MECCANO Twin-Cylinder MOTOR CYCLE ENGINE

(MODEL No. 10.16)

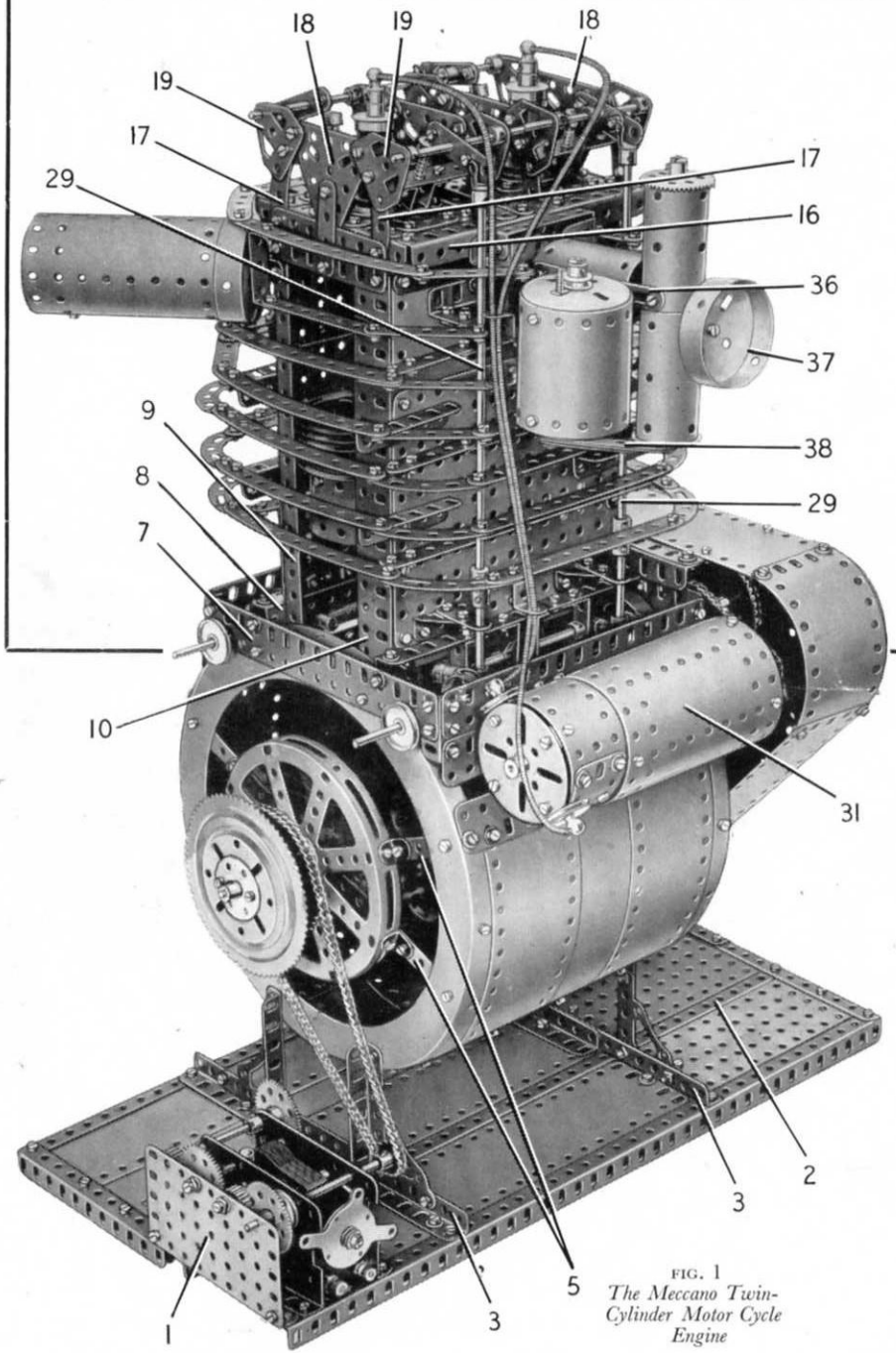

FIG. 1
The Meccano Twin-Cylinder Motor Cycle Engine

SPECIAL FEATURES

The Meccano Twin-Cylinder Motor Cycle Engine includes a counter-balanced crankshaft, camshafts and valves, and when set in motion by the E2OR Electric Motor fixed to its base, provides a striking and interesting demonstration of the working of an engine of this type.

The model described in this Leaflet represents a twin-cylinder motor cycle engine designed to operate on the four-stroke principle, and it provides an interesting working demonstration of the basic features of an internal combustion engine of this kind.

Details of the Base (Figs. 1, 3, 4 and 10)

The longer sides of the base are each formed by an 18½″ Angle Girder, and these are connected at each end by a 5½″ and a 4½″ Angle Girder bolted together. At one end the 4½″ Angle Girder is placed with its flange upward, and to it is bolted a 4½″ × 2½″ Flat Plate (1) (Fig. 1).

An 18½″ Angle Girder (2) (Fig. 4) is fixed along the base and two 9½″ Angle Girders (3) are bolted across the top. The top is filled in by four 12½″ × 2½″ Strip Plates, a 5½″ × 3½″ Flat Plate and two 5½″ × 2½″ Flat Plates. The ends of the Flat and Strip Plates are connected by 1½″ Strips, and the inner ends of three of the Strip Plates are attached to a 5½″ Angle Girder, which is bolted to one of the Girders (3) (see Fig. 4).

Construction of the Crankcase (Figs. 1, 2, 4 and 7)

The rounded crankcase is made by bolting two 7½″ Angle Girders (4) (Fig. 2) between two Flanged Rings. Two crossed 9½″ Strips (5) (Fig. 7) are fixed across each Flanged Ring as shown, and to these Strips Hub Discs are attached by Angle Brackets. A Bush Wheel is bolted to the centre of the Hub Disc at one end to form a bearing for the crankshaft, and to the Hub Disc at the other end a Circular Girder is attached by Fishplates. A 5½″ Strip (6) (Fig. 7) is bolted to the Circular Girder.

The crankcase is supported by four 3½″ Angle Girders fixed to the Girders (3) of the base, and braced by Corner Gussets. A 7½″ Flat Girder (7) (Fig. 1) is bolted to each Flanged Ring. At one side the ends of these Flat Girders are connected by a 7½″ Flat Girder and two 4½″ Flat Girders overlapped three holes. The Flat Girders are connected by 1½″ Angle Girders (Fig. 4). On the other side a similar arrangement is used (Fig. 3) but in this case the two 4½″ Flat Girders are replaced by a 5½″ Flat Girder extended by a 2½″ Flat Girder.

Two 7½″ Angle Girders (8) (Figs. 4 and 7) are connected to the Flat Girders (7) by Angle Brackets. The crankcase cover consists of six 12½″ × 2½″ Strip Plates arranged in pairs, each pair being overlapped 11 holes. The cover is bolted to two 7½ Strips fixed between the Flanged Rings, and each outer edge of the cover is fitted with a 5½″ Flat Girder extended by a 2½″ Flat Girder. These Flat Girders also are bolted to the Flanged Rings, but the assembly of this part of the model should not be completed until the crankshaft and the cylinder block units are in place.

The Cylinder Block (Figs. 1, 4 and 7)

Each side wall of the cylinder block is made by bolting two vertical 9½″ Angle Girders (9) (Fig. 1) to one of the Girders (8). A 9½″ Flat Girder (10) is fixed to each of the Girders (9) on one side. The side seen in Fig. 4 is filled in by two 5½″ × 3½″ Flat Plates placed vertically, with a horizontal 5½″ × 2½″ Flat Plate above them. The side shown in Fig. 1 consists of two vertical 5½″ × 3½″ Flat Plates, two vertical 4½″ × 2½″ Flexible Plates, and a 2½″ × 1½″ Flexible Plate placed between the top ends of the 4½″ × 2½″ Flexible Plates.

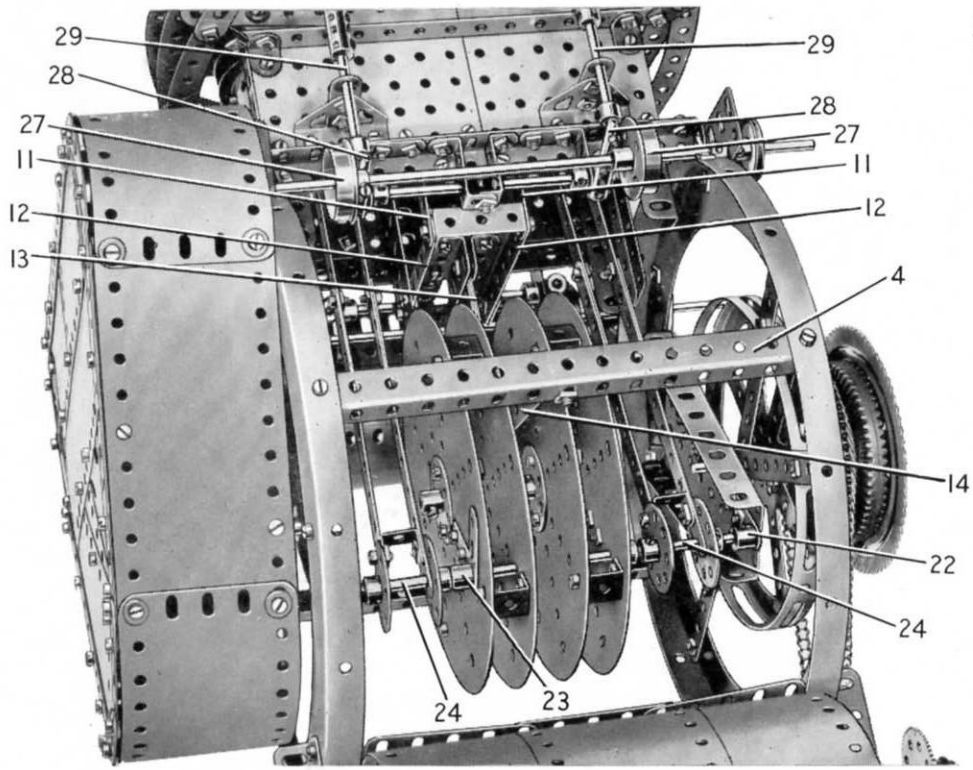

FIG. 2
In this view the crankcase plating has been removed in order to reveal the details of the crankshaft

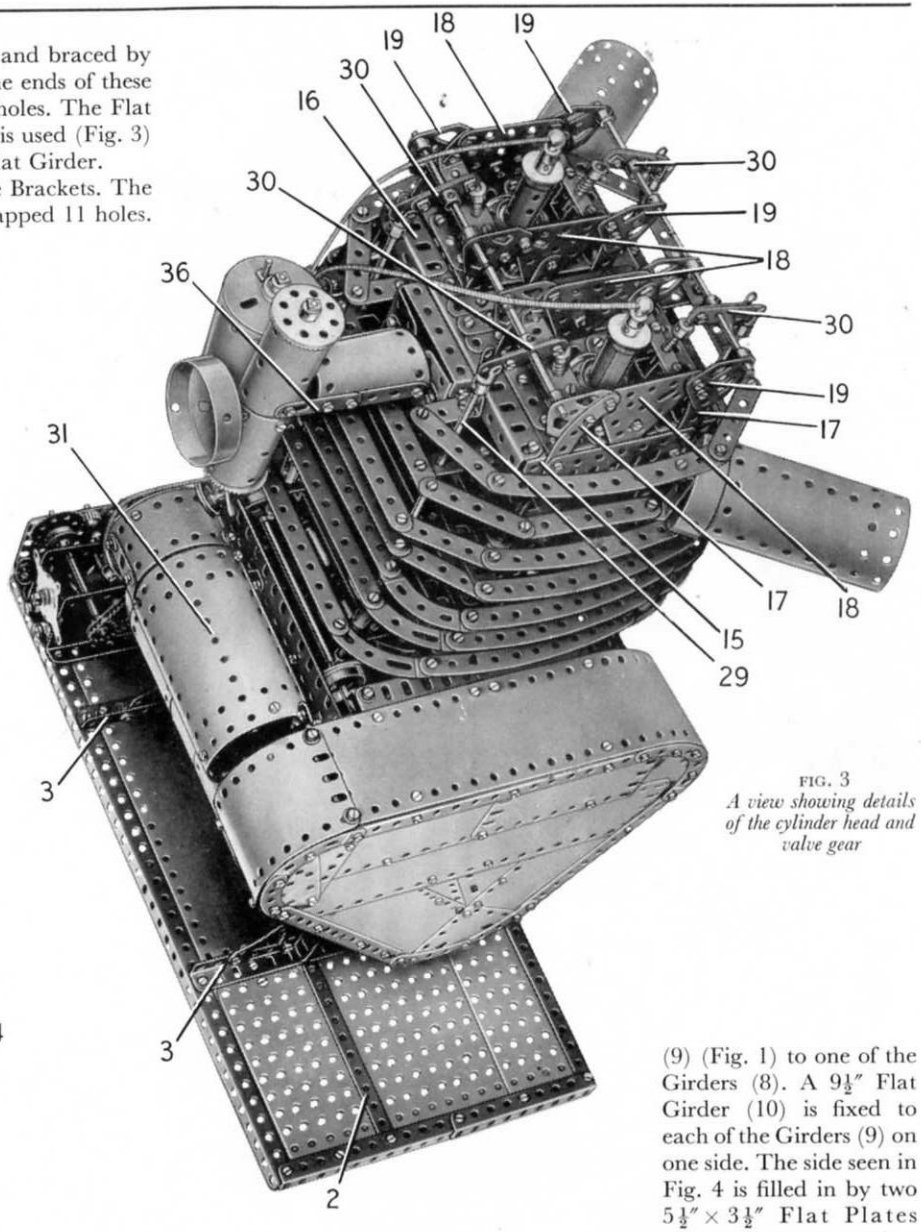

FIG. 3
A view showing details of the cylinder head and valve gear

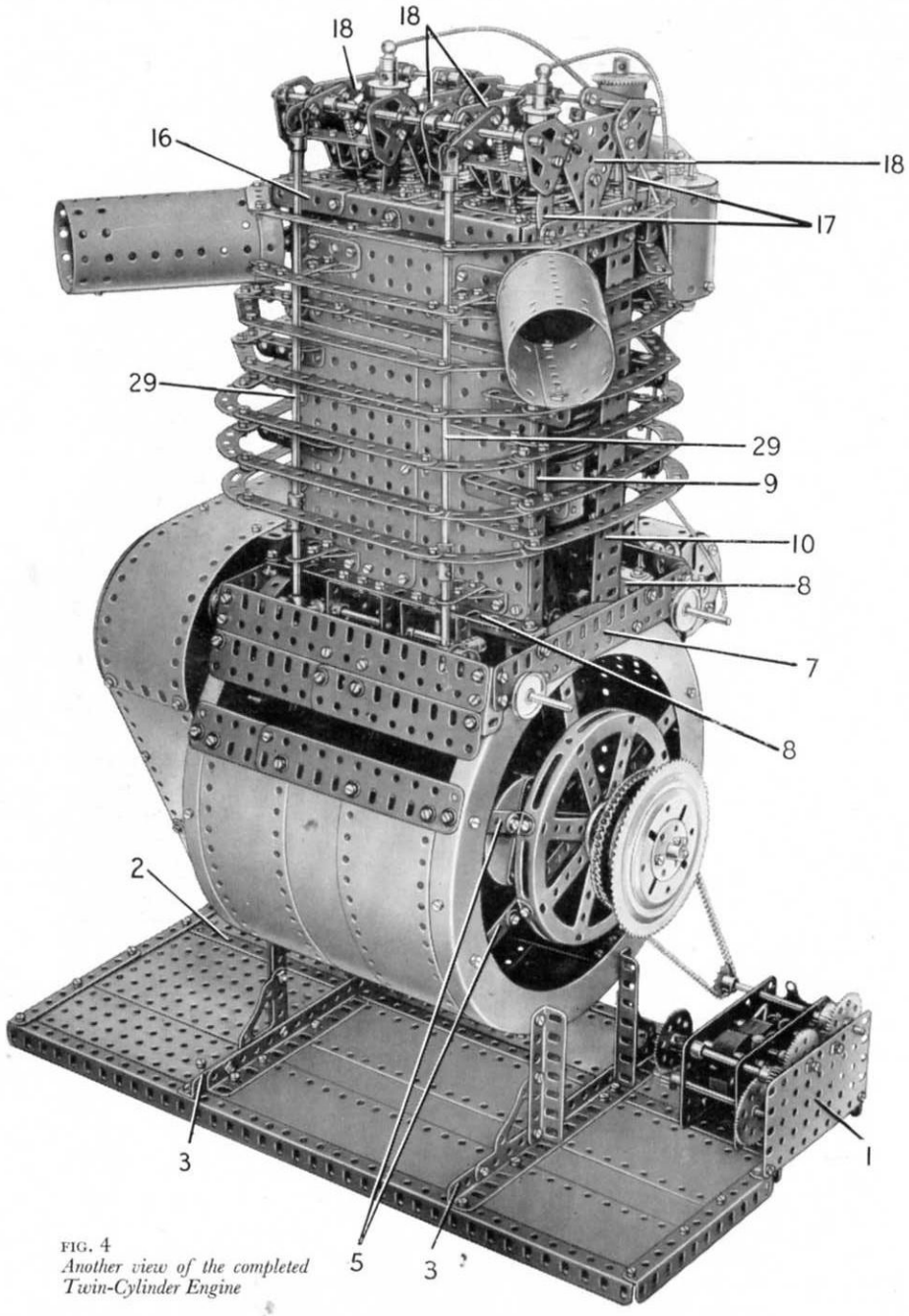

FIG. 4
Another view of the completed Twin-Cylinder Engine

Two 9½″ Angle Girders are bolted to one side of the cylinder block on the inside face, and to each of these Girders is fixed a 9½″ Flat Girder that corresponds to one of the Flat Girders (10). To the other side of the block two 9½″ Strips are attached by Angle Brackets. These Strips are indicated at (11) (Fig. 2). The lower ends of these Strips are connected by a 1½″×½″ Double Angle Strip, and they are joined across to the 9½″ Angle Girders of the opposite side by two 3½″ Angle Girders (12) (Fig. 2). Three 4½″ Strips (13) are placed face-to-face and are bolted between two 1½″ Angle Girders, each of which is fixed to one of the Girders (12). The lower ends of the Strips (13) are braced to each of the Girders (4) by two 5½″ Strips (14) placed face-to-face and connected to the Girders by Angle Brackets.

Details of the Cylinder Head (Figs. 1, 3 and 6)

Two 4½″ Angle Girders (15) (Fig. 6) are attached to the top of the cylinder block by 3½″ Flat Girders, and their outer ends are connected by made-up girders (16), each of which consists of a 5½″ and a 2″ Angle Girder. The top ends of the Strips (11) (Fig. 2) are joined to the Flat Girders opposite to them by 3″ Strips, each of which supports a 2½″ Angle Girder placed with its horizontal flange at the top. Two 4½″ Angle Girders are fixed to the 2½″ Angle Girders, and to these Girders and to the Girders (15) are bolted 2½″ Curved Strips (17) (Fig. 3). A vertical 2″ Strip is fixed to the centre of each 4½″ Angle Girder and these support 2½″ Triangular Plates (18). The Triangular Plates and the Curved Strips are bolted together as shown (Fig. 3), the bolts supporting also Flat Trunnions (19).

The cylinder head is filled in by three 4½″ Strips across the centre, with two 1½″ Flat Girders (20) (Fig. 6) bolted to 2½″ Strips on each side. Each sparking plug is made by bolting a 1½″ Pulley to two further 2½″ Strips on each side. A 3″ Rod is fixed in each Pulley and on it are placed a 1″ loose Pulley, a Sleeve Piece and ¾″ Flanged Wheel and a Handrail Coupling. A 2½″×½″ Double Angle Strip (21) (Fig. 6) fitted at its centre with a Double Bent Strip, is bolted between each pair of Curved Strips (17).

Assembly of the Crankshaft (Fig. 2)

Each outer web of the crankshaft is a Flanged Sector Plate with two Semi-Circular Plates and two 2½″ Strips bolted to its wide end as balance weights. A Crank is bolted to the centre of the Flanged Sector Plate and another Crank (22) (Fig. 2) is fixed to its narrow end. The Crank at the centre of the Sector Plate is fastened on a 3½″ Rod that is freely mounted in the outer crankshaft bearings formed by the Hub Discs and Strips.

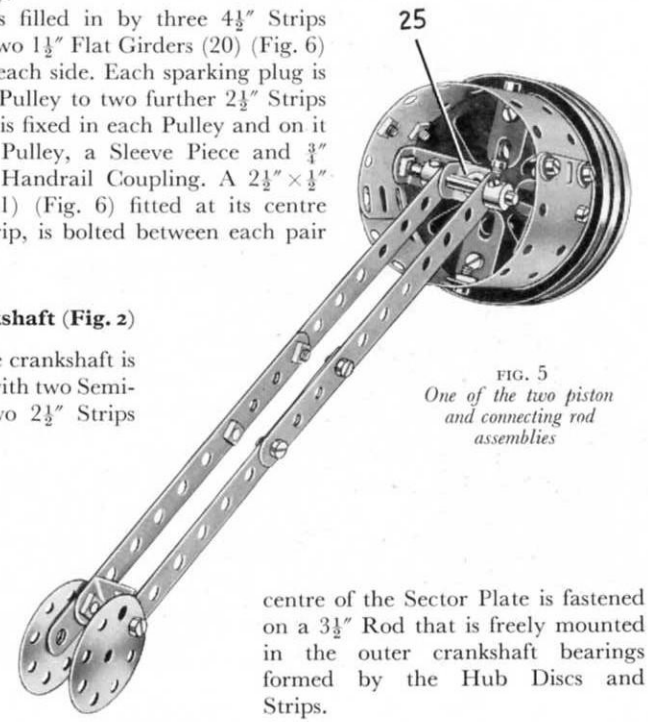

FIG. 5
One of the two piston and connecting rod assemblies

Each centre web of the crankshaft consists of two 6″ Circular Plates joined together by four Double Brackets. A Bush Wheel is bolted to the centre of each Circular Plate and these are used to fix the webs to the ends of a 3″ Rod, which is mounted in the end holes of the Strips (13). A Bell Crank (23) is bolted to the outer Circular Plate of each centre web. When the connecting rods and piston assemblies are completed the lower end of each connecting rod is freely pivoted on a 3″ Rod (24) that connects the inner and outer webs together. These Rods are fixed in the Cranks (22) and the Double Arm Cranks (23).

The Pistons and Connecting Rods (Fig. 5)

One of the piston assemblies is shown removed from the model in Fig. 5. Each piston consists of three 3″ Pulleys fixed on a 1½″ Rod that carries at its lower end a large Fork Piece (25). The skirt is formed by two 5½″ × 1½″ Flexible Plates with their ends overlapped three holes. These Plates are bolted to 1″ × ½″ Angle Brackets fixed to the lower one of the 3″ Pulleys.

The connecting rod is formed by two made-up strips, each consisting of two 5½″ Strips overlapped four holes. The two strips are joined at their lower ends by a Double Bracket, the bolts holding these fixing also a Wheel Disc on each side. The Wheel Discs and the strips are passed over one of the Rods (24) (Fig. 2) of the crankshaft and are centred on the Rod by two Collars. The upper end of the connecting rod pivots on a 1½″ Rod held in the Fork Piece (25) by Collars.

The pistons are arranged so that they can slide freely between the edges of the Angle Girders and the Flat Girders on the inside of the cylinder block assembly.

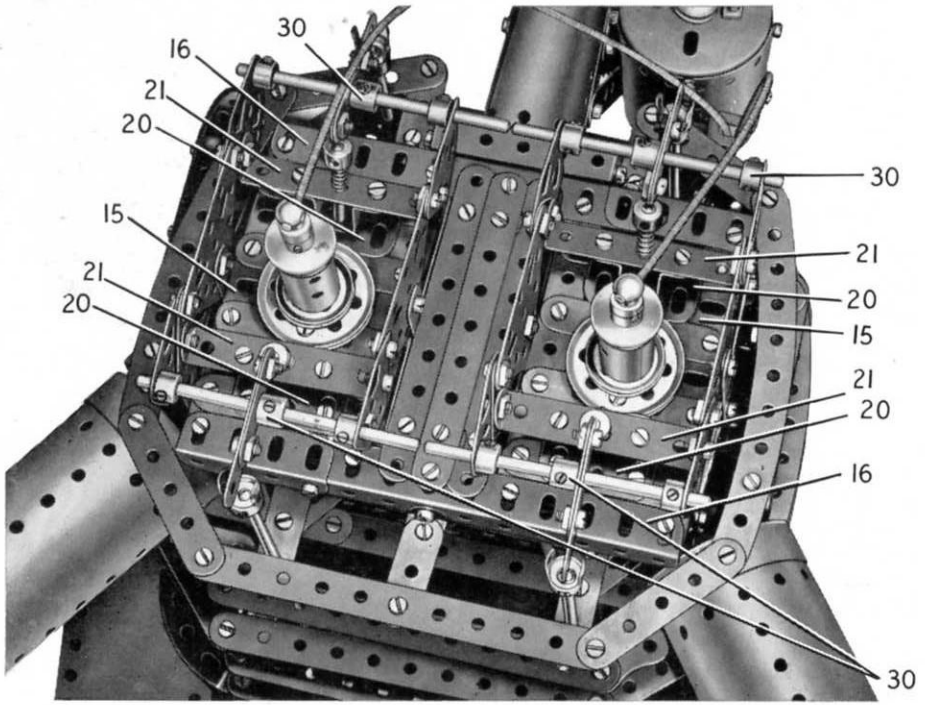

FIG. 6 *A close-up view of the cylinder block head showing the valves, sparking plugs, etc.*

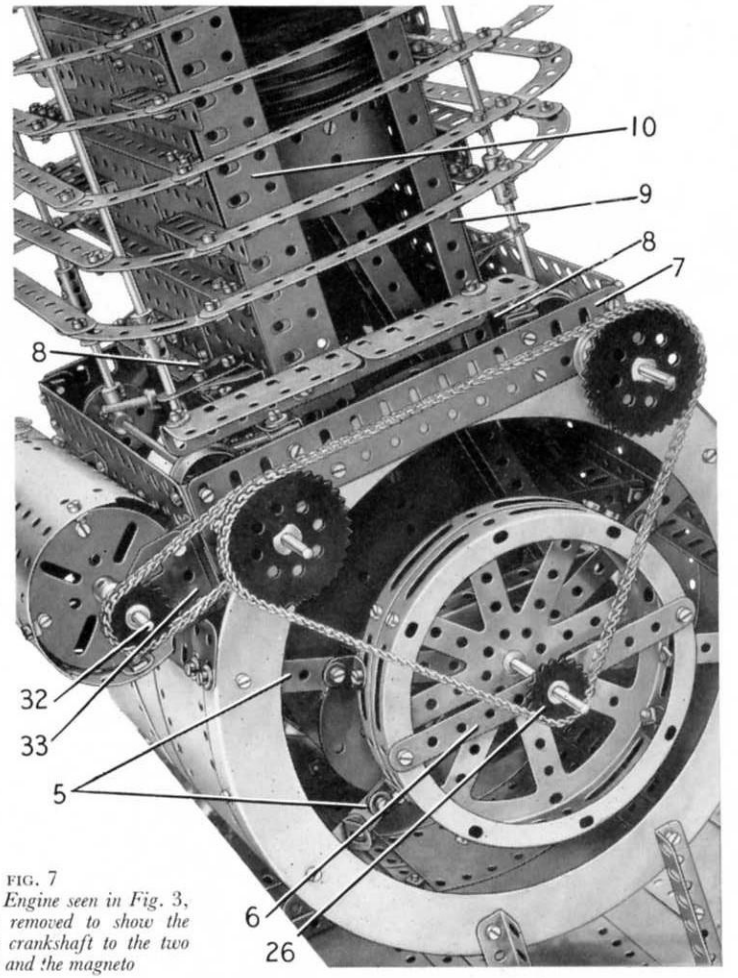

FIG. 7
The end of the Engine seen in Fig. 3, with the cover removed to show the drives from the crankshaft to the two camshafts and the magneto

Arrangement of the Camshafts and the Valve Gear (Figs. 2, 3, 4, 6 and 7)

The camshafts are driven by Chain from a 1″ Sprocket (26) (Fig. 7) fixed at one end of the crankshaft. The Chain passes round two 2″ Sprockets, each of which is fixed on one of the two camshafts. The camshaft and valve assembly on each side of the model are alike in general arrangement, and each camshaft is an 11½″ Rod held in the Flat Girders (7) by 1″ Pulleys. Two 1⅛″ Flanged Wheels (27) (Fig. 2) are fixed on the Rod.

The tappets (28) (Fig. 2) are each formed by a 1″ Rod held in a Coupling fixed on a 2″ Rod. These 2″ Rods are supported in 1″ × 1″ Angle Brackets and 1″ Reversed Angle Brackets bolted to the Girder (8) (Figs. 2 and 7), the lower lugs of the Reversed Angle Brackets being fixed together by a nut and bolt. The 1″ Rod bears against the boss of

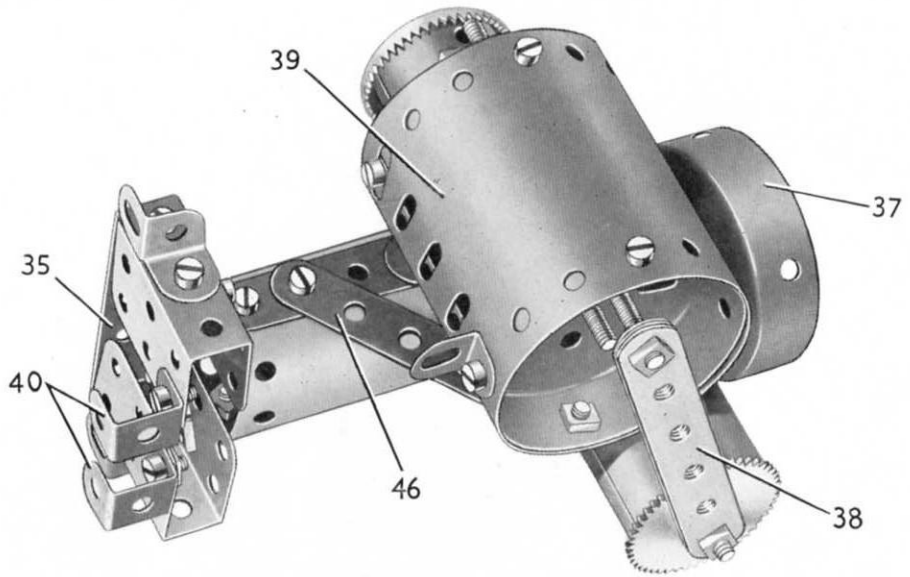

FIG. 8 *The complete carburettor removed from the Engine*

one of the Flanged Wheels (27) (Fig. 2), so that as the Flanged Wheel turns its set-screw raises and lowers the tappet.

The push-rods (29) (Fig. 2) are each made by joining a 2″ and an 8″ Rod by means of a Coupling. These rods slide in two bearings, the lower pair on each side being made from 1½″ Strips bolted to Trunnions. The upper pair on one side consist of 2″ Strips bolted to Trunnions, but on the other side the 2″ Strips are supported by Girder Brackets (Fig. 1). Each push-rod carries at its lower end a Collar that rests on the 1″ Rod of one of the tappets (28), and at its upper end a small Fork Piece arranged with its arms outside the end of one of the four rocker arms (30) (Fig. 6).

Each rocker arm consists of a 2″ Strip bolted to a Double Arm Crank mounted on a 3½″ Rod. The Rod is held by Collars in the Flat Trunnions (19) (Fig. 3). The inner end of the Strip bears against a Collar on a 2½″ Rod that represents the valve stem. This Rod is supported in one of the Double Angle Strips (21) (Fig. 6) and its Double Bent Strip, and a Compression Spring is fitted between the Collar and the Double Angle Strip. A 1″ Pulley on the lower end of the Rod represents the valve head.

A cover is fitted over the camshaft chain drive as shown in Figs. 1, 2, 3 and 4. The frame for the face of the cover consists of two 7½″ Strips and a 5½″ Strip connected at their ends by Curved Strips. This frame is filled in by a 9½″×2½″ Strip Plate, and Flexible Plates and Triangular Flexible Plates of various sizes. The edges of the cover are formed by two 12½″×2½″ Strip Plates, a 5½″×2½″ and a 4½″×2½″ Flexible Plate. These are connected to the front face by Angle Brackets and three 5½″ Angle Girders.

The cover is supported at the top by two 3″ Flat Girders, which are fixed to a 5½″ Angle Girder attached to one side of the cylinder block. The lower part of the cover is bolted to two Angle Brackets fixed to the Strips 5.

Construction of the Magneto (Figs. 1, 7 and 9)

The magneto is a Boiler (31) (Fig. 9) opened out slightly and connected by Angle Brackets to a Face Plate at each end. A 6½″ Rod (32) is free to turn in the bosses of the Face Plates and in a Flat Trunnion (33) (Fig. 7), which is attached to a 1½″ Angle Girder bolted to one side of the crankcase. The Rod is held in position by one half of a Dog Clutch and a 1″ Sprocket, which is driven by Chain from a similar Sprocket on one of the camshafts. A Rod Socket (34) (Fig. 9) fitted with a ½″ and a $\frac{7}{32}$″ Bolt, is fixed on the other end of the Rod. Two ½″×½″ Angle Brackets bolted to the Face Plate at the same end as the Rod Socket are set so that the ½″ Bolt just clears them as it rotates. Two 1″×1″ Angle Brackets are bolted to this Face Plate also to form clips that support the magneto cap.

The cap is made by bolting two 5½″×1½″ Flexible Plates to Angle Brackets and a 2½″×1½″ Double Angle Strip fixed to a Face Plate. The contacts are Handrail Supports spaced from the cap by 1″ loose Pulleys, and lengths of Spring Cord are arranged between them and the Handrail Couplings of the sparking plugs as shown in Fig. 1.

Assembly of the Carburettor and the Exhaust Ports (Fig. 1, 3 and 8)

The carburettor is shown separately in Fig. 8. Two Channel Bearings are connected by a 2½″×1″ Double Angle Strip (35) and two 1 $\frac{11}{16}$″ radius Curved Plates rolled into a cylinder are attached to each Channel Bearing by an Angle Bracket. The cylinder is strengthened by two 2½″ Strips, each of which is extended by a 2″ Slotted Strip (36) (Fig. 3). These Slotted Strips support the upper one of two 2½″ Cylinders, which are joined together by Fishplates. A Boiler End (37) and a 1″ Pulley are attached to the lower Cylinder by a ¾″ Bolt. A 6″ Screwed Rod is passed through the two Cylinders and on it is held a 1½″ Contrate at the top, and at its lower end are fixed a 50-tooth Gear and four 3″ Strips (38) placed face-to-face.

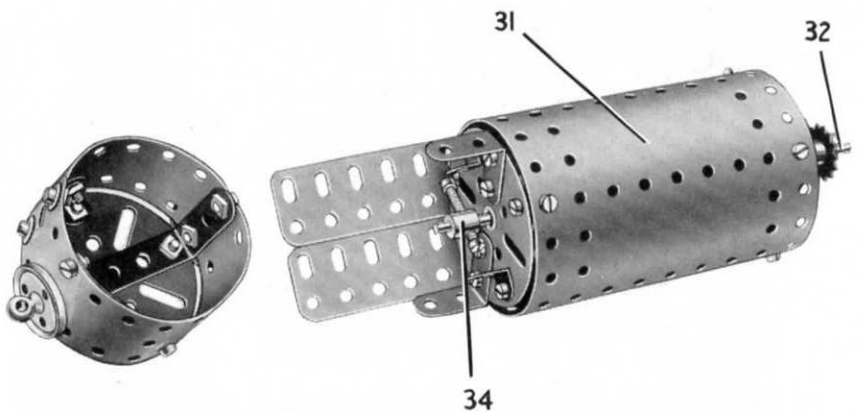

FIG. 9 *The magneto, with the cap shown separately*

The float chamber (39) is made by bolting a 5½″×2½″ Flexible Plate and a 1 11/16″ radius Curved Plate round two Boiler Ends. The top Boiler End is spaced from one of the Slotted Strips (36) by a nut on a ⅜″ Bolt, and the Strips (38) are clamped between nuts on a 3½″ Screwed Rod passed through the two Boiler Ends. A 3″ Strip (46) used as a brace, is bolted between the float chamber and the rolled 1 11/16″ radius Curved Plates.

The Double Brackets (40) are used to connect the complete assembly to the side of the cylinder block.

When the carburettor is in place Strips and Curved Strips representing cooling fins are arranged round the cylinder block as shown in Fig. 1 and other illustrations.

The exhaust ports are Boilers, each fitted with one Boiler End, and they are connected to the cylinder block by Obtuse Angle Brackets.

Driving the Model (Figs. 1, 4 and 10)

An E20R Electric Motor is bolted by its flanges to the base (Fig. 10), and a 7/16″ Pinion on its armature shaft drives a 60-tooth Gear (41) on a Rod mounted in the Motor side-plates. A ½″ Pinion on the same Rod engages a 57-tooth Gear on a Rod (42), which carries also a ½″ Pinion (43). The Rod (42) is held in place by the remaining half of the Dog Clutch left over after the completion of the magneto. Pinion (43) is in mesh with a 57-tooth Gear that is free to turn on a 1⅛″ Bolt, but is retained on the Bolt by *lock-nuts*. This Bolt is first fitted with a nut and a Washer, and is then passed through the Flat Plate (1) and is fixed in place by a further nut. The 57-tooth Gear drives a ½″ Pinion (44), which is mounted on a 1⅛″ Bolt in the same way as the Gear, and the Pinion in turn meshes with another 57-tooth Gear on a Rod (45).

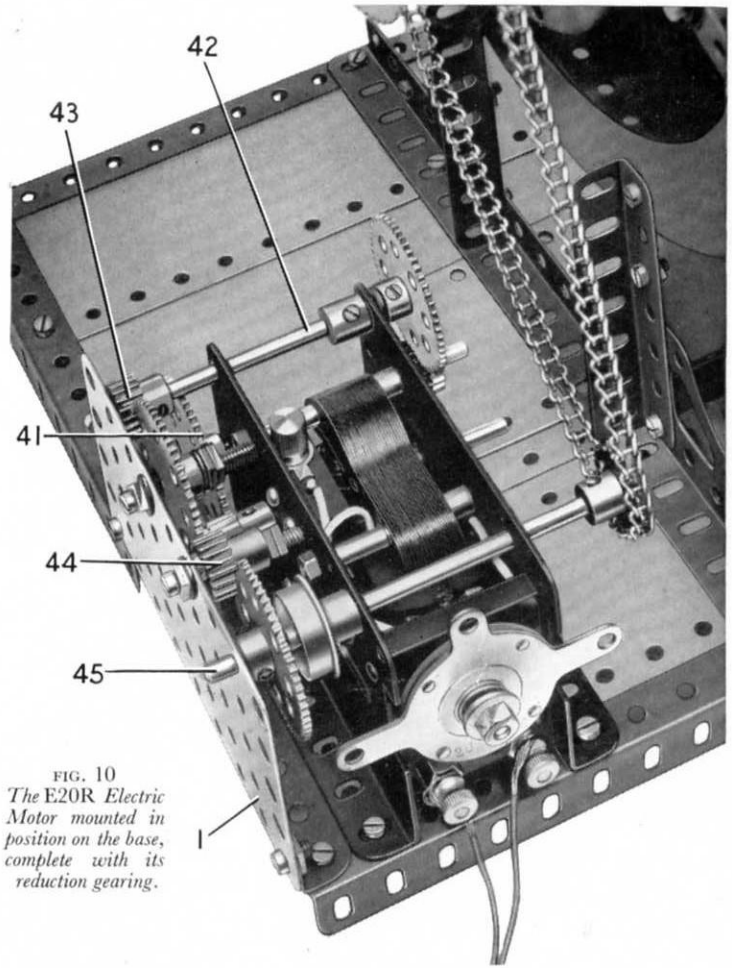

FIG. 10
The E20R Electric Motor mounted in position on the base, complete with its reduction gearing.

A ¾″ Sprocket on Rod (45) is connected by Chain to a 3″ Sprocket on the crankshaft. A Ball Thrust Race Toothed Disc, a 2″ Pulley and Tyre, and a Wheel Flange, are attached to the 3″ Sprocket by long Bolts, and together they represent the clutch assembly of an actual engine.

Adjusting the Valve Timing

It is now necessary to 'set' the valve gear. To do this the engine should be turned so that the nearest piston (Fig. 1) is at the top of its stroke. The inlet camshaft is then turned so that the first cylinder inlet valve, that is the one on the right nearest the carburettor in Fig. 6, is just about to open. As the piston descends the valve opens to admit the mixture. This is the induction stroke. The next movement of the piston is upward to compress the mixture, and both the inlet and the exhaust valve must be closed during this stroke. The next downward movement of the piston is the firing stroke, and both valves are again closed. To complete the cycle the piston again moves upward, and the exhaust or right-hand camshaft (Fig. 3) should be set so that the exhaust valve opens during this stroke.

The same procedure is adopted with the second cylinder, but in this case the inlet valve is timed to open one complete revolution of the crankshaft behind the inlet valve opening of the first cylinder. That is, the second cylinder induction stroke corresponds to the firing stroke of the first cylinder.

Parts Required to Build the Meccano Twin-Cylinder Motor Cycle Engine

6 of No. 1a	8 of No. 9b	7 of No. 16					2 of No. 136	1 of No. 162a	4 of No. 214
6 " " 1b	8 " " 9d	6 " " 16a	4 of No. 24	4 of No. 45	3 of No. 70	3 of No. 96	1 of No. 111	2 " " 136a	1 " " 162b	2 " " 216
33 " " 2	4 " " 9e	4 " " 16b	2 " " 24a	1 " " 47	4 " " 76	1 " " 96a	15 " " 111a	1 " " 137	2 " " 163	2 " " 221
8 " " 2a	8 " " 9f	8 " " 17	2 " " 24b	3 " " 48	4 " " 77	3 " " 103	23 " " 111c	2 " " 140	2 " " 165	2 " " 223
2 " " 3	24 " " 10	4 " " 18a	2 " " 24c	5 " " 48a	1 " " 79a	4 " " 103a	2 " " 111d	1 " " 142a	2 " " 167b	1 " " 224
5 " " 4	12 " " 11	4 " " 18b	3 " " 26	5 " " 52a	1 " " 80a	2 " " 103c	2 " " 116	1 " " 143	1 " " 168b	1 " " 225
35 " " 5	48 " " 12	4 " " 20	1 " " 26c	1 " " 53a	1 " " 80c	2 " " 103d	2 " " 118	1 " " 144	1 " " 179	
11 " " 6	8 " " 12a	3 " " 20b	1 " " 27	2 " " 54	12 " " 89	2 " " 103e	4 " " 120b	4 " " 146	1 " " 188	1 E20R
10 " " 6a	8 " " 12b	6 " " 19b	3 " " 27a	2 " " 55a	6 " " 89a	3 " " 103f	4 " " 124	6 " " 147b	6 " " 189	Electric Motor
3 " " 7a	2 " " 12c	1 " " 20a	1 " " 27d	1 " " 58	12 " " 90	1 " " 103g	2 " " 125	1 " " 154a	4 " " 191	(not included
6 " " 8a	2 " " 13	2 " " 21	1 " " 28	24 " " 59	8 " " 90a	4 " " 103h	6 " " 126	1 " " 154b	5 " " 192	in Outfit)
4 " " 8b	4 " " 13a	8 " " 22	730 " " 37a	4 " " 62	2 " " 94	4 " " 103k	10 " " 126a	2 " " 160	1 " " 196	
11 " " 9	1 " " 14	4 " " 22a	670 " " 37b	4 " " 62b	2 " " 95	4 " " 108	2 " " 128	2 " " 161	12 " " 197	
6 " " 9a	1 " " 15b	1 " " 23a	85 " " 38	8 " " 63	1 " " 95b	3 " " 109	2 " " 133a	2 " " 162	3 " " 200	

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