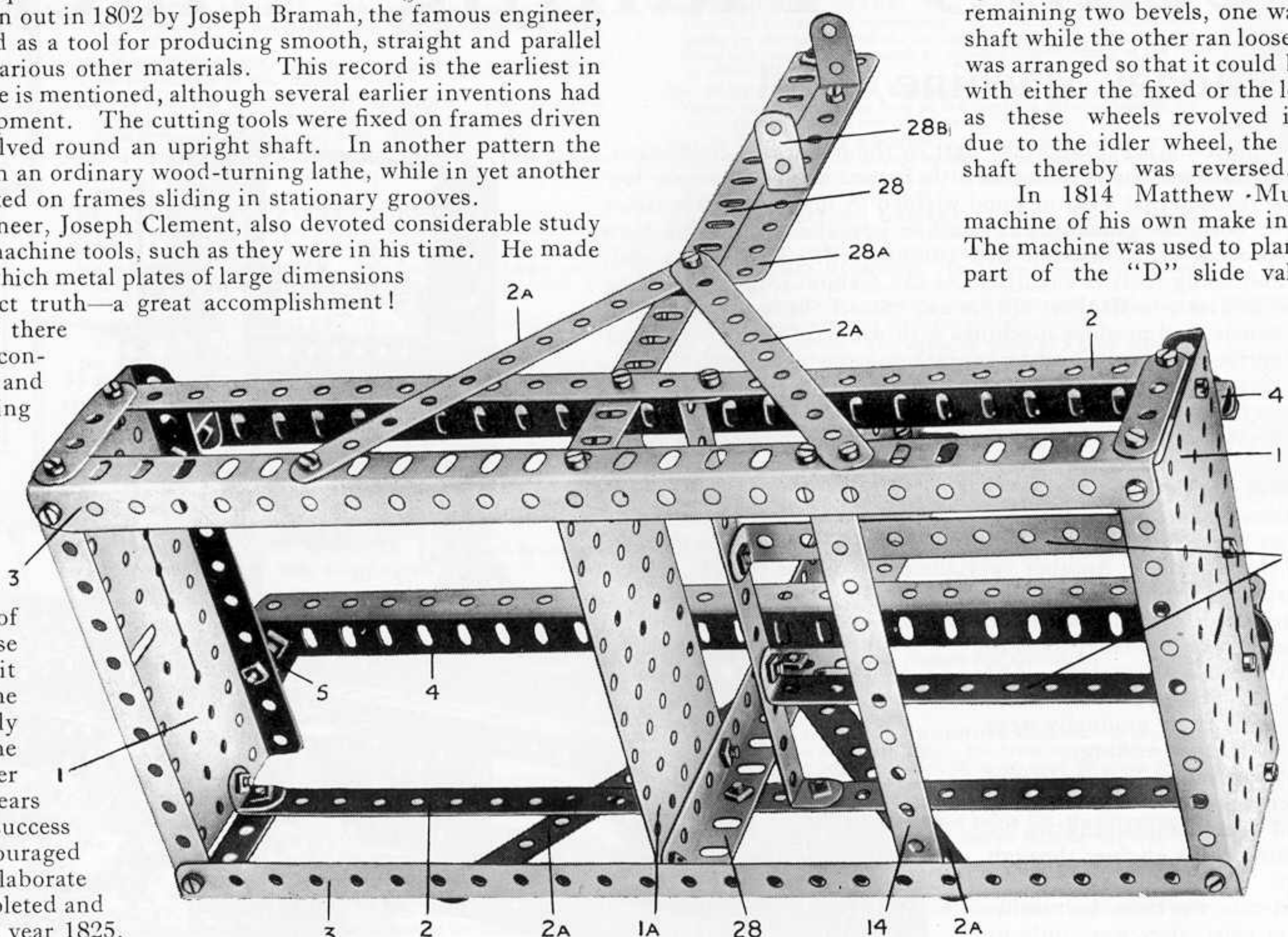

Fig. 2 Underneath View of the Framework of the Model

Fox's and Murray's Planing Machines

James Fox was another engineer who interested himself in the planing machine. It is claimed that he made the first really practicable planing machine in 1814. His machine was practically the same in principle as the planing machine now in general use. A self-acting ratchet motion for operating the slides of a compound slide rest was incorporated in the machine, and the table was self-reversing owing to an arrangement consisting of three bevel wheels, one of which was just an idler wheel running on a pivot. Of the remaining two bevels, one was fixed to the driving shaft while the other ran loose on the shaft. A clutch was arranged so that it could be moved into contact with either the fixed or the loose bevel wheels, and as these wheels revolved in opposite directions due to the idler wheel, the motion of the driven shaft thereby was reversed.

In 1814 Matthew Murray had a planing machine of his own make in use in his workshop. The machine was used to plane the back or circular part of the "D" slide valve, an improvement which Murray had by that time introduced in the steam engine. To make the valve work efficiently it was essential to obtain two perfectly plane surfaces on the valve. Like many other inventions of those days the machine was not patented, but was kept locked up in a small room. Only Murray himself had access to this room.

The history of the invention of the planing machine and of the various improvements that have been effected since the very early models is of considerable interest, but while a great deal more could be written of the trials and difficulties that each inventor had to overcome, our space will not permit of such matters being mentioned here.

A Modern Giant Planing Machine

To-day many types of planing machines are in use, each type differing widely in several important features, but the following description of a new planing machine recently installed at an engineering works in the north of England may serve to give some idea of the leading dimensions and features of a large modern planer.

The moving work table or platen is 32 feet long and the overall height of the machine is 26 feet. A very elaborate and intricate gear box forms a special feature of the machine, which will operate at a cutting speed of 150 feet per minute and a return speed of 180 feet per minute. It is one of the fastest planing machines yet designed. Two tool holders are used on the machine and are carried on a cross rail, both tool boxes being operated by a square-threaded screw. The bed or work table is cast in one section and contains T-slots, as is the usual practice. The table is moved to and fro by means of a rack and pinion movement, the rack being of cast steel and running the whole length of the table.

A special type of electric motor is mounted directly overhead on the cross piece of the vertical members and transmits the drive by means of double leather belts to the main countershaft connected with the gear box.

How a Planing Machine Works

The following is a brief description of the manner in which the usual type of planing machine is operated.

Before starting the machine the work to be planed is secured to the long table or platen by means of special bolts sliding in the T-slots cut in the table. Then the cutting tools are fixed into the tool holders or "boxes" attached to the cross piece and the whole cross piece is lowered and adjusted so that the tools will take the right depth of cut from the metal. Power is generally supplied by an electric motor and the table moves to and fro, carrying the work towards and from the cutting tool. After each cutting stroke of the table the tool holder moves across the table the width of the cutting tool, and so takes a fresh cut each time the work moves toward it.

Having now learnt something about planing machines in general, we may turn to the construction of the Meccano model. The Meccano planing machine embodies the principal features of the machines in actual practice. No difficulty should be experienced in building it, since each part is described in detail.

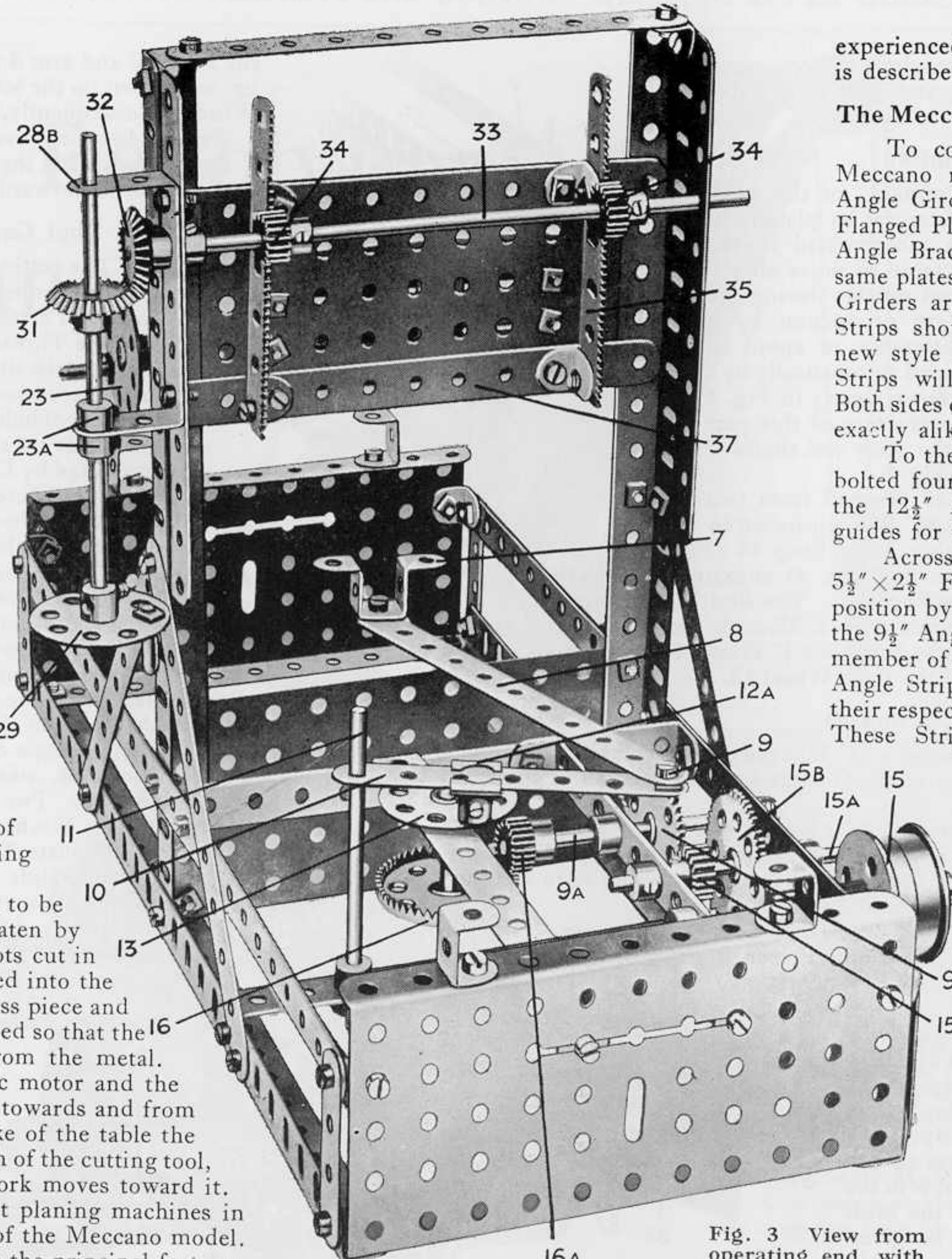

Fig. 3 View from operating end, with Table removed to show Gearing

The Meccano Model: The Framework

To construct the framework of the Meccano model first bolt the two $12\frac{1}{2}''$ Angle Girders 3 (Fig. 2) to the $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates 1 and secure—by means of Angle Brackets—two $12\frac{1}{2}''$ Strips 2 to the same plates 1. The ends of the two Angle Girders are spanned vertically by the 2″ Strips shown in the illustration. If the new style Flanged Plates are used these Strips will not be necessary, of course. Both sides of the framework are constructed exactly alike.

To the top Flanges of the Plates 1 are bolted four Double Brackets 5 that carry the $12\frac{1}{2}''$ Angle Girders 4 forming the guides for the moving work table 6.

Across the centre of the framework a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate is placed and held in position by means of bolts passing through the $9\frac{1}{2}''$ Angle Girders forming the vertical member of the machine. The $5\frac{1}{2}''$ Double Angle Strips 14 should now be secured to their respective Angle Girder as illustrated. These Strips 14 form the journals for the shafts of the driving gear, so care should be taken to ensure that each Strip is in perfect alignment.

The $9\frac{1}{2}''$ Angle Girders 28 that support the tool rest are bolted on the inside of the Strips 2 and held rigid by means of the four $5\frac{1}{2}''$ Strips 2a placed as shown. To the upper end of the Angle Girders 28 are bolted two Flat Girders 28a, and to one of these is secured a $2\frac{1}{2}'' \times 1''$ Double Angle Strip 28b in such a position as to form a journal for the shaft 30 (Fig. 1).

The vertical Angle Girders 28 are spanned across the top by means of a $5\frac{1}{2}''$ Strip secured to the Girders with Angle Brackets. This completes the construction of the framework of the model, and the work table and operating mechanism may now be assembled.

Main Gear Train (Figs. 3 and 4)

As only one of the two "strokes" of the work table performs any actual work so far as planing is concerned, a special device is incorporated in the mechanism so as to cause the table to move slowly during the working "stroke" and quickly during the return stroke, thus speeding up production by a considerable amount. This difference of speed in the operation of the table is obtained automatically by a quick-return device. This is shown clearly in Fig. 4 but before commencing the construction of this part it is necessary to proceed with the gears and shafts of the main drive as illustrated in Fig. 3.

The main driving Pulley 15 (formed from two Flanged Wheels) is carried on a 3½" Rod journalled in one of the Strips 2 and in a Double Angle Strip 14 (Fig. 2). The Rod also carries a ½" Pinion (see Fig. 4) engaging a 57-teeth Gear Wheel 15b carried on the Rod 15a. The Rod 15a also carries the ½" Pinion 15c (Fig. 3) that engages with a 57-teeth Gear Wheel 9c on the Rod 9a. On the inner end of the latter is a ½" Pinion 16a driving a Contrate Wheel 16 secured on the Rod of the Bush Wheel 13.

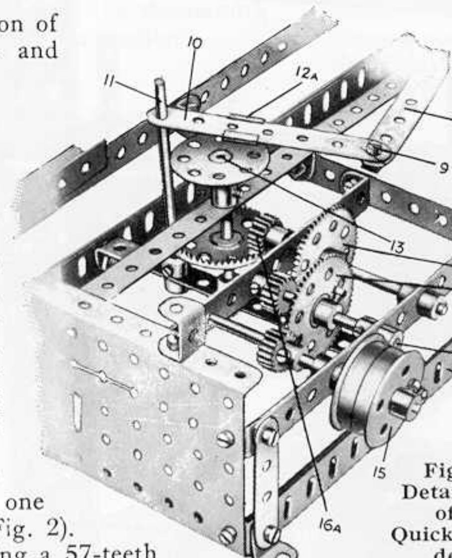

Fig. 4. Detail view of the Quick-return device

Quick-return Motion (Figs. 3 and 4)

The table 6 (Fig. 1) consists of a 5½" Flanged Plate arranged to slide to and fro on the upturned flanges of the Girders 4. The method of operation is as follows :—

The Plate 6 is bolted to a Double Bent Strip 7 (see Figs. 3 and 4) which is attached pivotally by means of a bolt and two nuts (see Standard Mechanism No. 262) to the 5½" Strip 8. (Note : Fig. 1 shows an old-style Flanged Plate used as the table, but if preferred, a new-style Plate will serve equally well). The end of the Strip 8, in turn, is attached pivotally by similar means at 9 to a 3½" Strip 10 pivoted on a Rod 11. The Rod 11 passes through one of the elongated holes in the Angle Girder 4 and to prevent play of the Rod a 2½" Strip 12 (Fig. 1) is bolted to the flange of the Girder 4 so that the Rod also passes through the end hole of this Strip.

The Strip 10 (Fig. 3) engages an Eye Piece 12a secured by its set-screw to the shank of a bolt passed through the Bush Wheel 13. The bolt should be given sufficient play to permit of its turning freely in the Bush Wheel. The latter rotates in a clockwise direction, rocking the lever 10 and arm 8 to and fro, and the swivel-guide 12a slides up and down on the lever as it follows the movement of the Bush Wheel. Consequently, the guide 12a (Figs. 3 and 4) is at a greater distance from the pivot or fulcrum of the lever during the forward stroke than it is on the return, with the result that the point 9 moves slowly on the forward stroke and more rapidly on the return.

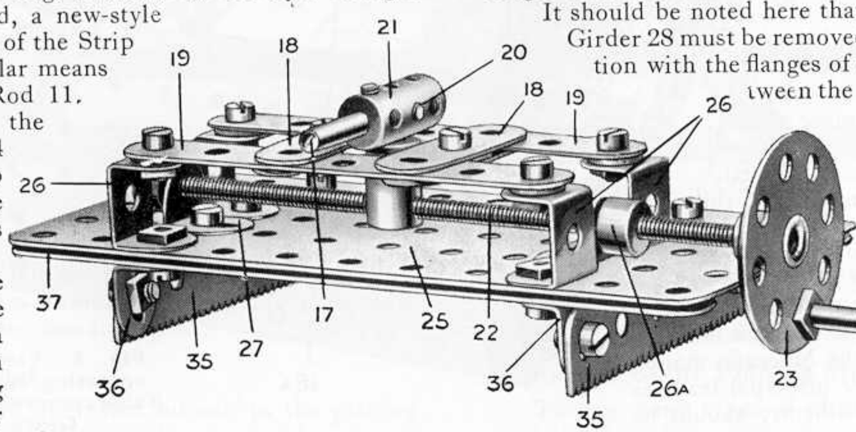

Fig. 5. The Tool Slide and Tool Box

The Tool Carrier

The cutting tool 17 is carried in a Coupling 21 (Fig. 5) which is connected by a Threaded Pin to a Threaded Boss on a 5½" Threaded Rod 22. Before passing the Coupling 21 over the Threaded Pin a 1½" Strip should be placed on the Pin. In the illustration (Fig. 5) the ends of this Strip can just be seen between the 1½" Strips 18, which form guides for the tool holder. These Strips 18 are placed in pairs and their ends are arranged to slide on 3½" Strips 19, which are supported by Double Brackets 26, the latter being attached to the Flat Plate 25. Washers are placed between the Strips 19 and the Double Brackets in order to give the necessary clearance for the Threaded Boss on the Threaded Rod 22.

The rotation of the handwheel 23 causes the tool holder to advance along the Threaded Rod 22 in a direction depending on the direction of rotation. The Rod 22 is held in position by Collars with set-screws placed at each end against the Angle Brackets in which the Rod is journalled.

The vertical movement of the Plate 25 on the upright Angle Girder 28 is effected from the Bush Wheel 29 (Figs. 1 and 3) mounted on a Rod 30, a Bevel Wheel 31 on this Rod engaging a corresponding Bevel 32 on a Rod 33. The latter carries two Pinions 34, which engage the Rack Strips 35 secured in position by Angle Brackets. Two 5½" Strips 37 (Fig. 5), are bolted to the Flat Plate 25 with spacing Washers between so that a clearance is provided between their ends and the Plate 25. In the slots so formed the flanges of the Angle Girders 28 are free to slide (see Fig. 3).

It should be noted here that the 5½" Strip spanning the top of the Angle Girder 28 must be removed to allow the tool holder to be placed in position with the flanges of the Angle Girders 28 occupying the space between the Flat Plate 25 and the ends of the 5½" Strips 37.

Parts required :

2	of No.	1	5	of No.	16	1	of No.	48b
7	,,	2	1	,,	18a	5	,,	48d
3	,,	3	2	,,	20	1	,,	50
1	,,	5	3	,,	24	2	,,	52
4	,,	6	5	,,	26	12	,,	59
3	,,	6a	2	,,	27a	1	,,	63
4	,,	8	1	,,	28	1	,,	64
2	,,	8a	2	,,	30	2	,,	70
8	,,	11	74	,,	37	1	,,	80
12	,,	12	3	,,	37a	2	,,	103
1	,,	14	9	,,	38	2	,,	110
1	,,	15	2	,,	46	2	,,	115