THE TORQUE CONVERTER

REMARKABLE INVENTION REPRODUCED IN MECCANO

IT has always been claimed for Meccano that any movement known in mechanics may be reproduced in model form. A striking vindication of this claim is furnished by the model of the Constantinesco Torque Converter. This model clearly demonstrates the working principle of this new device, which, incidentally, is stated to be based on principles understood only by those having a knowledge of advanced mechanics and mathematics. The fact that it is possible to reproduce in Meccano so highly technical a piece of apparatus is in itself a striking tribute to the Meccano system.

An Invention of Promise

The Torque Converter created a considerable sensation in engineering circles a short time ago and was briefly described in our February issue, in our interview with Mr. George Constantinesco, the inventor. We believe that there is a great future before this remarkable invention, and for some time past our model-building department has been at work endeavouring to evolve a model of the Converter in Meccano. After some considerable experiment we have succeeded in perfecting a model that, although not built on the same lines as the actual Constantinesco Converter, admirably fulfils the purpose of demonstrating the remarkable principle on which the original Converter is based.

This model will be of general interest to readers of the "*M.M.*" More especially will it interest those who are contemplating building the model of the Meccano Chassis, and who are desirous of eliminating the standard gear-box and clutch and incorporating the latest invention instead. Those of our readers who have already constructed the Chassis may build the Torque Converter into their existing model without difficulty.

Motor Cars Without Gears

We may here explain that there are two main ideas behind the Constantinesco invention. One is that it makes possible the construction of motor cars without clutches or gears, and the other that it fulfils the purpose of an infinitely variable gear that automatically adjusts itself to the conditions imposed by the nature of the gradient on which the car is travelling and by the load on the car. Cars fitted with the device are therefore controlled simply by the throttle, which governs the engine speed. The inventor recently declared that he believes his Torque Converter will revolutionise all forms of transport, for it is not confined to the motor car alone, but may be applied with equal success to locomotives, aeroplanes, ploughs, tractors and indeed all similar forms of vehicles.

One of the great advantages of such an invention is that vehicles will require engines of only about half the size of the engines used to-day. Not only will an economy in petrol and oil consumption be effected, but the complicated mechanism of engines with four, six, or eight cylinders will be eliminated and the costly material, machinery and labour used in their manufacture will no longer be necessary. In future an engine with a single cylinder, and perhaps a cheap two-cycle engine, may be sufficient to drive almost any vehicle.

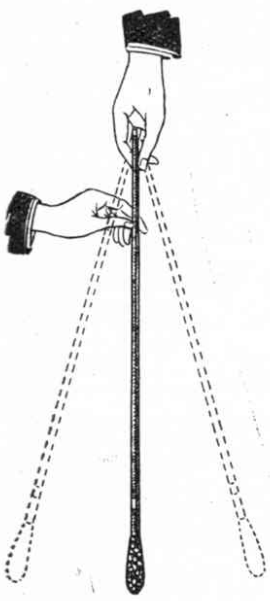

Fig. 2

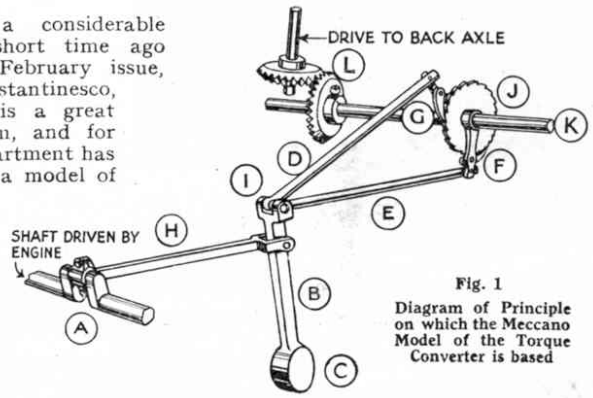

Fig. 1
Diagram of Principle on which the Meccano Model of the Torque Converter is based

Principle of Our Model

In an interview, Mr. Constantinesco informed us that without falling back on advanced mathematics and highly technical engineering knowledge it was impossible for him to explain how he obtained his results in such a manner that the non-technical reader could understand. If the inventor himself found it impossible to give this information, our readers will realise that we are confronted by a task of some difficulty in ourselves endeavouring to explain the principle of the Torque Converter! We propose, therefore, to simplify matters by confining our explanation to the working of the Meccano model of the Converter. We wish, however, to again emphasise the fact that this model is not a replica of the actual device—it is a model by which the working principle of the Converter is demonstrated.

A diagram of the working of the model is given in Fig. 1. The crank (A) driven by the engine, is connected to a lever (B), to the lower end of which is fixed a heavy weight (C) forming a pendulum. The other end of the lever (B) is connected to two rods (D and E) carrying pawls (F and G) which bear on a ratchet wheel (J). In this manner the torque, or twisting effect, is delivered to the rod (K) and through it by bevel gears and shaft (L) to the differential on the back axle (not shown in the diagram). No matter whether the rods (D and E) be pushed towards the ratchet or pulled away from it, the turning motion imparted by the pawls to the rod (K) is always constant in direction.

A Simple Analogy

Our readers will obtain a clearer idea of the working principle of the Torque Converter by taking a walking stick with a heavy knob and suspending it with the knob downwards, as shown in Fig. 2. With the left hand take hold of the stick a few inches below the tip and swing it gently to and fro. Notice that it swings evenly and pivots in the thumb and finger of the right hand.

As long as the impulses given to the stick by the left hand are not excessive, the swinging of the stick will be easy and pendulum-like. If the frequency of the impulses be increased, however, a different state is set up, as is evidenced by an increase in pressure conveyed to the right hand acting as a pivot for the stick. As the impulses increase in frequency, a change in equilibrium takes place. Instead of the stick tending to pivot between the finger and thumb of the right hand, the pivot shifts down the stick, until at last—given a sufficiently high frequency—it moves to the opposite end of the stick and the heavy knob at the end of the stick becomes the pivotal point, while the pendulum-like movements are now carried out by the hand in which the stick originally pivoted.

An Irresistible Force

This change is made manifest in a remarkable manner to the person holding the stick. As the impulses increase in intensity, the hand holding the tip of the stick finds itself compelled to yield to an irresistible increasing pressure. It

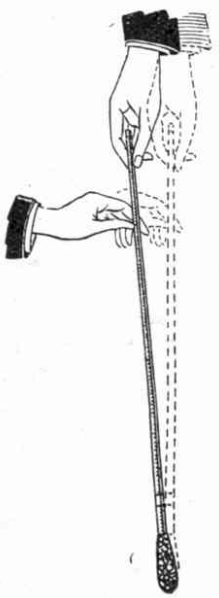

Fig. 3

is moved backwards and forwards by a powerful superior force, oscillating this way and that, with a degree that depends entirely on the frequency of the impulses received by the stick.

The original conditions have thus become entirely reversed. Instead of the knob oscillating to and fro and the right hand remaining at rest, with the tip of the stick pivoting in the finger and thumb, the knob ceases to oscillate and becomes the point on which both stick and supporting hand now pivot. The oscillations originally performed by the knob are transferred to the other end of the stick and are now performed by the right hand. Expressed in engineering language, it would be said that the fulcrum has receded.

It is important to realise that the pivotal point does not change suddenly from the tip of the stick to the knob, but moves slowly from one to the other, according to the frequency of the impulses received by the stick. If these are not sufficient the fulcrum may never reach the knob. If the frequency varies, the position of the fulcrum will vary also every instant, its location alternating momentarily between the tip and the knob. If the oscillations decrease in intensity beyond a certain point, the pivotal point returns to the tip and the original order of things is restored.

This is the principle on which the Constantinesco Torque Converter is based, and the Meccano model works on the same principle. In it the hand moving the stick is replaced by the connecting rod (H Fig. 1) coupled to a crank (A). The place of the hand forming the pivot is taken by the bolt (I) which carries the rods (D and E) in our diagram. Impulses from the crank are transferred to the pawls (F and G), which in turn pass on the impulses—now converted into a turning movement—to the driving shaft.

"How It Works"

When the engine is running slowly only a slight swinging movement is given to the lever carrying the weight, which movement is not sufficient to move the pawls on the gear wheels. As the speed of the engine increases, however, the weight is compelled to swing faster and faster, imposing an increasingly heavy force or load upon the pawls. At length this load becomes so great that the resistance of the back axle is overcome; the pawls move the gear wheel and the driving shaft, and the car moves slowly forward, to gather speed subsequently.

The conditions of our analogy in Fig. 2 are simulated when the weight (C Fig. 1) swings without imparting any movement to the shaft, through the ratchets. On the other hand, when the engine is running rapidly the fulcrum recedes and the weight (C) becomes the pivot, as it cannot respond to the rapidly-repeated impulses of the rod (H) with sufficient rapidity.

The condition illustrated in Fig. 3 arises when the resistance caused by starting up the car is overcome, and when the lever pivots on the weight (C). In these circumstances the drive from the engine is practically a direct drive to the back axle.

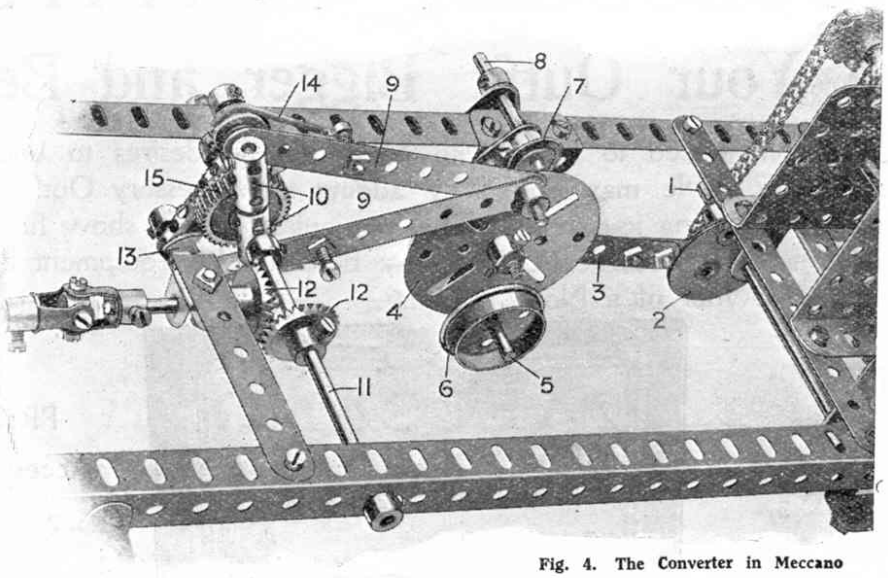

Fig. 4. The Converter in Meccano

Building the Meccano Model

The Meccano model of the Torque Converter may be constructed as follows. The rod 1 (Fig. 4) is rotated by a sprocket chain from the electric motor fitted to the chassis. This rod carries a triple throw eccentric (2) which is connected by a 3" strip (3) to the centre of a face plate (4). A short rod (5) passes through the lower hole of the face plate and carries two flanged wheels (6) which act as the pendulum weight. The rod (5) and the weights (6) are suspended by two cranks (7) from the short pivotal rod (8) mounted on the main member of the frame as shown. Two 4½" strips (9) are connected to the top hole of the face plate (4) and their other ends are connected to elements each formed by two couplings (10) secured on short rods, the couplings rocking loosely on the driven rod (11) from which the drive to the differential is conveyed through the bevels (12). Two pawls (13) are mounted on short rods secured in the outer holes of the coupling (shown more clearly in Fig. 5), these pawls, being controlled by short tension springs (14) so that they are kept in contact with a 1" gear wheel (15). When moving in one direction they trail idly over this gear wheel, but when moving in the other direction, they drive the gear wheel (15) and consequently the rod (11) to which the wheel is secured.

Theory and Operation of the Model

Technically, the theory of the mechanism is as follows:—When the motor is running slowly the pendulum tends to oscillate about the rod (8) and little, if any, movement is imparted to the pawls; this corresponds to a low power. Should the resistance to movement in the rear axle be great, however, the fulcrum recedes towards the weight (5). Owing to the inertia or reluctance to vibrate quickly the face plate then pivots about the weight and a greater force is exerted on the strips (9) to drive the shaft (10). In this way the gear accommodates itself automatically to the work to be done.

In operation the rod (1) is rotated by the motor, the eccentric (2) tends to drive the strips (9) to and fro as the weight oscillates. This to and fro movement of the strips (9) results in a corresponding movement of the pawls. As the pawls are mounted to lie in opposite directions round the gear wheel (15) the latter is driven in one constant direction in a series of pulsations.

Remarkable Power Obtained

An interesting detail is the remarkable increase in power obtainable even from so small a form of Converter as that adopted in the Meccano model. This is demonstrated by jacking up the rear axle to allow the driving wheels to freely rotate, when it has been found impossible to prevent the revolution of the driving shaft when gripped with the finger and thumb below the universal joint. When it is remembered that the driving force is obtained only from a small electric motor, driven by a 4-volt accumulator, the remarkable power imparted by the Torque Converter becomes apparent. By holding the shaft with greater or less degree of pressure the Converter may be made to demonstrate its automatic adjustment to a varying load or resistance in a remarkably effective manner.

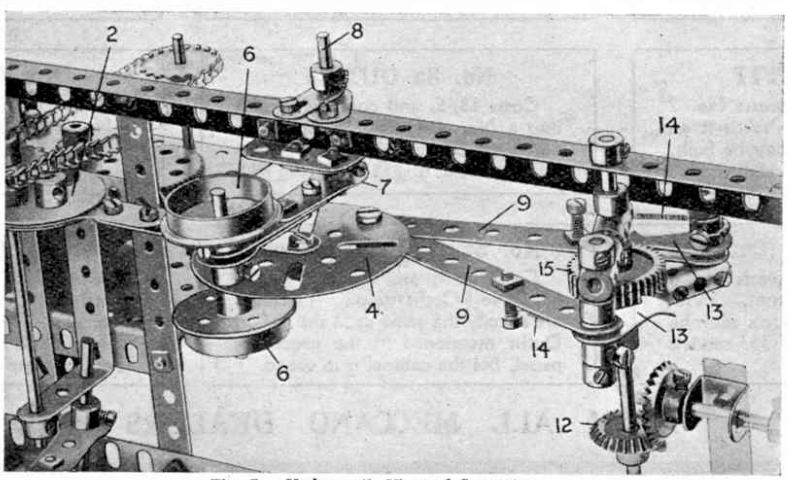

Fig. 5, Underneath View of Converter

Automatic "Gear" Adjustment

The automatic adjustment of the gear to the load and to the gradient is one of the most interesting

(Continued on page 107)

How to Run a Meccano Club

by the
Guild Secretary

Having found a Leader for the club, the next thing is to procure a suitable room. This should be as comfortable as possible, furnished with tables or benches, brightly lighted, and suitably warmed in cold weather. The choice of a room is of importance, for the success of the club will often depend upon it. If the room is cold and cheerless it will damp the ardour of even the most enthusiastic members.

The Club Room

If any difficulty is experienced in obtaining a room, and if there is no boys' club in the district, you might make application for a room belonging to a Church, Chapel, or Institute. A schoolroom would be quite suitable if one is available. It is surprising how kind people are when they know what is wanted and why it is required. A polite request and a clear statement of the facts of the case will seldom fail to secure the use of a suitable room, if it is at all possible. Even if you do not succeed at the first attempt you should not give up trying. Once it is realised for what fine objects the Meccano Guild stands, and the good it will do in the district, a room should soon be forthcoming.

If you have any difficulty in the choice of a Leader or in obtaining a suitable room, you should write to me. I am in touch with many influential gentlemen in all parts of the country who may be able to find someone willing to act as Leader. At any rate, I shall be able to send you the names and addresses of Guild members in your district, and by visiting or writing to them you will gain new members, some of whom may be able to suggest a suitable Leader, or where a room may be obtained. Do not forget that in the Guild Headquarters staff every member has real helpers and friends.

One other point. Whilst I am always ready to give a hand in any difficulty, I want you to realise that you must only appeal to me as a last resource. The successful working of a club depends upon the Guild members on the spot. Unless they are prepared to work hard, both in the formation of the club and afterwards, no club will be successful. "What is worth doing at all, is worth doing well" is an old saying that continues to hold good in regard to many things, and in regard to running a Meccano Club in particular. If the members are keen and enthusiastic they will nearly always be able to arrange for both a Club Leader and a club room without having to seek my assistance.

Having decided the above-mentioned details, the next thing to do is to draw up the club rules. Although all are agreed that rules relating to the conduct of members at meetings are essential, it is not suggested that rigid discipline be exercised. Members must, however, be made to realise that disorder and rowdyism will find no place in a Meccano Club. Ordinary conversation and freedom to move about at model building meetings should generally be permitted, for the members' enthusiasm will soon evaporate if the club is run on the lines of a school-room. Let every member enter into the spirit of the club, and remember that each is able to contribute materially to the others' happiness by gentlemanly behaviour. It should be made clear, too, that all movement and noise should cease if the Leader or Secretary wishes to address the members. Respect and obedience to the officers of the club must be given by all members.

Rules for Meetings

Sometimes it may be difficult for members to obey some ruling—they may think to themselves "Who is X that he should say 'do this' or 'do that'?" Remember then that you are obeying him not as the individual, but by virtue of the office he holds, to which office he has been elected by all the members. In the Army, men may sometimes dislike their officers, but they remember that they are the representatives of their King and Emperor, whom they have sworn to serve faithfully and well, and because of this they sink personalities and cheerfully carry out the officers' orders.

Obey the Club Officials

It is impossible to lay down hard and fast rules for the guidance of a club. This is only possible to those who are on the spot and who are consequently familiar with local conditions. The requirements of each club differ from all others. These differences are principally those of environment and the type of boy of which the club consists. Each club, therefore, must establish itself, draw up its own rules, and run its own affairs in the manner that is considered most suitable.

(To be continued)

Meccano Club Leaders

No. 12. Mr. S. R. CARLILE

Founded in December, 1921, the Parkstone Congregational Meccano Club largely owes its present satisfactory position to the enthusiasm and energy of its Leader, Mr. S. R. Carlile. Commencing with a membership of 18, the Club made such splendid progress that affiliation with the Guild was granted in February of the year following its inception. Since that time the Club has never looked back, and its work has been most successful.

Mr. Carlile is one of the rapidly-increasing number of Club Leaders who believe in keeping their members together during the summer months. Some time ago he introduced a Gymnastic and Physical Drill Section, which have proved very popular. In addition to the usual club activities the Parkstone M.C. also runs a Concert Party and (in season) Football Team. Wireless is an important and very popular item in the club programmes.

Club Notes—*(cont. from page 106)*

Wynberg (S. Africa) M.C.—A meeting was recently held to welcome the South African agent of Meccano Ltd., on his visit to Capetown. The attendance was the highest on record, and there were as many adults present as Guild Members. During the proceedings, the Chairman, Mr. Mansergh, C.B.E., made a very impressive speech which was afterwards reported in the Press, together with an account of the meeting. An inter-club model contest was also recently held between this club and the Observatory M.C. which was voted a complete success by members of both clubs. *Secretary:* Mr. A. J. Lewis, Wynberg Park, near Cape Town, South Africa.

The Torque Converter—*(cont. from page 91)*

features of this Meccano model, and to watch it operate is a fascination that will delight everyone with engineering interests. The turning movement delivered to the back axle is in the nature of a number of impulses given by the pawls to the gear wheels. In the Meccano model these impulses vary from about twelve teeth of the gear wheels (on what is equivalent to top gear) to one or two teeth, when great power is required to overcome considerable resistance.

In Fig. 1 and in the Meccano model of the gear, we have used a ratchet composed of pawls and gear wheel. It should be pointed out that in the actual Constantinesco Torque Converter, ratchets and gear wheels are not employed for the drive. Instead a system of "uni-directional valves" is being perfected by Mr. Constantinesco, and these form the subject of a separate patent.

As mentioned at the commencement of this article, the fact that it has been possible to build this Torque Converter with Meccano is a splendid illustration of the adaptability of Meccano parts. There is no movement known to which the Meccano system may not be applied with success, and as the Torque Converter will undoubtedly be very much in evidence in engineering in the future we earnestly commend every Meccano boy to study this remarkable invention. There is no better method of understanding the working principle of the Converter than that of building this model with standard Meccano parts. The time spent will well repay every reader, and will enable him to explain the working of the Converter to his parents and friends when next it is mentioned in the newspapers.