MECCANO Beam Bridge

(MODEL No. 10.8)

SPECIAL FEATURES

The Beam Bridge described in this Leaflet has a span of 24½", which is raised by a Meccano E20R Electric Motor. The approach pier is fitted with traffic barriers that fall into position automatically when the span is raised.

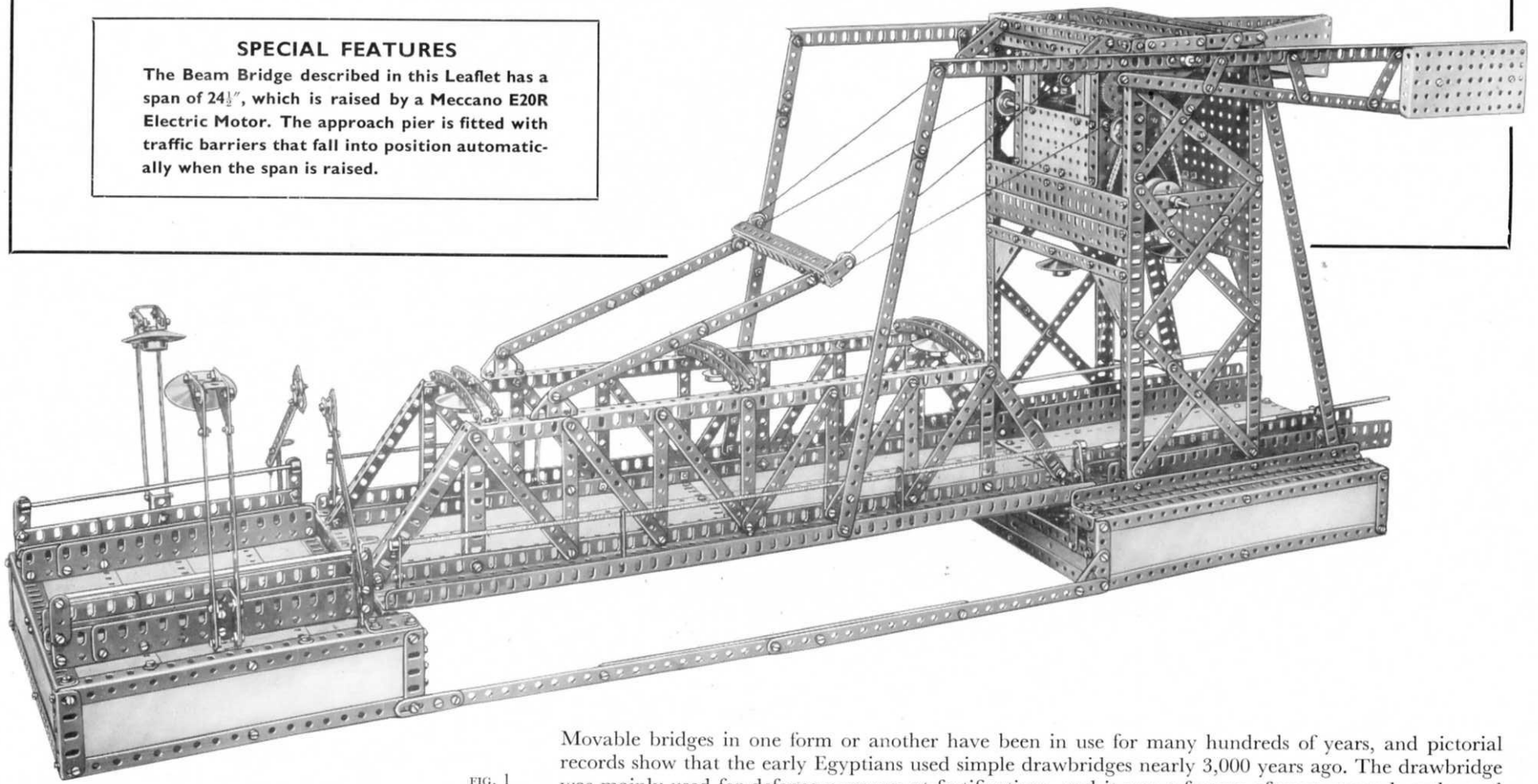


FIG. 1
General view of the Meccano Beam Bridge described in this Leaflet

Movable bridges in one form or another have been in use for many hundreds of years, and pictorial records show that the early Egyptians used simple drawbridges nearly 3,000 years ago. The drawbridge was mainly used for defence purposes at fortifications, and it was a feature of most moated castles and forts of the middle ages. From the simple drawbridge engineers have developed more elaborate and efficient structures suitable for spanning navigable waterways, and which can be moved aside or upwards when required in order to allow the uninterrupted passage of ships.

The early drawbridge was a very crude affair and required a great amount of energy to hoist it into an upright position. Later the idea of fitting the hinged span or bascule with some kind of balance weight was conceived, and this resulted not only in a considerable saving in the power required to operate the bridge but also permitted the construction of bridges with much longer and heavier spans.

These bascule bridges as they are known took many forms, and they became very popular in the Netherlands for bridging the network of canals that are a feature of that country. In the most common type of small bascule bridge the lifting span is balanced by a pair of pivoted overhead levers or beams, which are fitted with counterweights at their shore ends to compensate for the weight of the span itself, to which they are linked by chains or girders. These bridges may be used either singly or double. That is, there may be one balanced span extending right across a narrow channel, or in the case of a wider channel, two spans, one on each side, the two meeting at the centre of the river.

The working Meccano model described and illustrated in this Leaflet is based on a typical balanced beam bridge of the larger type and will be found both attractive to construct and interesting to operate. It is powered by an E20R type Electric Motor housed in the tower, and it has a span of 24½ in.

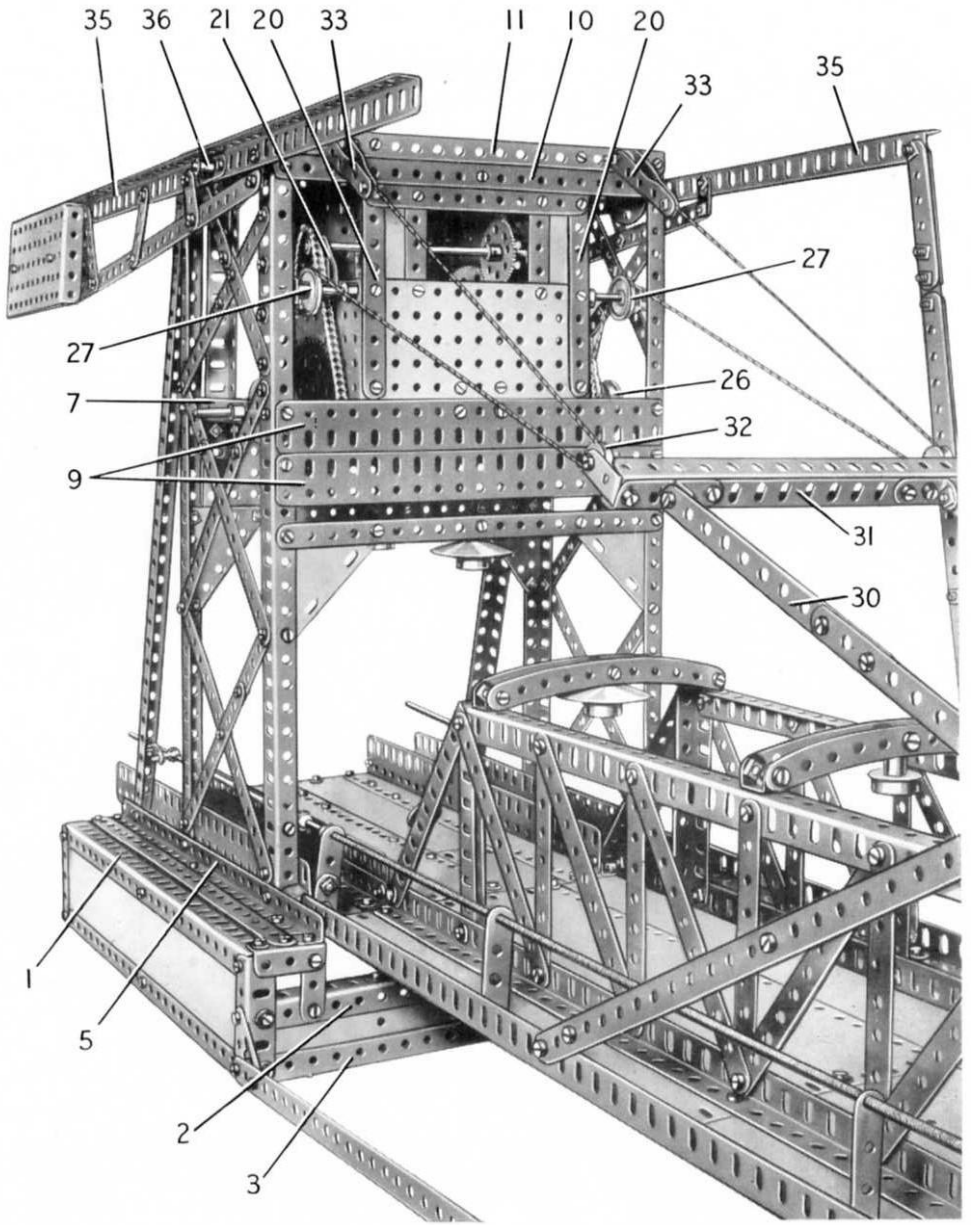


FIG. 2
The main pier and tower that supports the balanced beams

Construction of the Model:
The Main Pier (Figs. 2 and 3)

Each side consists of a 12½″×2½″ Strip Plate strengthened by a 12½″ Angle Girder (1) and a 12½″ Strip. The back also is a 12½″×2½″ Strip Plate and it is edged by two 12½″ Angle Girders. The back and the sides are connected by a 2½″ Angle Girder at each corner. The front is formed by two 12½″ Angle Girders (2) and (3) (Fig. 2), with a 2½″×1½″ and two 5½″×1½″ Flexible Plates bolted between them. The front is fixed to 2½″ Angle Girders bolted to the sides, and a 1½″ Angle Girder is bolted to the top end of each 2½″ Angle Girder and is connected to the Girder (2) by a 1½″ Strip. Two 12½″ Angle Girders (4) are bolted across the base of the pier as shown in Fig. 6.

A 12½″ Angle Girder (5) and a 12½″ Strip on each side are fixed across the top, and two 12½″ Strips held by bolts (6) (Fig. 3) are attached to the Girders (5). These Strips support the Plates that fill in the top of the pier. Three 12½″×2½″ Strip Plates, and a 9½″×2½″ Strip Plate extended by a 3½″×2½″ Flexible Plate, are used for this purpose. The Plates are bolted to the Strips so that one clear hole on each side is left in the Strips between the Plates and the Girders (5). The rear edges of the Plates are strengthened by a 5½″ Strip and a 3½″ Strip.

The guard rails between the roadway and the pavements are 12½″ Flat Girders bolted to 12½″ Angle Girders. The outer rail of one pavement is a 12½″ Flat Girder supported by Angle Brackets, and the corresponding rail of the other pavement is made from a 9½″ Flat Girder and a 3½″ Flat Girder. These Flat Girders also are attached to the base by Angle Brackets.

Construction of the Tower (Figs. 1, 2, 3 and 4)

Each side of the tower consists of two 18½" Angle Girders bolted vertically to the Girders (4) and (5) of the main pier. The top ends of the 18½" Girders on each side are connected by a 5½" Strip, and the Girders are braced by built-up strips as shown in Figs. 1 and 2. Two 5½" Strips (7) (Fig. 3) placed face-to-face, are fixed to the side. Each side is braced by an 18½" Angle Girder (8) bolted at its lower end to the Girder (5).

The sides of the tower are connected at the front by a 9½" Strip braced by two 2½"×2½" Triangular Flexible Plates, by two 9½" Flat Girders (9), a 9½" Strip (10) and a 9½" Angle Girder (11). At the back a 9½" Strip (12) braced by two 2½"×2" Triangular Flexible Plates, is bolted between the sides. A 9½" Flat Girder (13) and a 9½" Strip (14) also are bolted across the back of the tower. Two 4½"×2½" Flat Plates are attached to the Strip (12) and the Flat Girder (13), and a 5½"×3½" Flat Plate and a 5½"×2½" Flat Plate are bolted to the Flat Girder and are attached to the Strip (14) by Fishplates. A vertical 7½" Angle Girder (15) is bolted along the edge of the 5½"×2½" Flat Plate and a similar Angle Girder (16) is fixed in position (Fig. 4).

A 5½"×½" Double Angle Strip (17) is bolted between the Girders of each side of the tower, and a 9½" Angle Girder (18) is connected to these Double Angle Strips by Angle Brackets. Two 5½"×3½" Flat Plates are bolted to the Girder (18), but are removed in Fig. 4 to show the interior of the control cabin. A Semi-Circular Plate (19) (Figs. 3 and 4) is fixed to each side of the tower.

The imitation lamps fitted to the tower are ¾" Flanged Wheels and Conical Discs, attached to Angle Brackets by ½" Bolts. The handrails along the pavements are fixed in Handrail Supports, which are attached to Angle Brackets bolted to the Girders of the tower.

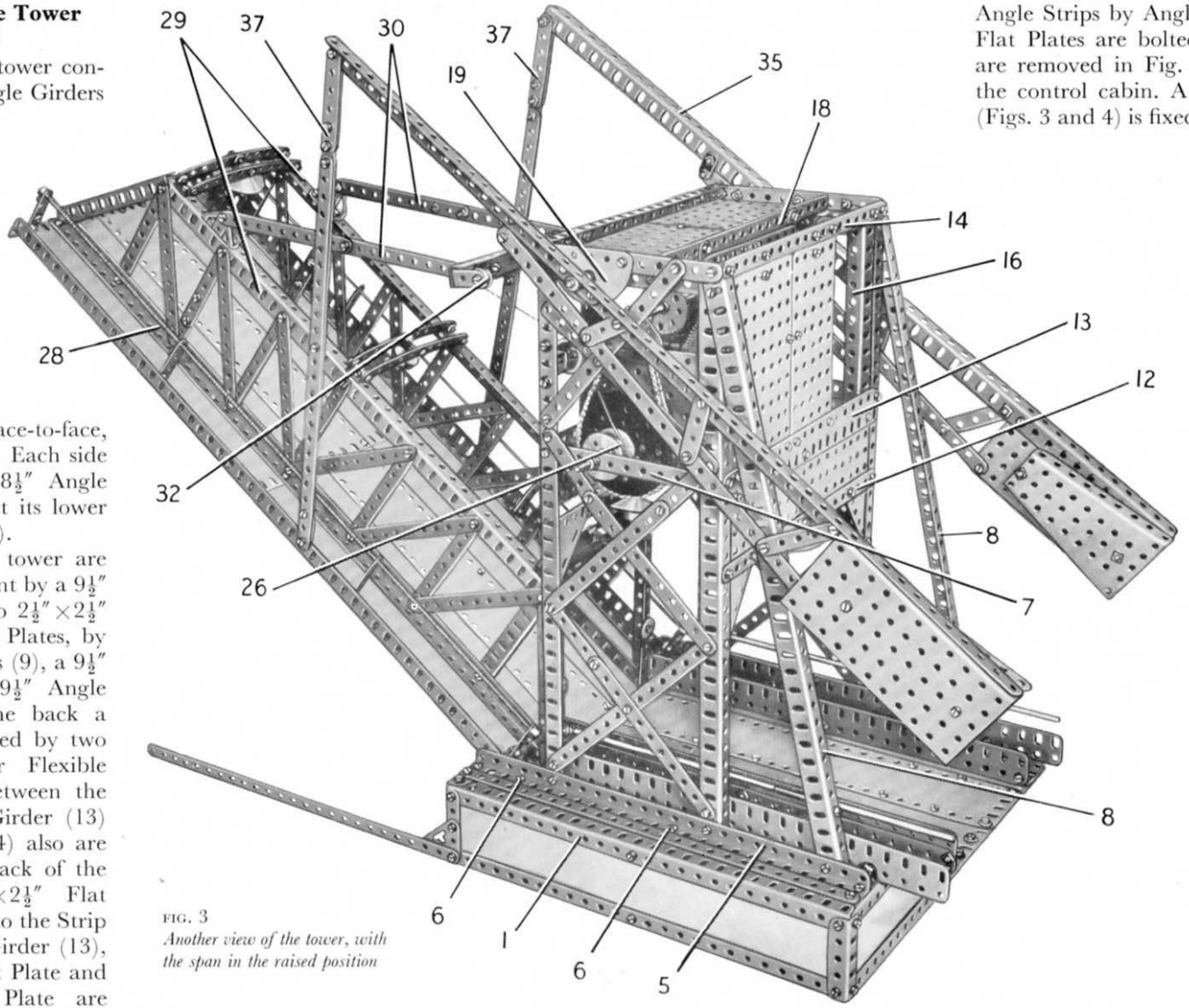


FIG. 3
Another view of the tower, with the span in the raised position

Details of the Operating Cabin (Figs. 2, 3 and 4)

Each side of the cabin consists of a 5½"×2½" Flat Plate with a vertical 5½" Strip (20) (Fig. 2) at each end. Two 2½"×1½" Flexible Plates and two 2½" Strips are bolted to the side and are connected at their upper ends by a 5½" Strip. The ends of the cabin are 3½"×2½" Flanged Plates, to each of which a Flat Trunnion (21) is bolted. Two 3½"×2½" Flanged Plates fixed between the sides, form the floor of the cabin.

An E20R Electric Motor is bolted to the floor (Fig. 4), and a $\frac{7}{16}$" diameter Pinion on the Motor shaft drives a 60-tooth Gear on a 2½" Rod. This Rod is mounted in the Motor side-plates, and it carries a ½" Pinion (22) that engages a 57-tooth Gear on a second 2½" Rod. The latter Rod also is supported in the Motor side-plates, and is fitted with a Worm (23).

A $6\frac{1}{2}$" Rod mounted in the Flat Trunnions (21) carries a $\frac{3}{4}$" Sprocket (24) at each end and a 57-tooth Gear that is driven by the Worm (23). The operating cabin is fixed to the tower by bolting the top ends of the Strips (20) to the Angle Girders (11) and (18). The front of the cabin is connected to one of the Flat Girders (9) by two Fishplates. A Collar is screwed on to a bolt fixed by a nut in the top arm of the Motor switch. A $3\frac{1}{2}$" Rod held in the Collar is passed through one of the Strips (20) and is fitted with a $\frac{1}{2}$" fixed Pulley (25) (Fig. 4).

The Sprockets (24) are connected by Chain to 3" Sprockets on an $11\frac{1}{2}$" Rod supported in the Strips (7). This Rod carries two winding drums (26), each of which consists of two $1\frac{1}{8}$" Flanged Wheels (Figs. 2 and 3).

Two 1" Pulleys (27) are fixed on $1\frac{1}{2}$" Rods, which are supported in the ends of the operating cabin and in Double Bent Strips bolted to the sides of the tower. The Rods are held in position by Collars (Fig. 2).

The Lifting Span (Figs. 2, 3 and 5)

The underside of the span is shown clearly in Fig. 5. The framework to which the roadway is bolted consists of two $24\frac{1}{2}$" Angle Girders connected at each end by a $9\frac{1}{2}$" Angle Girder. Three $5\frac{1}{2}$" Angle Girders are attached to the $24\frac{1}{2}$" Angle Girders by Angle Brackets. The roadway is formed by ten $12\frac{1}{2}" \times 2\frac{1}{2}$" Strip Plates bolted to the framework as shown, with the outer edges strengthened by $24\frac{1}{2}$" Angle Girders (see Fig. 3).

Two $24\frac{1}{2}$" Angle Girders (28) are fixed to the top of the roadway, and two $18\frac{1}{2}$" Angle Girders (29) are supported by $5\frac{1}{2}$" Angle Girders at each end. The Girders (28) and (29) are joined by vertical $4\frac{1}{2}$" Strips and diagonal $5\frac{1}{2}$" Strips, two of the $4\frac{1}{2}$" strips each being made from a $3\frac{1}{2}$" and a $2\frac{1}{2}$" Strip. The Girders (29) are connected across by six $5\frac{1}{2}$" Curved Strips, which are bolted in pairs to the lugs of Double Brackets. A Double Bracket fixed to the centre of each pair of Curved Strips supports an imitation lamp formed by a $\frac{3}{4}$" Flanged Wheel. Two of the lamps carry shades made from Conical Discs.

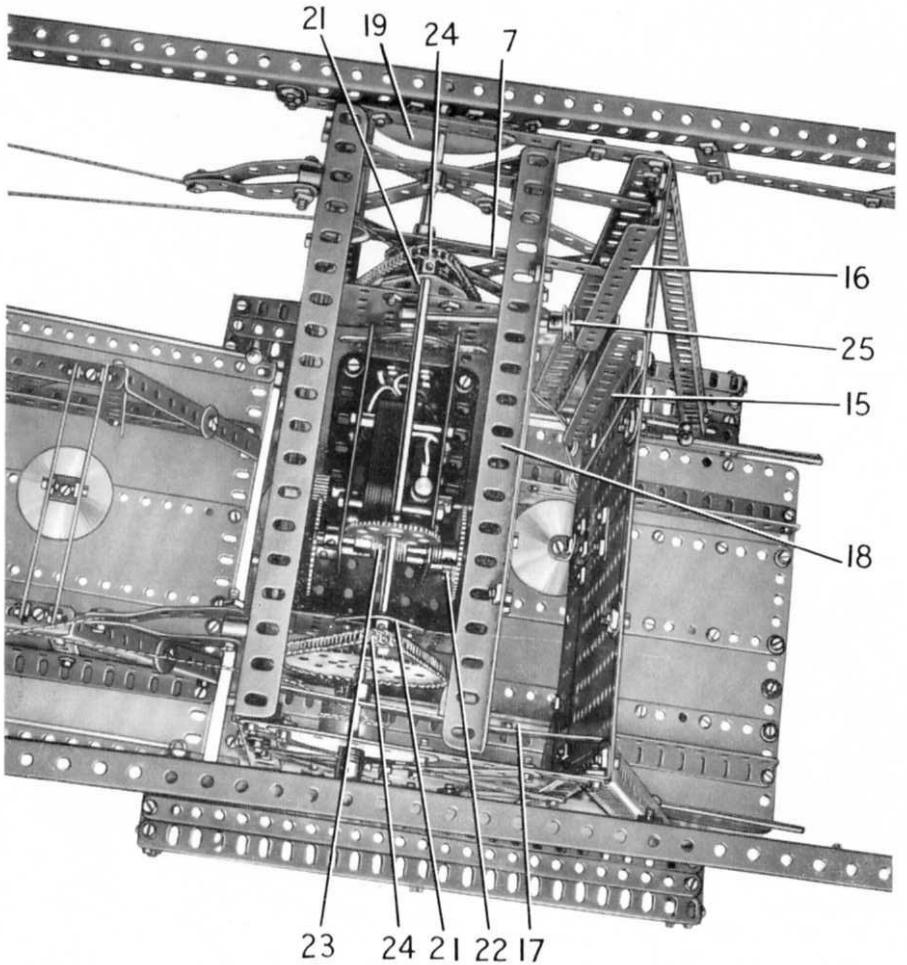


FIG. 4 *A view looking into the top of the operating cabin with the plating removed, and showing the location of the driving Motor*

The handrail along each side of the span is made from a length of Spring Cord. This is stretched slightly and is passed through 2" Strips, which are attached to the span by Angle Brackets. A Collar fitted with a $\frac{7}{32}$" bolt is fixed at each end of the Spring Cord to hold it in the Strips.

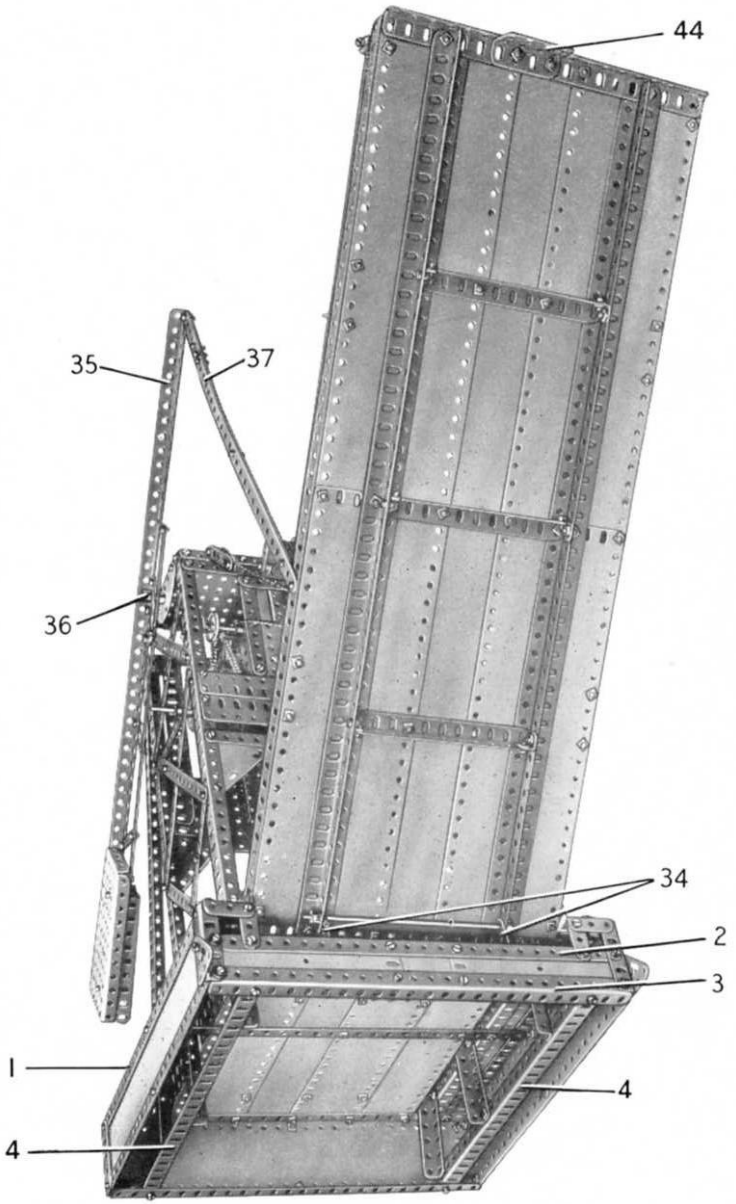
A Trunnion is bolted to each of the Girders (29), and to it is *lock-nutted* a built-up strip (30). This strip is made from three $5\frac{1}{2}$" Strips, two of which are placed face-to-face and overlap the third Strip by three holes. The top ends of the Strips (30) are *lock-nutted* to $1" \times \frac{1}{2}$" Angle Brackets bolted to a beam (31) (Fig. 2), made from two $7\frac{1}{2}$" Angle Girders. A Single Bent Strip is fixed to each end of the beam and in it a $\frac{1}{2}$" loose Pulley (32) is freely mounted on a $\frac{1}{2}$" Bolt held by *lock-nuts*.

A length of Cord is fastened to each winding drum (26), is taken round Pulleys (27) and (32) and is tied to a pivoted bracket (33). Each of these brackets consists of two $2\frac{1}{2}$" Strips bolted together at one end and splayed out slightly at the other end. The Strips fit over a Rod Socket fixed to the Angle Girder (11), and pivot on a $\frac{3}{4}$" Bolt that is screwed into the Rod Socket and is fitted with *lock-nuts*.

The span pivots on a $6\frac{1}{2}$" Rod supported in $1" \times 1$" Angle Brackets (34) (Fig. 5), which are bolted to the Angle Girder (2).

Assembly of the Balance Beams (Figs. 2, 3 and 4)

Each beam is made from a $24\frac{1}{2}$" Angle Girder (35), to one end of which a $5\frac{1}{2}" \times 2\frac{1}{2}$" Flanged Plate is bolted. A second $5\frac{1}{2}" \times 2\frac{1}{2}$" Flanged Plate is fitted



over the flanges of the first Plate, and is held in place by two $1\frac{1}{8}$" Bolts that secure also a Flanged Sector Plate.

A $12\frac{1}{2}$" Strip is bolted to one of the Flanged Plates and is connected to the Girder (35) by a Fishplate.

A Double Arm Crank (36) (Fig. 2) is bolted to each Angle Girder (35) and is fixed on a 2" Rod. This Rod is supported in the Semi-Circular Plate (19) and the Double Angle Strip (17) (Fig. 4), and is held in place by a Collar. The Girder (35) is spaced from the Semi-Circular Plate by a Collar and four Washers on the Rod.

Each beam is linked to the span by a built-up strip (37), which is *lock-nutted* at each end. The strip is made by placing two $12\frac{1}{2}$" Strips face-to-face and then bolting two more $12\frac{1}{2}$" Strips, one on each side, so that they *overhang* the face-to-face Strips at one end by *two* clear holes each. Two 3" Strips are then attached to the other ends of the face-to-face Strips in the same way, and overhang them by *four* clear holes each. In Fig. 2 one of the strips (37) is detached from the Girder (35) in order to show the details of the operating cabin clearly.

Construction of the Support Pier (Figs. 1, 6 and 7)

Each side of the support pier consists of a $9\frac{1}{2}" \times 2\frac{1}{2}"$ Strip Plate strengthened by a $9\frac{1}{2}$" Angle Girder and a $9\frac{1}{2}$" Strip. The back is a $12\frac{1}{2}" \times 2\frac{1}{2}"$ Strip Plate edged by a $12\frac{1}{2}$" Angle Girder and a $12\frac{1}{2}$" Strip, and it is connected to the sides by two $2\frac{1}{2}$" Angle Girders. The front is formed by two $12\frac{1}{2}$" Angle Girders and a $12\frac{1}{2}$" Flat Girder, and these also are connected to $2\frac{1}{2}$" Angle Girders bolted to the sides. Two $1\frac{1}{2}$" Flat Girders (38) are fixed in position at the front.

The top of the support pier is filled in by four $12\frac{1}{2}" \times 2\frac{1}{2}"$ Strip Plates strengthened at the front by a $12\frac{1}{2}$" Angle Girder (39). The guard rails are each made from a $7\frac{1}{2}$" Flat Girder and a $2\frac{1}{2}$" Flat Girder overlapped three holes and bolted to $4\frac{1}{2}$" Angle Girders fixed to the top of the approach. The handrails are 8" Rods held in Collars, each of which is screwed on to a bolt that is fixed by a nut in a $1\frac{1}{2}$" Strip.

FIG. 5 (*left*)
This underneath view shows how the lifting span is hinged to the main pier

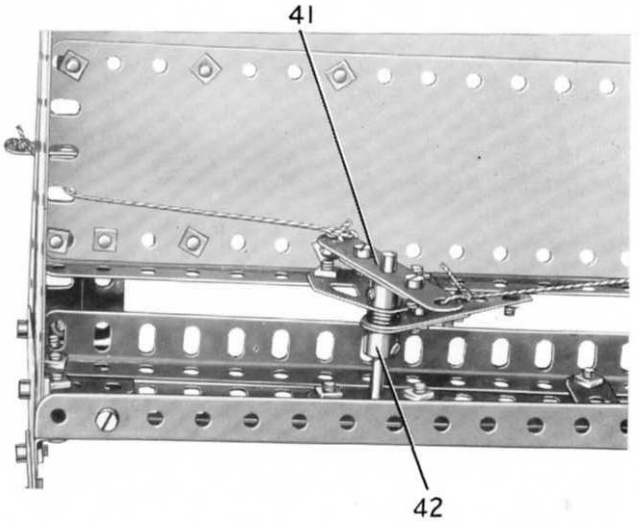


FIG. 6 (*right*)
An underneath view of a section of the support pier, showing the arrangement of the cords that operate the traffic barriers

The lamps are attached to Double Brackets bolted between 2½″ Strips and 2½″×1½″ Triangular Flexible Plates supported by 7½″ Strips. Each pair of 7½″ Strips is fixed to a Channel Bearing that is bolted to one of the guard rails.

Each section of the traffic barrier is a 5½″ Strip (40) extended by a Flat Trunnion, to which a ½″ loose Pulley is bolted. The Strips (40) are *lock-nutted* to 2½″×½″ Double Angle Strips fixed to the top of the approach as shown. A length of Cord tied to the outer end of each of the Strips (40) is passed through the floor of the pier and is fastened to one end of a 2½″ Strip (41) (Fig. 6), which is bolted centrally to a Double Arm Crank. The Double Arm Crank is fixed on a 2″ Rod, which is mounted in a Flat Trunnion bolted to the Angle Girder (39) and in a 1½″ Strip that covers the slotted holes in the Flat Girder at the front of the approach. A Crank (42) (Fig. 6) is fixed on the Rod and is extended by a 2½″ Strip fitted with a bolt (43) (Fig. 7). When the span is lowered a Girder Bracket (44) bolted to its end engages the bolt (43), and thus depresses the Crank (42). This movement is transmitted through the Strip (41) and the lengths of Cord, so that the barriers rise automatically.

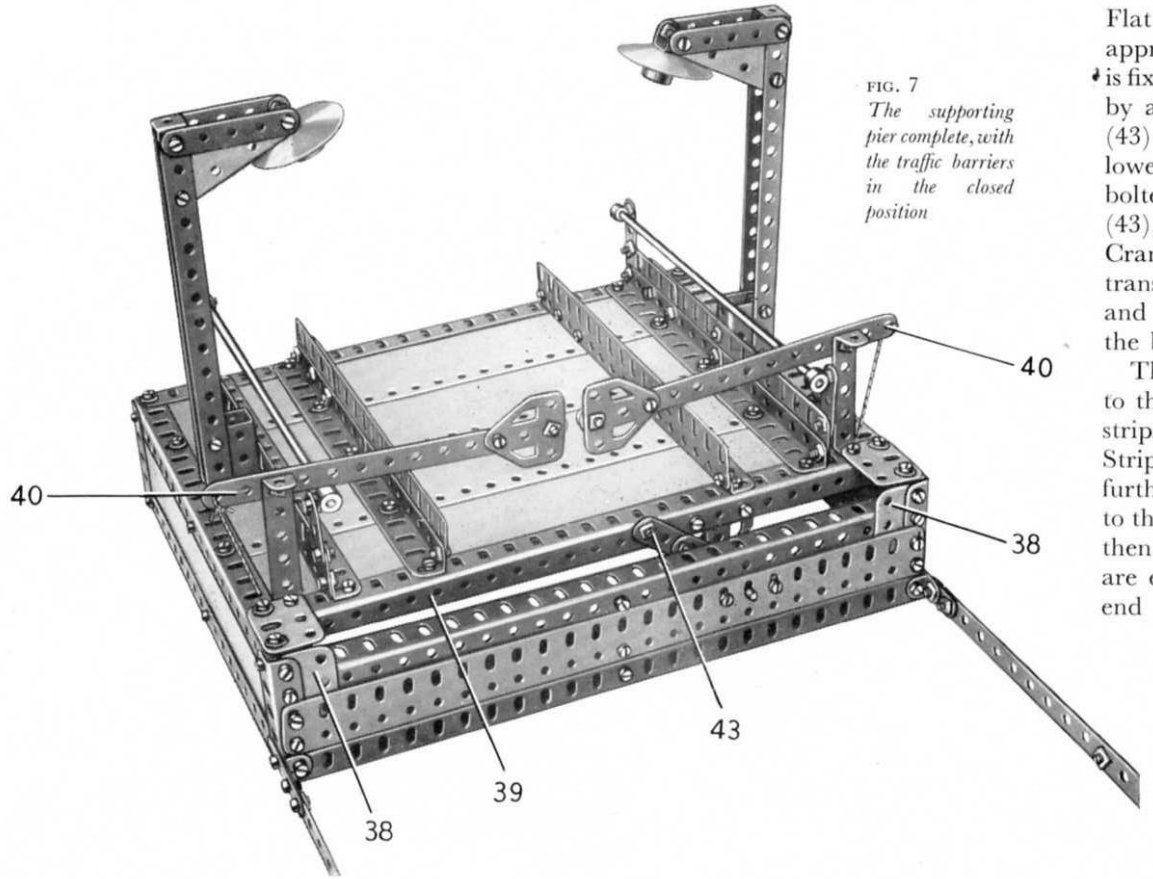


FIG. 7
The supporting pier complete, with the traffic barriers in the closed position

The support pier is connected to the main pier by two built-up strips, each made from two 12½″ Strips overlapped four holes. A further 12½″ Strip is fixed centrally to the overlapped Strips to strengthen them. The built-up strips are extended at the support pier end by 2″ Slotted Strips. The Slotted Strips are bolted to the sides of the pier, and the built-up strips are connected to the front by Angle Brackets.

Parts Required to Build the Meccano Beam Bridge

23 of No.	1	8 of No.	7	12 of No.	11	5 of No.	17	1 of No.	32	3 of No.	52a	6 of No.	89	4 of No.	103h	2 of No.	160	2 of No.	213
6 " "	1a	8 " "	7a	28 " "	12	4 " "	20	613 " "	37a	4 " "	53	1 " "	94	4 " "	103k	1 " "	161	2 " "	214
6 " "	1b	16 " "	8	2 " "	12a	7 " "	20b	560 " "	37b	2 " "	53a	2 " "	95b	2 " "	111	2 " "	179	4 " "	221
36 " "	2	6 " "	8a	6 " "	12b	2 " "	22	84 " "	38	2 " "	54	2 " "	96a	9 " "	111a	6 " "	187a	2 " "	222
8 " "	2a	4 " "	8b	1 " "	13	4 " "	23	4 " "	38d	2 " "	55a	2 " "	102	18 " "	111c	5 " "	188	2 " "	223
11 " "	3	11 " "	9	4 " "	13a	1 " "	23a	1 " "	40	1 " "	58	2 " "	103	4 " "	111d	2 " "	189		
4 " "	4	8 " "	9a	2 " "	14	1 " "	26	2 " "	45	20 " "	59	4 " "	103a	2 " "	126	1 " "	190a	1 E20R Electric Motor (not included in Outfit)	
24 " "	5	8 " "	9d	2 " "	15b	1 " "	26c	2 " "	48a	1 " "	62	4 " "	103b	5 " "	126a	1 " "	192		
11 " "	6	2 " "	9f	2 " "	16a	2 " "	27a	2 " "	48d	3 " "	62b	1 " "	103d	2 " "	133	4 " "	196		
9 " "	6a	4 " "	10	1 " "	16b	1 " "	27d	4 " "	52	3 " "	70	4 " "	103f	4 " "	136	20 " "	197		

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