A NEW MECCANO MODEL

Model No. 603
PORTABLE CRANE

DURING the past few months we have devoted a considerable amount of space in the "*M.M.*" to giant cranes of various types. These monsters are so impressive that there is a danger of overlooking altogether the smaller, but equally useful, members of the crane family. The ordinary type of portable crane, for instance, illustrated in the model reproduced on this page, is not capable of lifting the huge loads that are handled so easily by its big brothers, but none the less it plays a very prominent part in industry, and to a large extent its value is actually due to its small size. It is also used on the platforms of railway stations, where it serves many useful purposes.

Advantages of Portable Cranes

Portable cranes are specially adapted for use in machine shops, where as a rule there is very little room to spare. The handy size of these cranes enables them to be manipulated with ease, where a larger crane would not only be useless, but indeed very much in the way. By means of a portable crane, a heavy casting may be brought close up to a particular machine and held suspended until the necessary adjustments are made to bring it into position for the machine to commence operation.

The usefulness of this type of crane, however, is by no means confined to machine shops. Wherever comparatively small but heavy materials have to be lifted from one place to another, the use of such a crane not only avoids all danger of workmen injuring themselves as the result of overstrain through trying to lift weights too great for their strength, but also it effects a great reduction in handling costs and speeds up the work to a very marked extent.

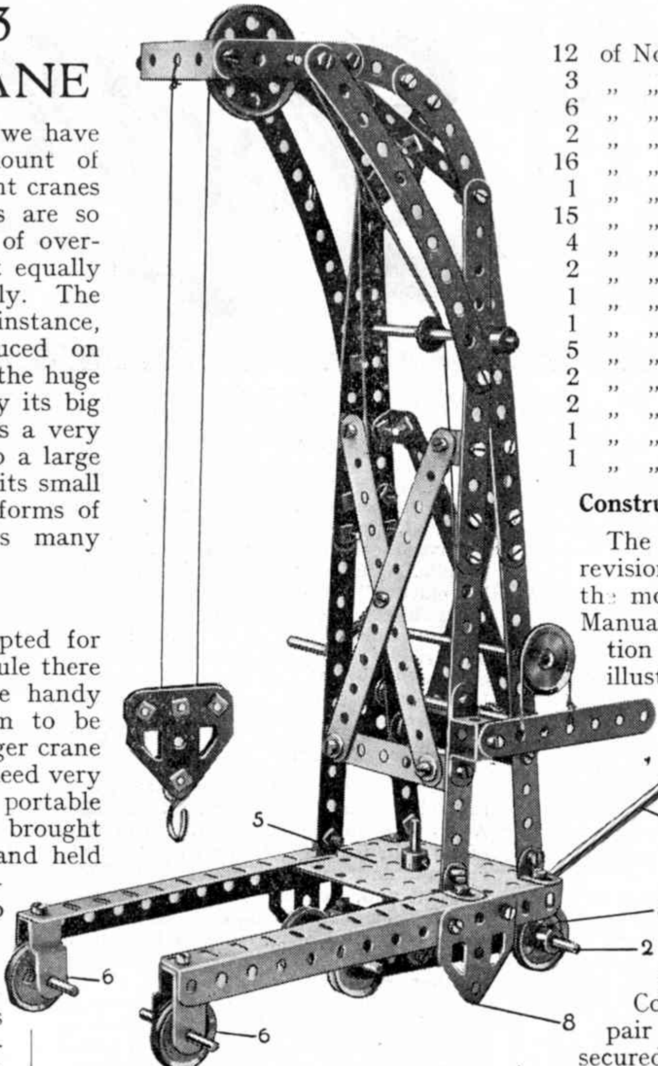
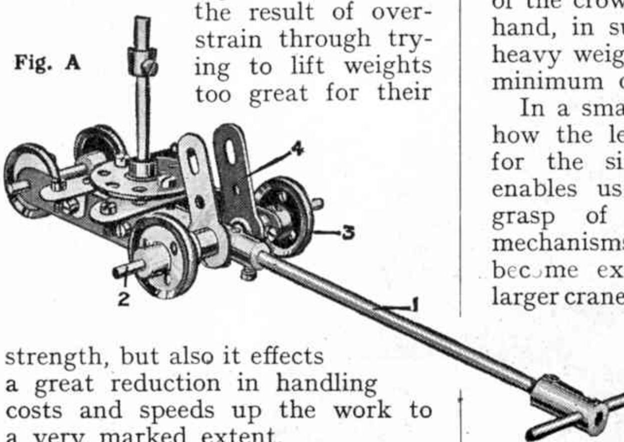


Fig. A



Cranes are Levers

Small cranes are interesting also from another point of view. Last month, in describing our model of a radial travelling crane, we referred to the fact that a crane really represents the scientific application of the crowbar used for levering by hand, in such a way as to enable heavy weights to be lifted with the minimum of effort.

In a small crane it is easy to see how the lever principle is utilised, for the simplicity of the design enables us to obtain a thorough grasp of the various essential mechanisms. These movements become extremely complicated in larger cranes, in which a greater range is required. If the working principle of a small hand crane is once thoroughly understood, there is really very little difficulty in understanding the working of even the most complicated steam or electrically-driven giants.

Parts required:

12	of No. 2	1	of No. 27A
3	,, ,, 3	74	,, ,, 37
6	,, ,, 5	16	,, ,, 38
2	,, ,, 9	1	,, ,, 40
16	,, ,, 12	2	,, ,, 44
1	,, ,, 15	1	,, ,, 45
15	,, ,, 16	1	,, ,, 48
4	,, ,, 17	2	,, ,, 48A
2	,, ,, 18A	1	,, ,, 53
1	,, ,, 19	1	,, ,, 57
1	,, ,, 21	10	,, ,, 59
5	,, ,, 22	2	,, ,, 62
2	,, ,, 22A	2	,, ,, 63
2	,, ,, 23	2	,, ,, 89
1	,, ,, 24	2	,, ,, 90
1	,, ,, 26	4	,, ,, 126A

Constructing the Model

The model illustrated is a revision and an improvement on the model shown in the Complete Manual. Details of its construction are quite clear from the illustrations on this page.

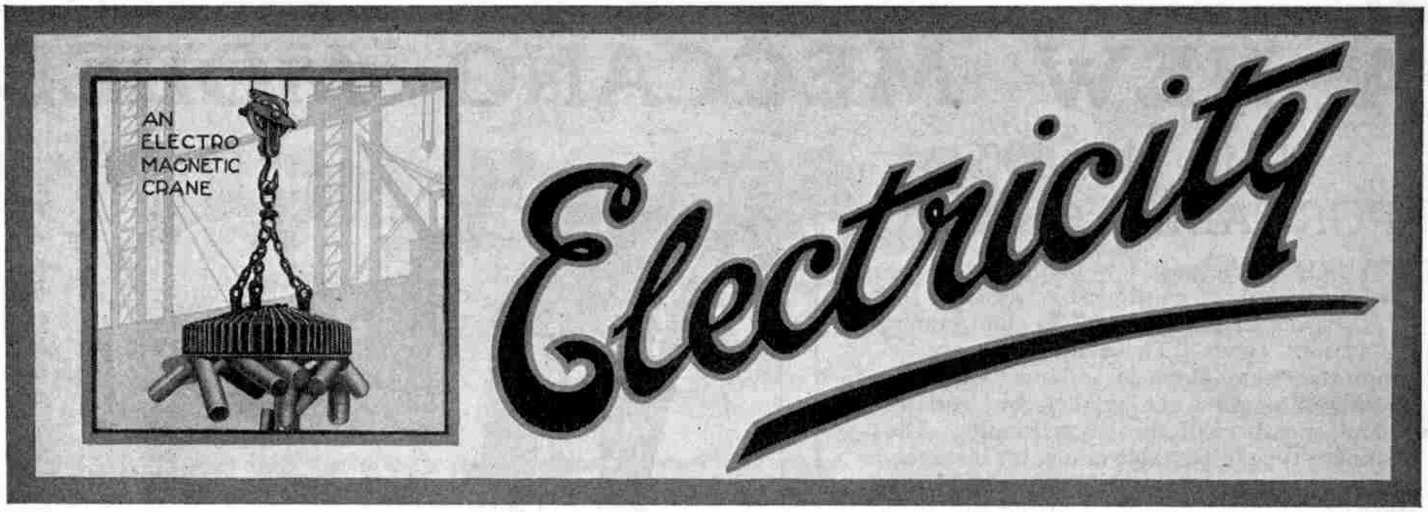
The Crane is moved about by depressing the handle (1) fixed by a Coupling to an Axle Rod (2) carrying 1" Loose Pulley Wheels (3), which are secured in position by Collars and set screws. A pair of Cranks (4, Fig. A) are secured to the Axle Rod (2) and are so arranged that when the handle is depressed they bear against the under-face of the small Rectangular Plate (5), thus lifting the Crane clear of the ground so that it runs freely on the Pulley Wheels (3 and 6).

When the handle (1) is depressed, the tips of the Cranks (4) engage an Angle Bracket to prevent the Spindle from coming completely away from engagement with the Plate (5).

When the Crane is brought to rest, its weight forces down the Cranks (4) and this raises the handle (1) so that the Flat Trunnions (8) together with the front wheels (6) then support the Crane.

NEXT MONTH:—

STONE-SAWING MACHINE



VI. DYNAMOS AND ELECTRIC MOTORS

IN the year 1831 Michael Faraday, one of the greatest of British scientists, discovered that a current of electricity could be induced in a coil of wire by moving the coil towards or away from a magnet, or by moving a magnet towards or away from the coil.

For example, if we connect the ends of a coil of insulated wire to a galvanometer and move a bar-magnet in and out of the coil, the galvanometer shows us that a current is induced in the coil when the magnet is inserted, and again when it is withdrawn. Last month we saw that a magnet is surrounded by lines of magnetic force, and Faraday found that a current was induced when the lines of force were cut across. He also found that the two currents produced in the experiment we have just described flowed in opposite directions.

This discovery formed the basis of the first dynamo, or machine for generating electric current. The dynamo is well-named, for the word comes from the Greek *dynamis*, meaning "force."

The First Dynamo

Faraday's first dynamo consisted of a copper disc rotating between the poles of a horse-shoe magnet so as to cut the lines of force at each revolution. The current flowed from shaft to rim, or *vice versa*, according to the direction of rotation, and was conducted from the machine by means of two wires having spring contacts, one pressing against the shaft and the other against the disc. This arrangement, however, did not prove satisfactory, and Faraday soon substituted rotating coils of wire for the disc. Gradually the dynamo was developed into an efficient machine, one of the greatest advances being the abandonment of permanent magnets in favour of electro-magnets, which gave a much more powerful field of magnetic force.

Fig. 1 is a diagram of a dynamo in its very simplest form. Between the poles of the magnet (marked N and S) revolves a coil of wire (A^1 A^2) mounted on a spindle. This revolving coil is called the "armature." The two insulated rings (R R) are each connected to one end of the coil, and the brushes (B B) made of copper or carbon, each press on one ring. The current is conducted away from these brushes into the main circuit, where we will suppose it to be used to light a lamp.

Alternating Current

Let us suppose the armature to be revolving in a clockwise direction. Then A^1 is descending and cutting the lines of force in front of the north pole of the magnet, and so a current is induced in the coil and, of course, also in the main circuit. Passing on its way, A^1 reaches the lowest point of its circle and begins to rise in front of the south pole, inducing another current, but this time in the opposite direction. The general result is to produce a current that reverses its direction every half-revolution, and such a current is called an "alternating current."

In a dynamo such as our diagram represents there are only two magnetic poles, and the current flows backward and forward once every revolution. By using a number of magnets, however, arranged so that the coil passes the poles of each, successively, the current may be made to flow backward and forward several times. One complete flow of the current backward and forward is called a "period," and the number of periods per second is the "periodicity" or "frequency" of the current. A dynamo having one coil or set of coils gives what is called "single-phase" current, that is a current having one wave that flows backward and forward. If the dynamo has two distinct sets of coils a "two-phase" current is generated, in which there are two separate waves, one rising as the other falls. Similarly, by employing more sets of coils, "three-phase" or "polyphase" currents may be produced.

Continuous Current

Alternating current is unsuitable for certain purposes, and by making a small change in the dynamo this current may be converted into "direct" or "continuous" current, which does not reverse its direction (see Fig. 2).

The difference between a direct and an alternating current dynamo lies in the rings. In place of the two rings in Fig. 1 there is a single ring divided into two parts, each half being connected to one end of the revolving coil. Each brush thus remains on one half of the ring for half a revolution and then passes over on to the other half. Thus, during one half-revolution the current is flowing from brush B^1 in the direction of the lamp. During the next half-revolution the current will reverse its direction, but as brush B^1 has now passed over to the other half of the ring, the current is still leaving by it.

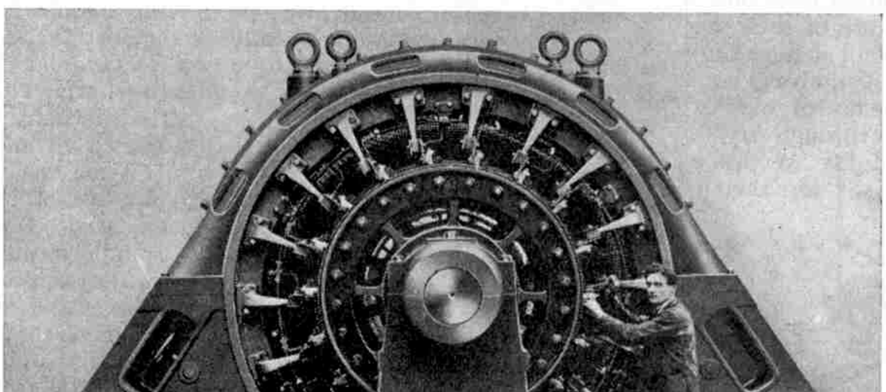


Photo courtesy of] [*Messrs. Mather & Platt Ltd.*

End view of large dynamo for generating the very heavy currents used in the electrical production of chemicals

A moment's thought, therefore, will show that the current must always flow in the same direction in the main circuit. This arrangement for converting an alternating current into a continuous current is called a "commutator," from the Latin *commuto* meaning "I exchange."

The dynamos used in actual practice are much more complicated than the simple device we have just described. Each one has a set of electro-magnets, and the armature consists of many coils of wire mounted on a core of iron, which has the effect of concentrating the lines of magnetic force. In small dynamos the armature usually revolves, but in larger ones the electro - magnets revolve.

Current for the Electro-Magnets

The electro-magnets in a dynamo, of course, require a current to be flowing through their windings before they acquire magnetic powers. A continuous current dynamo starting for the first time has its electro-magnets supplied with current from an outside source, but afterwards the dynamo will always be able to start again because the magnet cores retain sufficient magnetism to set up a weak magnetic field. The repeated cutting of the magnetic lines of force sets up a weak current, which, acting upon the magnets, gradually brings them up to full strength. Once a dynamo is generating current it continues to feed its magnets by sending through them either the whole or part of its current.

What has just been said applies only to continuous current dynamos. An alternating current dynamo cannot feed its own magnets, and these are supplied with current from a separate continuous current dynamo, which may be of quite small size.

As dynamos require the application of mechanical power to revolve their moving parts, they are therefore machines for converting mechanical energy into electrical energy. If, on the other hand, we supply a dynamo with electric current instead of mechanical power, we find that its armature begins to revolve. The machine is now no longer a dynamo but has become an electric motor—in other words, an electric motor is simply a dynamo reversed.

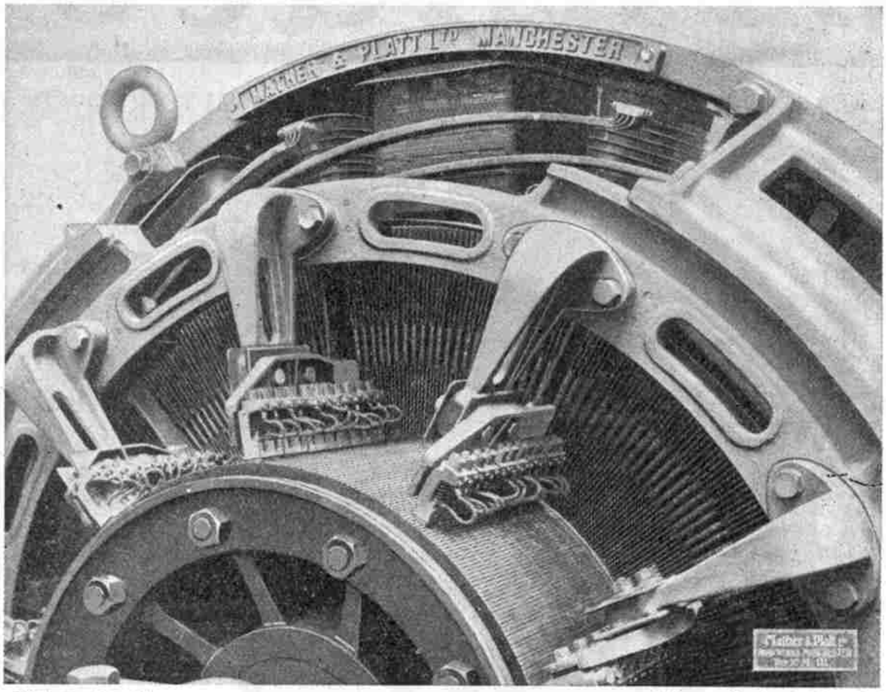


Photo courtesy of] [*Messrs. Mather & Platt Ltd.*

Close-up view of large dynamo, showing the carbon brushes pressing on the copper segments of the commutator. The poles and their windings are also seen, at the top of the photograph.

The Electric Motor

Bearing in mind what we have learned about the principle on which the dynamo works, it is quite easy to understand the operation of an electric motor. Suppose, for instance, we wish to use the dynamo illustrated in Fig. 2 as a motor. First of all we take away the lamp and substitute for it a second continuous current dynamo. We know from the article on Magnetism in last month's "*M.M.*" that when a current is sent through a coil of wire the coil becomes a magnet, having a north pole and a south pole. In the present case the coil in our dynamo becomes a magnet immediately the current from the second dynamo is switched on, and the attraction between its poles and the opposite poles of the magnet causes it to make half a revolution. At this stage the commutator reverses the current, and consequently also the polarity of the coil. There is now repulsion where before there was attraction, and the coil makes another half-revolution. This process continues until the armature attains a very high speed. The operation of an electric motor is thus entirely based on the attraction of unlike and the repulsion of like poles.

In general construction there is little difference between a dynamo and a motor, but there are differences in detail that adapt each to its own particular work. By making certain alterations in their construction, electric motors may be run with alternating current.

A Profitable Accident

The possibility of reversing a dynamo and using it as a motor was known probably as early as 1838, but it was not until 1873 that the enormous industrial value of this reversibility was realised. In that year a great industrial exhibition was held at Vienna. One day a machinery attendant at this exhibition happened to connect two cables to a dynamo that was standing idle, and to his great astonishment the machine began to revolve at a great speed. Investigation showed that the cables led to another dynamo that was running at the time, and that the current supplied to the first dynamo had converted it into a motor. This incident drew general attention to the great possibilities of the combination of the dynamo and the electric motor.

To-day the electric motor is one of the most wide-spread of all machines. If we first instal a powerful dynamo and a suitable engine to drive it, we can place electric motors wherever we like, driving them by current supplied through a connecting cable. In large factories or workshops motors may be placed close to the machines they are required to drive, thus doing away with elaborate systems of shafting and belts. More than this, electric motors may be used for purposes for which no other mechanism will serve. We find these motors at work driving the domestic sewing machine, the dentist's drill—the mere thought of which makes us shudder—and ventilating fans of all sizes and in every conceivable position. It would be very difficult to think of any other means by which such machines could be driven satisfactorily.

Other points in favour of the electric motor are its compactness, its comparatively silent running and its ability to work for long periods with practically no attention.

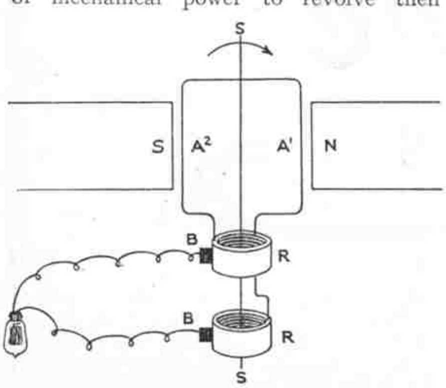


Fig. 1. Dynamo producing Alternating Current

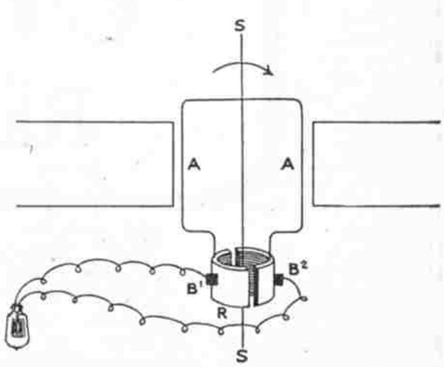


Fig. 2. Dynamo producing Continuous Current