

Two Fascinating Working Models

An Anti-Aircraft Gun and a Designing Machine

THIS month we are describing working models of an anti-aircraft gun and a harmonograph, each of which can be built with a No. 5 or larger Outfit. The harmonograph is capable of producing innumerable intricate designs, such as the two illustrated in Figs. 3 and 4, and watching the machine trace out these designs is a fascinating pastime at which many hours can be spent. The anti-aircraft gun fires Washers or Collars, and can be swivelled and elevated like a real gun.

The base of the gun, which can be seen in Fig. 1, is constructed first. It consists of a $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate to which two $5\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plates are bolted. The sides of the base are filled in by $5\frac{1}{2}"$ Strips that are fastened in position by Angle Brackets. A 3" Pulley is next bolted to the centre of the base, and around it two $5\frac{1}{2}" \times 1\frac{1}{2}"$ Flexible Plates 10 are fastened. The Flexible Plates are not attached to the 3" Pulley, but it will be found that if the Plates are bolted together tightly they will grip the rim of the Pulley firmly. A 2" Rod, which forms a swivel for the superstructure of the gun, is locked vertically in the boss of the 3" Pulley and is further supported by the centre hole of a Double Bent Strip secured by two $\frac{1}{2}"$ Bolts to the base. Each Bolt carries four Washers on its shank to space the Double Bent Strip upwards.

At its upper end the 2" Rod carries a second 3" Pulley, which is spaced from the Double Bent Strip by a 1" fast Pulley. Two $2\frac{1}{2}" \times 1\frac{1}{2}"$ Flexible Plates 11 are mounted on the 3" Pulley by a $1\frac{1}{2}" \times \frac{1}{2}"$ Double Angle Strip and these are braced on their inner sides by $2\frac{1}{2}"$ Strips. Two $2\frac{1}{2}"$ small radius Curved Strips are also bolted to the Flexible Plates, as shown in Fig. 1, to form the supporting arms for the gun barrel. The front of the turret is filled in by a $2\frac{1}{2}" \times 1\frac{1}{2}"$ Flanged Plate 12, which is fastened in position by three Angle Brackets, and is extended upward by a Flat Trunnion.

The firing platform of the gun is formed by a $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flexible Plate mounted on two $5\frac{1}{2}"$ Strips bolted to the 3" Pulley.

The remaining portion of the model to be constructed is the gun itself. This is shown partially dismantled in Fig. 2. The barrel consists of two $12\frac{1}{2}"$ Angle Girders 1, which are joined together at 2, in Fig. 1, and 3 by two Double Brackets. At this stage in the construction of the model, however, the Double Brackets are only bolted to one of the Angle Girders, the other Girder being fitted later when the firing mechanism has been assembled. A $9\frac{1}{2}"$ compound rod, built up of a 5" and a $4\frac{1}{2}"$ Rod joined by a Rod Connector, is journaled in the centre holes of the Double Brackets and it carries at its forward end a Cord Anchoring Spring. This is pressed on the rod about half an inch from the muzzle end to form a stop for the Washer or Collar used as a missile. A Washer is fitted on to the rod just behind the Rod Connector, and around this the end of a 6" Driving Band is looped. The other end of the Driving Band is passed through the hole in the lower Angle Girder directly behind the front Double Bracket, and is anchored to a bolt secured at the extreme forward end of the barrel.

A handle 4 is provided at the rear of the $9\frac{1}{2}"$ rod to enable it to be pulled back preparatory to firing. The handle consists of a $1\frac{1}{2}"$ Strip and is attached by an Obtuse Angle Bracket to a Rod and Strip Connector on the end of the compound rod. The bolt attaching

the Obtuse Angle Bracket to the Rod and Strip Connector carries three Washers on its shank, so that it does not catch against the sides of the barrel.

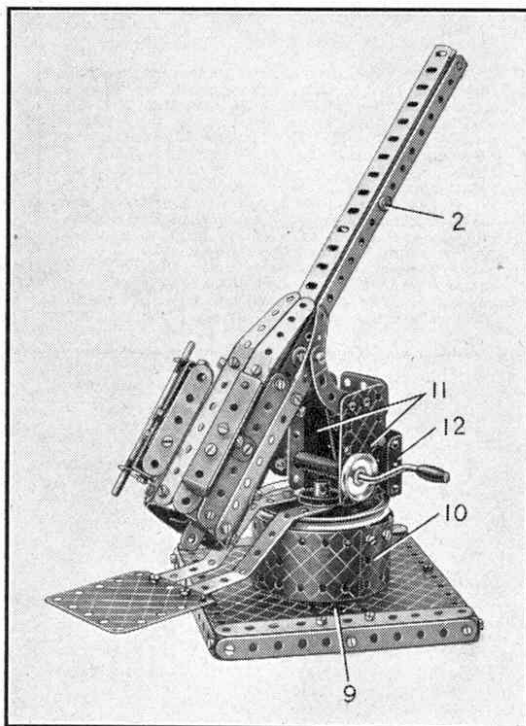


Fig. 1. A fine model of an anti-aircraft gun that shoots Washers or Collars. It is built up of parts included in Meccano Outfit No. 5.

This is done by fastening two bolts through the end holes of the Curved Strips bolted to Plates 11, in Fig. 1, so that they form swivels on which the barrel can rest. The elevation of the barrel is controlled by a Crank Handle journaled in Flexible Plate 11. Cord is tied to the Crank Handle, wound around it several times, and its other end attached to the barrel just in front of the pivot. Turning the Crank Handle in one direction pulls down the muzzle

of the gun, and the weight of the butt end swings the gun to increase the elevation when the movement of the Handle is reversed. Two 1" Pulleys fixed on the Crank Handle press tightly against the Flexible Plates 11 so that the gun does not turn too easily and is held in any desired position.

Parts required to build model anti-aircraft gun: 14 of No. 2; 2 of No. 3; 12 of No. 5; 2 of No. 6a; 2 of No. 8; 6 of No. 10; 3 of No. 11; 12 of No. 12; 3 of No. 12c; 1 of No. 15; 1 of No. 15a; 1 of No. 16; 1 of No. 17; 2 of No. 19b; 1 of No. 19c; 3 of No. 22; 2 of No. 35; 87 of No. 37a; 82 of No. 37b; 14 of No. 38; 1 of No. 40; 1 of No. 45; 1 of No. 48; 2 of No. 48a; 1 of No. 51; 1 of No. 52; 2 of No. 90a; 2 of No. 111a; 1 of No. 111c; 1 of No. 115; 2 of No. 125; 1 of No. 126a; 1 of No. 176; 1 of No. 186a; 2 of No. 188; 2 of No. 189; 1 of No. 190; 2 of No. 192; 1 of No. 212; 1 of No. 213.

The harmonograph is seen in operation in Fig. 5. It consists of a pendulum that carries a table at its upper end and is mounted so that it is free to swing in any direction. A pen suspended above the table then traces out a design on a piece of card attached to the table. The addition of a second pendulum to the lower end of the first one makes the designs produced by the machine more intricate.

The base of the harmonograph is a box-shaped structure built by joining the ends of two $12\frac{1}{2}"$ Angle Girders by $5\frac{1}{2}"$ Strips. Four $2\frac{1}{2}"$ Strips are bolted vertically to the ends of the Angle Girders; the

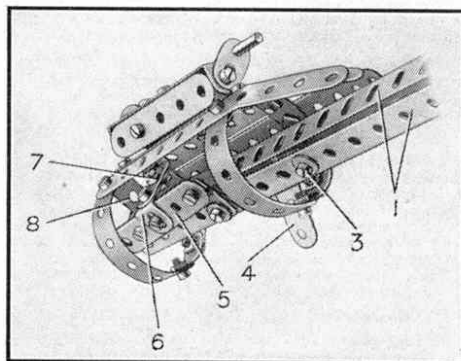


Fig. 2. The construction of the barrel of the gun.

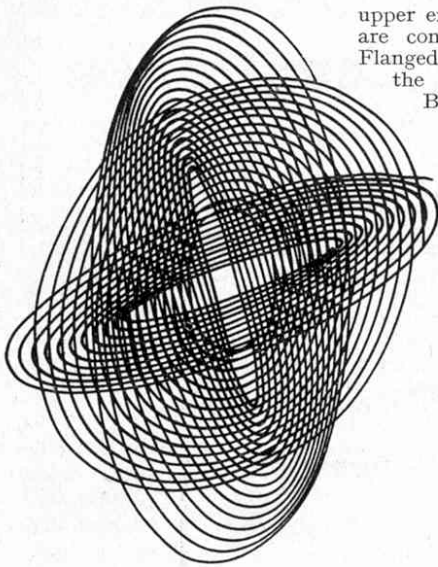


Fig. 3. A design produced by the harmonograph, using a single pendulum.

Two $12\frac{1}{2}$ " Angle Girders 2 are bolted to the base in the positions shown, and to them two Flat Trunnions 3 and 4 are fastened, each bolt carrying two Washers on its shank between the Flat Trunnions and Angle Girders. Reversed Angle Brackets, one of which is shown at 7, are then bolted to the inner sides of the Flat Trunnions, and through the free end hole of each Bracket a bolt is fastened to form the supports for the swivel frame 5, which is constructed by joining two $2\frac{1}{2}$ " \times $\frac{1}{2}$ " Double Angle Strips by $1\frac{1}{2}$ " Strips. Two 3" Screwed Rods passed through the centre holes of the $1\frac{1}{2}$ " Strips are screwed into the boss of a 1" Pulley 6, which holds a 5" Rod.

This Rod is joined to the pendulum at its lower end by a Rod and Strip Connector. The pendulum consists of three $12\frac{1}{2}$ " Strips and a $5\frac{1}{2}$ " Strip bolted end to end, and is weighted at the bottom by two $2\frac{1}{2}$ " Semi-Circular Plates and four $2\frac{1}{2}$ " small radius Curved Strips. An extra weight is added in the form of two Flanged Sector Plates, to the inner sides of which six $5\frac{1}{2}$ " Strips and eight $2\frac{1}{2}$ " Strips are bolted. The second pendulum is made by fastening two Road Wheels and two 3" Pulleys on a $3\frac{1}{2}$ " Rod, and attaching this unit to the lower end of the main pendulum by a length of Cord.

The designs are drawn on sheets of paper pinned down on the Table, Part No. 107, which is of wood and is 6 in. square. A Bush Wheel carrying a 5" Rod in its boss is screwed to its underside, and the 5" Rod is joined by a Rod Connector to the upper end of the 5" Rod held in Pulley 6. If desired the Hinged Flat Plate included in the Outfit can be used as a table by fastening it to the Bush Wheel by two Double Brackets. It is not as steady as the wooden Table, however, and does not produce such good results. The paper used should be of good quality and have an even surface. Rough paper and also paper with a highly finished surface should not be used, as it absorbs the ink.

The support for the pen arm consists of two compound strips 10, each comprising two $5\frac{1}{2}$ " Strips overlapping four holes, which are

upper ends of the forward pair are connected by a $5\frac{1}{2}$ " \times $2\frac{1}{2}$ " Flanged Plate 1, and those of the rear pair by Angle Brackets and a $5\frac{1}{2}$ " Strip.

Two $12\frac{1}{2}$ " Strips are also bolted between the shorter flanges of Plate 1 and the rear $2\frac{1}{2}$ " Strips. Each side of the base is filled in by two $5\frac{1}{2}$ " \times $2\frac{1}{2}$ " Flexible Plates and one $2\frac{1}{2}$ " \times $2\frac{1}{2}$ " Flexible Plate, which are bolted between the $12\frac{1}{2}$ " Strips and Angle Girders. The top of the base consists of two $4\frac{1}{2}$ " \times $2\frac{1}{2}$ " and two $2\frac{1}{2}$ " \times $2\frac{1}{2}$ " Flexible Plates, together with one $5\frac{1}{2}$ " \times $1\frac{1}{2}$ " Flexible Plate. These are arranged as shown in the illustration and supported at the sides by Angle Brackets.

secured to the Girders 2. The Strips 10 are joined at their upper ends by Double Angle Strip 12, the bolts holding also two $12\frac{1}{2}$ " Strips 9. The lower ends of the $12\frac{1}{2}$ " Strips are fastened by a further $2\frac{1}{2}$ " \times $\frac{1}{2}$ " Double Angle Strip to the base of the model. The pen arm is a $12\frac{1}{2}$ " Strip and is pivotally attached, by a lock-nutted bolt in the eleventh hole from its forward end, to a Trunnion that is bolted underneath the Double Angle Strip 12. A second Trunnion is added to balance the first. For the pen a piece of glass tubing $\frac{1}{4}$ " in diameter and 6" in length is used. This is held with its centre in a gas flame, rotating it to give even heating, until the glass is soft, and its ends are then drawn steadily apart until only a very thin portion is left in the centre. The glass is then cooled and snapped at the tapered portion. If this is done carefully, two short lengths of tubing, each with a very fine hole at one end, will be obtained. These can be loaded, one with red ink and the other with black ink, so that designs in two colours can be obtained. If no glass tubing is available, a fountain pen can be substituted.

The pen holder is formed by a Double Bent Strip 11, one end of which is bolted to the pen arm. The other end of the Double Bent Strip is prevented from springing outward by a Flat Bracket, which is positioned as shown in Fig. 5. The Double Bent Strip is provided with a lock-nutted $\frac{1}{2}$ " Bolt in its centre hole to grip the pen.

The pressure of the pen on the paper is adjusted by a balance weight, which is moved along the arm until the pen just rests lightly on the paper. The weight consists of two $\frac{3}{4}$ " Discs clamped by a bolt to the $12\frac{1}{2}$ " Strip, but this is not heavy enough if a fountain pen is substituted for the glass pen. In this case two 1" Pulleys fastened on a Rod passed through a hole in the $12\frac{1}{2}$ " Strip should be used.

Of the two designs illustrated on this page the one shown in Fig. 3 was made using a single pendulum, and superimposing three circular patterns one on top of the other to give a fine watered-silk effect. The design shown in Fig. 4 was made using a double pendulum, and by varying the movement of the two pendulums in relation to one another, it is possible to produce many other attractive patterns. Very interesting effects can also be obtained by superimposing a design produced by a double pendulum upon one produced by a single pendulum.

Patterns in which the lines are closer together can be traced by adding extra weights to the pendulums, which then also swing more steadily. Another way of introducing variety into the designs that are produced by the harmonograph is to vary the weights on the two pendulums, increasing the load on one and slightly decreasing that on the other.

Parts required to build model harmonograph: 9 of No. 1; 14 of No. 2; 12 of No. 5; 2 of No. 6a; 4 of No. 8; 3 of No. 10; 9 of No. 12; 2 of No. 15; 2 of No. 19b; 1 of No. 24; 91 of No. 37a; 85 of No. 37b; 14 of No. 38; 1 of No. 45; 1 of No. 52; 2 of No. 54a; 2 of No. 80c; 4 of No. 90a; 2 of No. 111a; 6 of No. 111c; 2 of No. 125; 2 of No. 126; 2 of No. 126a; 2 of No. 187; 1 of No. 188; 1 of No. 189; 4 of No. 190; 2 of No. 191; 4 of No. 192; 1 of No. 212; 1 of No. 213; 2 of No. 214; 2 of No. 217b.

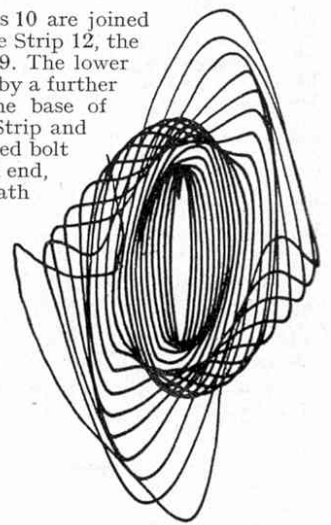


Fig. 4. A more intricate harmonograph design. A compound pendulum was used.

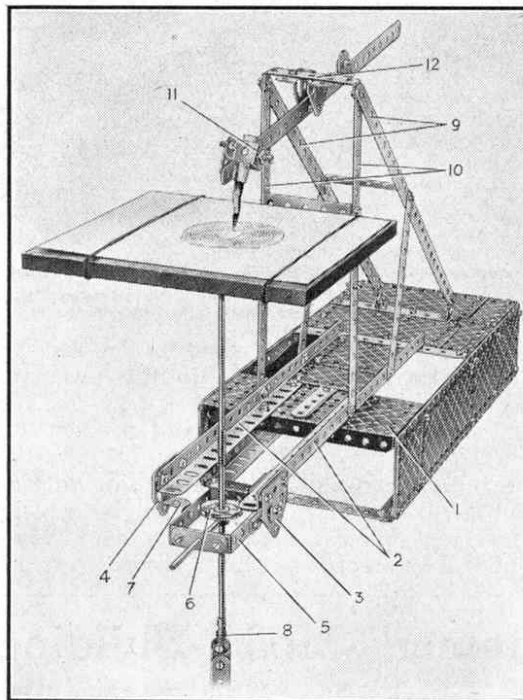


Fig. 5. This No. 5 Outfit Model of an harmonograph is easy to build if the instructions on this page are followed.

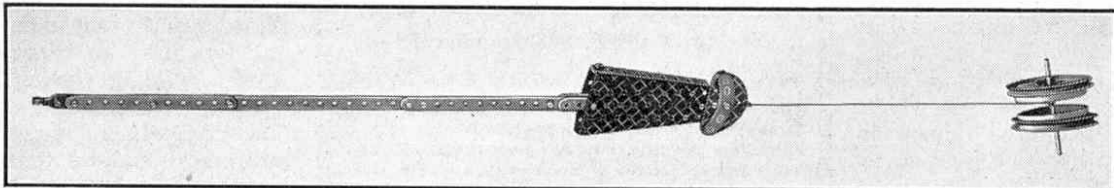


Fig. 6. The compound pendulum that is fitted to the harmonograph shown above.