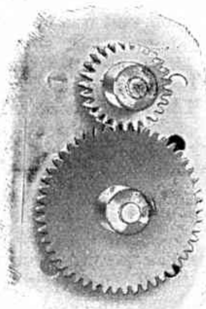
MECCANO STANDARD MECHANISMS

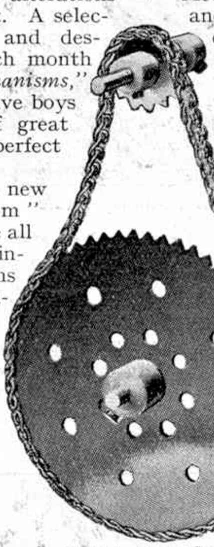
GEAR RATIOS AND BELT AND ROPE MECHANISM

NO Meccano boy is content to build only the models illustrated in the Meccano Manuals, for every boy who thinks is keen on inventing and likes to build models from his own ideas. With this in mind, and to assist boys to embody correct engineering practices in their new models, we have collected and classified a number of Meccano movements that have to a certain extent become standardised. That is to say, these movements may be applied to more than one model—in most cases without any alteration, but in some few cases with only slight alterations to the standard movement. A selection will be illustrated and described in the *"M.M."* each month as *"Meccano Standard Mechanisms,"* and we believe that inventive boys will find these articles of great assistance in helping to perfect their Meccano models.



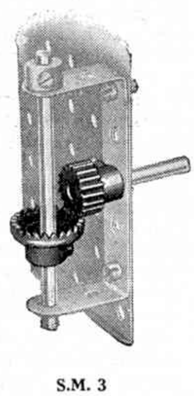
S.M. 1
¾″ Pinion and 50-tooth Gear Wheel

We are also compiling a new "Standard Mechanism" manual which will comprise all these movements, divided into thirteen different Sections and indexed so that immediate reference may be made to any particular motion that it is desired to incorporate in a model. The sections dealing with "Pulleys" and "Levers" will be amplified by the description of several interesting experiments carried out with Meccano.



S.M. 7 Chain Gear

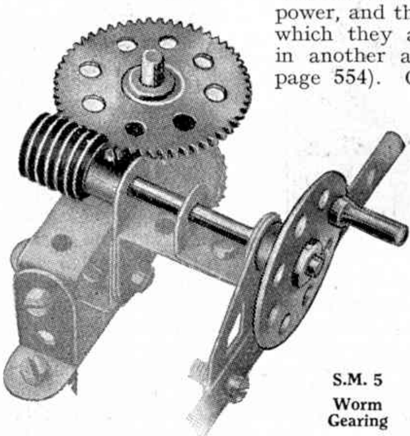
Other features will include Clutches, Reversing and Drive-changing Mechanism, Brakes and Retarding Appliances, Bearings, Screw Gear, Steering Gear, Traversing Mechanism, etc. The principles involved in these details will well repay the study of any boy interested in engineering.



S.M. 3
Contrate Gear (for shafts at right angles)

Cutting Meccano Gears

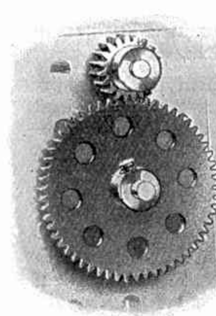
The important part played by toothed wheels in the transmission of power, and the wonderful processes by which they are made, are described in another article in this issue (see page 554). Gear Wheels are equally indispensable in Meccano engineering, and Meccano Gear Wheels are made in much the same manner as are the gears used in actual practice.



S.M. 5
Worm Gearing

We believe all Meccano boys would like to watch a "No. 26" or "27" as it passes through the various stages of manufacture. It is certainly very interesting to observe solid pieces of brass being transformed with amazing rapidity into beautifully finished Gear Wheels, destined, in all probability, to provide many years of hard service in hoisting loads or working hammers, drills, lathes, engines, clocks, and motor cars, at the bidding of some happy Meccano boy!

The first process is the cutting and shaping of the wheel from the bars of solid brass, boring out the centres, and cutting the thread to receive the set-screws. Next a number of these blanks—still quite unfamiliar in appearance to the Meccano boy—are placed face to face and inserted on a mandril in a wonderful machine-tool. Here a circular cutting tool, revolving at a high speed, passes along the row of brass discs, and in doing so cuts out a single tooth in each wheel. When the tool has reached the end of its stroke, the blanks are rotated slightly, and the tool, returning, cuts out the next tooth. This process is repeated until all the teeth are shaped.

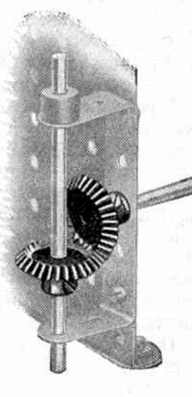


S.M. 2
½″ Pinion and 57-tooth Gear Wheel

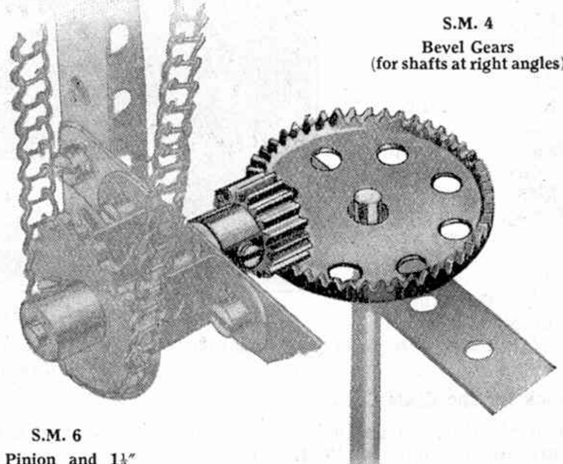
Section I. Gear Ratios

Standard Mechanism No. 1 shows the Meccano ¾″ Pinion in mesh with a 50-tooth Gear Wheel. Since the Pinion possesses 25 teeth, it is obvious that it must rotate twice to every one revolution of the Gear Wheel. Thus the speed ratio of this gear is 2 to 1.

S.M. 2 illustrates the ½″ Pinion (19 teeth) and 57-tooth Gear Wheel, giving a ratio of 3 to 1. A larger ratio is obtained from the use of a ½″ Pinion and 3½″ Gear Wheel (133 teeth), in which the Pinion must revolve seven times as fast as the Gear Wheel.



S.M. 4
Bevel Gears (for shafts at right angles)



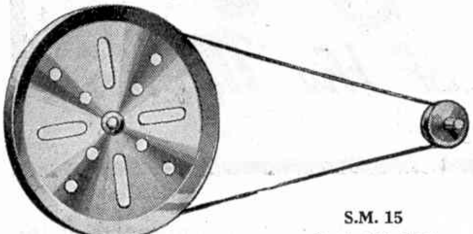
S.M. 6
½″ Pinion and 1½″ Contrate Wheel (for shafts at right angles)

Meccano Standard Mechanisms—(*continued*)

One to one ratios may be obtained by connecting two shafts by means of 1″ Gear Wheels or two $\frac{1}{2}''$ Pinions.

Either Bevel Wheels or Contrate Wheels may be employed to drive shafts placed at right-angles to one another.

The Bevel drive (S.M. 4) provides for a 1 to 1 ratio only, but varying speeds can be produced with contrate gears. S.M. 3 illustrates a $\frac{1}{2}''$ Pinion and $\frac{3}{4}''$ Contrate Wheel, giving an approximate ratio of $1\frac{1}{3}$ to 1, while S.M. 6 shows the $1\frac{1}{2}''$ Contrate Wheel driven by a $\frac{1}{2}''$ Pinion, in which the ratio is roughly $2\frac{2}{3}$ to 1. A 2 to 1 gear is provided by a $\frac{3}{4}''$ Pinion and $1\frac{1}{2}''$ Contrate Wheel.



S.M. 15
Open Belt Gear

S.M. 5 is a typical Worm drive, providing for the big speed reduction of 57 to 1. To find the speed ratio in Worm gears, it may be assumed that the number of revolutions of a Gear Wheel (or Pinion) to one revolution of the Worm correspond with the number of the teeth in the Gear Wheel. For example, $\frac{1}{2}''$ Pinion and Worm gear gives a ratio of 19 to 1.

The Meccano Sprocket Chain gear is unique in model engineering. It provides a positive and smooth-running drive which lends itself to an unlimited number of applications, and the wide range of sizes to which the Sprocket Wheels are made provide a number of varying speed ratios. The illustration (S.M. 7) shows a chain drive between $\frac{3}{4}''$ and 3″ Sprocket Wheels, giving a speed reduction of four revs. to one. Two to one drives may be obtained by employing one 1″ and one 2″ Sprocket Wheel, or one $\frac{3}{4}''$ and one $1\frac{1}{2}''$ Sprocket Wheel, while ratios of 1 to 1 may be obtained by running the Chain over any two Sprocket Wheels of like diameter.

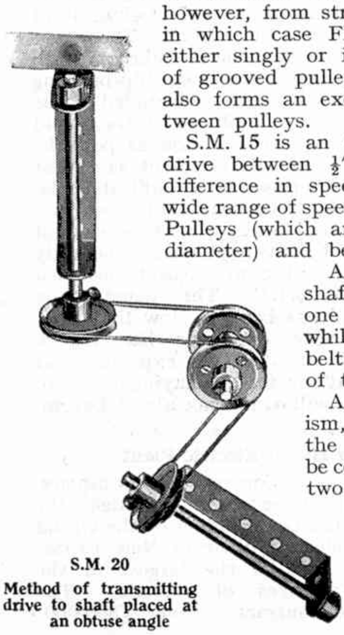
Reduction gearing becomes of special importance in models driven by Meccano Electric Motors, for it should be remembered that the Motors prove most efficient when running at maximum speed, no matter at what rate the model itself is required to move.

Section II. Belt & Rope Mechanism

In Meccano models, cords usually take the place of belts for this method of power transmission. Miniature belting may be made, however, from strips of canvas, indiarubber, etc., in which case Flanged Wheels should be used, either singly or in pairs (as in S.M. 18) instead of grooved pulleys. The Meccano Spring Cord also forms an excellent means of connection between pulleys.

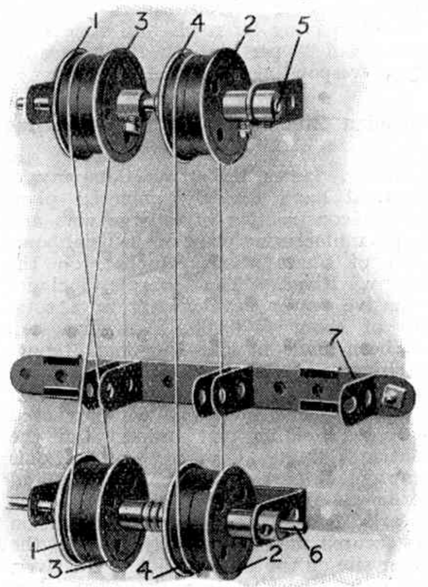
S.M. 15 is an example of ordinary open belt drive between $\frac{1}{2}''$ and 3″ Pulleys, giving great difference in speed between the two shafts. A wide range of speeds may be procured with Meccano Pulleys (which are made in sizes from $\frac{1}{2}''$ to 6″ diameter) and belt gear.

A method of connecting two shafts placed at right angles to one another is shown in S.M. 16, whilst S.M. 17 illustrates a crossed belt drive, which reverses the motion of the driven shaft.



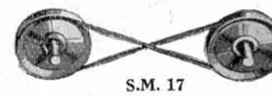
S.M. 20
Method of transmitting drive to shaft placed at an obtuse angle

A practical belt reversing mechanism, suitable for most drives where the load is not too heavy, may be constructed as follows (see S.M. 18); two pairs of Flanged Wheels, 1 and 2, are fixed, and two pairs 3 and 4 are loose, on a driving shaft 5 and a driven shaft 6. The wheels 1 are connected by a crossed belt, thereby reversing the motion of the driven shaft 6 (as in S.M. 17), while the wheels 4 are connected by an open belt. The operation of a lever 7 moves one of the belts on to a pair of fixed pulleys, at the same time throwing the other on to a loose pair, and vice versa, thereby reversing the action of the driven shaft 6.

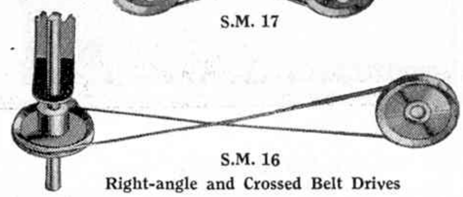


S.M. 18
Belt Reversing Gear and Belt Clutch

The pulleys 4 and 2, in the same illustration, also serve to demonstrate the principle of a belt clutch. The driven shaft 6 may be thrown into gear with the driving shaft 5 by moving the belt on to the fixed pair of wheels 2. By reversing the operation the shaft 6 is thrown out of gear again without stopping the driving shaft 5.



S.M. 17



S.M. 16
Right-angle and Crossed Belt Drives

S.M. 19 is an arrangement adopted when the pulleys are not in line with one another, and forms an alternative method to direct gearing. The guide pulleys 1 ride freely upon the axle 2. It will be seen that this is a useful means of avoiding an obstruction—such as a moving lever or wheel—that may lie between the two Pulleys.

The final example in this section shows a method of transmitting power to a shaft placed at an obtuse angle. The belt is led round the 1″ loose guide pulleys.

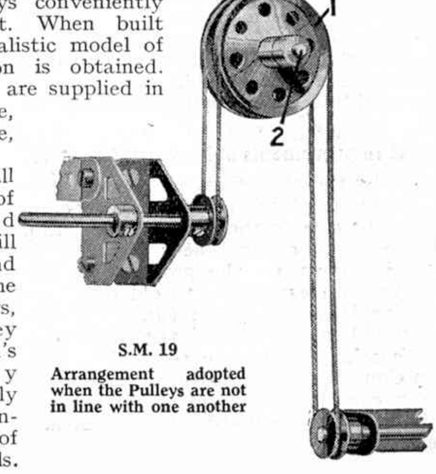
Non-Slip Device

In order to ensure a positive drive with rope mechanism, and to guard against the possibility of slipping, it is advisable sometimes to give the cord or rope an additional turn round each of the pulleys. A still more efficient drive may be obtained by using ropes in duplicate, or even triplicate. In this arrangement each loop of rope engages between a separate pair of pulleys; thus, supposing an ordinary open belt gear (such as S.M. 15) is required to withstand an exceptionally heavy load; all that is necessary is to repeat the existing gear—by adding further $\frac{1}{2}''$ Pulleys and 3″ Pulleys alongside those already shown—until the requisite "grip" is obtained to rotate the shafts.

Jockey-Pulley Device

A method frequently adopted in order to keep a belt always at a certain degree of tightness consists of an additional "idle" wheel known as the "jockey" pulley. This pulley is arranged to ride upon the belt, and is caused to exert a slight pressure upon it by means of a spring or a weight, etc. In this way, the jockey-pulley takes up any "slack" due to expansion of the belt in running.

Meccano Shafting Standards have been specially designed for use in connection with belt driving, etc.; they may be used, for example, to carry the main driving shaft of a miniature workshop or similar model, in which the belts operating the various machines are driven from pulleys conveniently mounted on the shaft. When built in this way a most realistic model of belt power transmission is obtained. The Shafting Standards are supplied in two sizes; large size, price 1/- each, small size, price 8d. each.



S.M. 19
Arrangement adopted when the Pulleys are not in line with one another

Next month we shall publish Section III. of "Meccano Standard Mechanisms." This will deal with "Pulleys and Pulley Blocks," and the various kinds of pulleys, fixed and moveable pulley blocks, as well as Weston's "Differential Pulley Block, will be simply explained and demonstrated with a number of ingenious Meccano models.

MECCANO STANDARD MECHANISMS

Section III. PULLEYS AND PULLEY BLOCKS

This article is the second of a series reprinted from the new Manual entitled "Meccano Standard Mechanisms," now in course of compilation. Pulleys were the subject of an article published in the Magazine some time ago ; this has been considerably amplified and re-written, however, and the present article will be found to contain many novel features. The simple demonstration of the principle of "energy" applied to Pulleys should prove interesting to every student of Mechanics.

PULLEYS are a development of the lever, and when scientifically employed make possible a great saving of labour and energy. A fixed pulley cannot be described as a mechanical power, for it simply changes the direction of a force without increasing it—in fact, a small amount of energy is lost in its use owing to friction. The combination of a rope with several pulleys, however, produces a mechanical power, and with the help of a few experiments we shall endeavour to explain as simply as possible some of the interesting results so obtained.

A man carrying a sack of cement to the top of a building has to carry his own weight in addition to that of the sack. If he attaches a rope to his load and passes the rope over a pulley fixed at the top of the building, he is then able to raise the load by hauling on the other end of the rope while he remains on the ground. This is an example of the pulley used as a convenient method of changing the direction of a force, for it changes the man's downward pull to an upward force by which he is able to raise the sack of cement. It must be remembered that although the man has eliminated his own weight, he has not diminished his load. On the other hand he has increased it, for the energy he now exerts must not only equal the weight of the load but must also overcome a certain amount of friction.

The Meaning of "Energy"

The amount of work, or "energy," of which a machine is capable is measured by "foot-lbs." The unit of this is based on the amount of energy necessary to raise a 1 lb. weight through a height of 1 ft. For example, suppose a weight of 2 lbs. has to be raised through a height of 1 ft. ; the energy required would be exactly equal to that necessary to raise a weight of 1 lb. through a height of 2 ft.—namely, 2 foot-lbs.

If 10 lbs. be lifted 100 ft., 10 foot-lbs. are required for the first foot, the same for the second, third, and so on up to 100 ft., making a total of 1,000 foot-lbs. of energy.

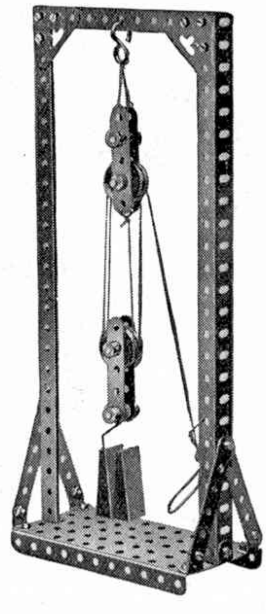


Fig. 3
The Two-Sheave Pulley Block

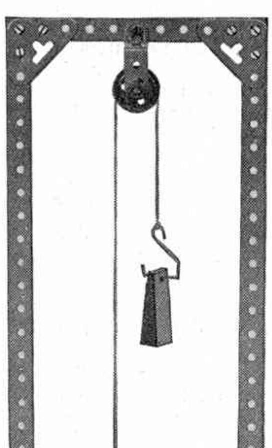


Fig. 1
Single Fixed Pulley

Supposing a man, by hauling on a rope, lifts 1 cwt. to a height of 20 ft. The energy he expends should be sufficient to raise a load of one ton through a height of 1 ft., but it is impossible, of course, for a man to move a direct load of one ton, however short the height through which it is to be moved, although he can create sufficient energy (2,240 foot-lbs., or 1 foot-ton) when moving a load of 1 cwt. through a height of 20 ft. With the aid of a series of pulleys, however, he is able to arrange a contrivance with which he may lift one ton through 1 ft. by the same means ; i.e. by moving a smaller weight, or exerting a smaller pull, through a greater height.

Friction in Pulleys

Friction plays an important part in calculating the advantages of pulleys, although in the majority of Meccano models its effect is naturally very small. In every pulley there is a slight loss of power from the necessity of bending the rope, and in actual practice, where heavy ropes are used, this loss becomes of great importance. It is for this reason that pulleys are usually made as large as possible, for the bending of a rope around the circumference of a large pulley creates less friction than when used with a smaller pulley. Small pulleys also cause damage to the rope by excessive bending.

Example 1

A simple fixed pulley is shown in Fig. 1.

If we attach a hook to the rope at the point where it is tied to the base, and suspend from this hook a weight equal to that already shown, we find that the original weight remains suspended in mid-air, in spite of the law of gravitation by which the highest weight should fall, thereby raising the lower weight.

Because this is the case, we know that there must be some force that is retaining the suspended weight in position. This force is friction, created by the bending of the cord and from the contact of the pulley on its bearings. If a 50-gramme weight is attached to each hook, we find that the addition of five Washers is required to the uppermost hook to cause the weight to fall, so raising the other hook supporting the lower weight. Thus the amount of friction present in our model is equal to the weight of five Washers.

Example 2

In Fig. 2 we have a moveable pulley B in addition to our fixed pulley A. The rope is fastened to the cross beam, passed (or "rove") through the moveable pulley B, and over the fixed pulley A.

With this arrangement it will be found that a power load of, say, 11 lbs. attached to the free or "running" end *a* of the rope will raise a weight of 20 lbs. suspended from the moveable pulley B. Here, then, the moveable pulley B is employed as a mechanical power and gives an advantage of nearly double the available force. To this mechanical advantage the fixed pulley A does not contribute, but only changes the direction of the force, converting a downward pull on the rope at *a* to an upward force at *b*.

The explanation of the increased power, or mechanical advantage, obtained is as follows. In our model we find that to raise the load 1 in. the power must descend 2 in.—for it is clear that if B is to rise 1 in. the lengths of rope *c* and *b* must each be shortened by 1 inch—therefore *a* must be lengthened by 2 in. To raise 20 lbs. through 1 ft. requires 20 foot-lbs. But the power load of 11 lbs. descending through twice that distance—2 ft.—yields 22 foot-lbs. This is 2 foot-lbs. more than is actually necessary ; hence it may be stated that friction has absorbed 2 foot-lbs. of the energy exerted.

From this we learn that a moveable pulley enables a force to move through a greater distance than that moved by the load it lifts. We also know that the energy exerted by a force is increased proportionally to the distance through which it moves. Therefore by using a single moveable pulley we may almost halve the force that would be necessary

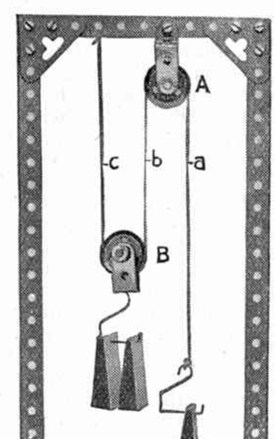


Fig. 2
The Single Moveable Pulley

without it, for it enables us to move the force through a distance twice as great. It should be noted here that in all the mechanical powers, the force is increased always at the expense of speed, since it must move through a greater distance than the load it lifts

Example 3

The principle in Fig. 3 is the same as in Example 2, but two further pulleys have been added. The rope is rove through one of the pulleys, or "sheaves" as they are termed, situated in the fixed pulley block, thence under one of the sheaves in the lower moveable block, over the second fixed sheave, and down to the second moveable sheave. From there it is led up and secured to the framework of the fixed pulley block.

The load is thus supported by four lengths of rope, and to raise the load through one inch, each of the four parts of the rope from the upper block to the lower block must be shortened one inch. Therefore, the running end of the rope must be lengthened by four inches, from which it may be calculated that, eliminating friction, one quarter of the load attached to the running end would be sufficient to raise the load, for, as we have already seen, the energy exerted by a force is increased proportionally to the distance through which it travels. In actual practice it will be found that a little more than a quarter of the load is required to raise it, the surplus being absorbed by friction.

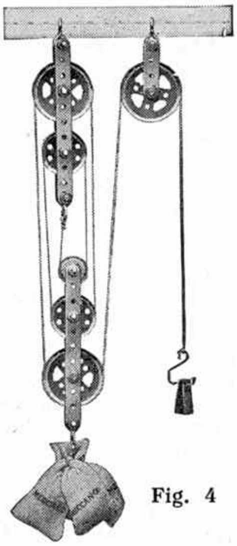


Fig. 4

Example 4

A popular arrangement of pulleys is well illustrated in the Meccano Model No. 709, Stiff-Leg Derrick Crane As shown in S.M. 31 the tackle here consists of two pulley blocks, one fixed and one moveable, as in Example 3. The upper block contains two sheaves or pulley wheels, while the lower or moveable block has three sheaves. The end of the cord that passes over the large pulley in the jib of the crane is the running-end.

The model shown in Fig. 4 makes the relative arrangement of the sheaves and cords easier to understand. As will be seen, instead of all the sheaves in one block being on the same axle they are separated in this model one from another. The action of the pulleys in Fig. 4 is similar to that in the Stiff-Leg Derrick.

In this case we have six lengths of cord supporting the moveable pulley block, so by a similar calculation to that made in Example 3, it will be seen that we obtain a mechanical advantage of six—that is, a force equal to one sixth of the load will be sufficient to raise it (ignoring friction).

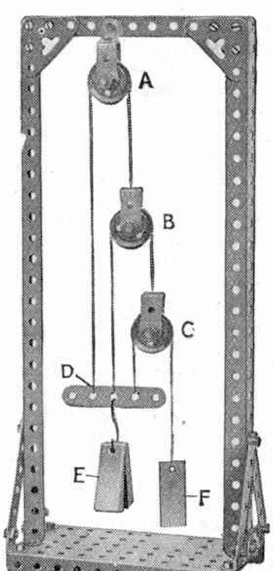


Fig. 5
Separate Cord System

Example 5

In Fig. 5 separate cords are substituted for the previous continuous single cord. One end of the outermost cord is attached to a Strip D and the cord then passes over the pulley A, which is bolted to the upper framework. The other end of this cord is fixed to the block B. The centre cord is also fastened to D and then passes over the pulley B to be secured to the block C. The remaining cord passes over the pulley C, and serves as the running or pulling-end of the tackle. The load E is suspended from the Strip D, and the power F is attached to the running-end of the cord C.

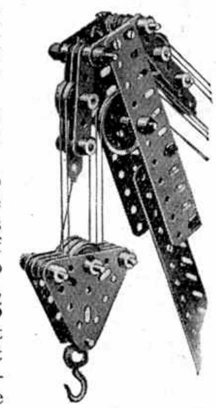
With this ingenious arrangement we obtain a mechanical advantage of seven; that is, it enables a load of, say, 70 lbs. to be lifted by an applied force of only 10 lbs. (ignoring friction).

The explanation is not quite so obvious, perhaps, as in our previous examples. If D is raised 1 in. the block B, suspended from the first cord that passes over A, must fall 1 in. Since the pulley B descends 1 in. that part of the second cord between B and C must be lengthened by 2 in. (We learned in Example 2 that to raise a moveable pulley 1 in., 2 in. of cord must be drawn up—therefore to drop a moveable pulley 1 in., 2 in. of cord must be let down). We must remember that D has risen 1 in., so that the second cord has been lengthened by a further inch between B and C. Therefore the pulley C has dropped 3 in. altogether. From this, again working on the theory of the moveable pulley, we find that the running end of the third cord, which passes over the pulley C, must descend through 6 in. Finally, by adding to the running end the additional length of 1 in. derived from the movement of D, we arrive at the total movement of the power load F, namely, 7 in.

Therefore if the power load is 10 lbs., it exerts 70 foot-lbs. energy for every foot the load is raised.

It should be mentioned that in the Meccano model it is first necessary to balance the weight of the pulley blocks B, C. This may be done by suspending a weight of approximately 75 grammes from the Strip at D. Then having attached a load, say, of 175 grammes, at E we find that 25 grammes on the power hook F is sufficient to balance it. By the addition of about eight Washers the load is raised; therefore the loss by friction is equal to the weight of the Washers.

This arrangement of cords and pulleys, though using a smaller number of sheaves than the continuous cord system, is seldom employed by engineers for the reason that the continuous cord is more convenient to fix and use.



S.M. 31
Arrangement of Pulleys in Stiff-Leg Derrick (Model No. 709)

Example 6

Our final example deals with a very ingenious contrivance, known as Weston's differential pulley block. This apparatus consists of three parts—an upper fixed pulley block, a moveable pulley and an endless chain (Fig. 6). In our Meccano model, the load C may be raised or lowered by a slight pull on the chain at A or B.

The principle on which this pulley block is based will be understood from the diagram shown in Fig. 7. Two Gear Wheels, D (57 teeth) and E (50 teeth), are employed as the sheaves in the fixed pulley block, in order that their teeth may prevent the chain from slipping. They are both secured to the axle F, and must therefore turn together at similar speeds. The chain passes from the hand at A over the larger sheave D, then downwards at G, and under the moveable pulley H, which supports the load. It passes up again at K, over the smaller sheave E, and then back again by B to the hand at A.

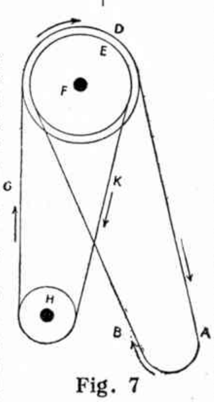


Fig. 7

When A is pulled downwards, the sheaves D and E must both rotate in the direction indicated by an arrow in the diagram. The larger sheave D is therefore winding up the chain at G while E is lowering at K.

The effective circumference of D is $4\frac{1}{2}$ in. and that of E is 4 in. In one revolution of the axle F, D must draw up $4\frac{1}{2}$ in. of chain; but in the same time E has lowered 4 in.; hence the length of chain between the two must have been shortened by $\frac{1}{2}$ in. (the difference between $4\frac{1}{2}$ in. and 4 in.)

This can only have taken place, however, by raising the moveable pulley H through half that amount, that is, $\frac{1}{4}$ in. Therefore the power at A has moved through a distance 18 times greater than that through which the load moves, for in order to rotate the axle F once, A must have pulled out $4\frac{1}{2}$ in. (the circumference of D). This means that the theoretical mechanical advantage in our model is 18, and by it a load of, say, 1,800 lbs. could be

(*Continued on page* 699)

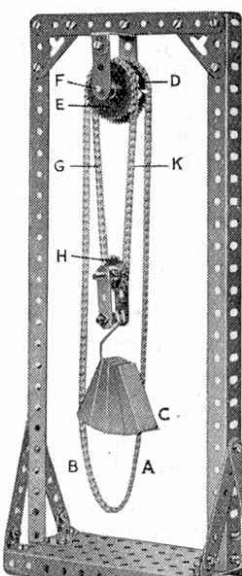


Fig. 6
Differential Pulley Block

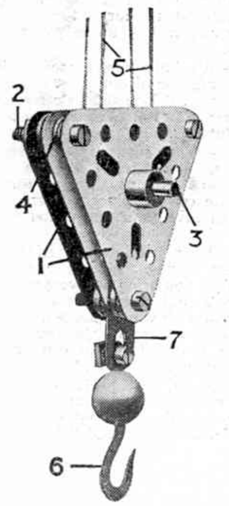
MECCANO STANDARD MECHANISMS

Section III. PULLEYS AND PULLEY BLOCKS *(contd.)*

This article is the third of a series describing Meccano Model-building practice. Last month, the principle of the Pulley was explained in detail and demonstrated by simpl Meccano experiments. The following article deals with the general application of pulleys in Meccano models, and describes how some ingenious movements may be obtained with their aid.

STANDARD Mechanism No. 32 illustrates a pulley block having two sheaves, or grooves, round which the hoisting rope may be passed. The principle of the two-sheaved pulley block was described fully in Example 3 (page 637, December "*M.M.*"), and it will be remembered that a fourfold increase in power was shown to be obtainable from such an arrangement of pulleys.

The block is constructed from three 2½" Triangular Plates (1) held together by ¾ in. Bolts (2). Two 1 in. loose Pulleys, forming the "sheaves," are pivoted on the axle (3), which is journalled through the centre holes of the Plates and fitted with Collars on each end. Four Washers (4) are placed on the bolts (2) between the Plates (1) in order to ensure clearance for the Pulleys, round which the winding cord (5) passes. The Hook (6) is carried from the lower bolt by means of the Flat Bracket (7).



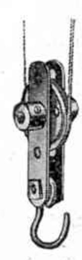
S.M. 32

The usual arrangement of the hoisting cord (5) is as follows: one end is tied to the "tail" of the fixed pulley block (secured to the model from which the block 1 is suspended), and the cord is led down to the moveable pulley block (1) and round one of its sheaves. Then it passes upwards and round one of the sheaves in the fixed pulley block, down to the second "moveable" sheave, and up again to the second "fixed" sheave. On passing over the latter, that portion of the cord forms the "running-end," by which the pulley block (1) is raised.

Single Moveable Pulleys

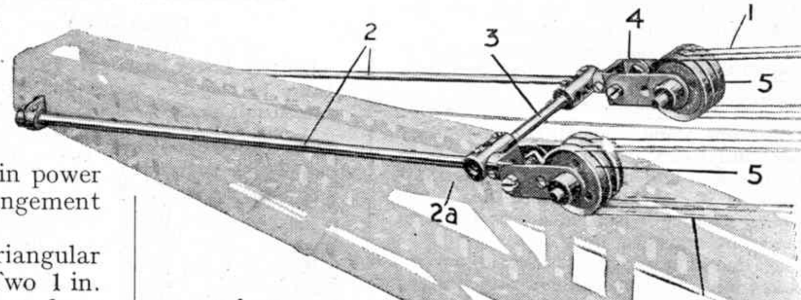
Three types of Meccano single pulley tackle are illustrated in S.M. Nos. 33, 34 and 35. In each case one end of the cord is secured to the tail of the "fixed," or standing block, and the other end is rove through its pulley and leads down as the running or hauling-end. In S.M. Nos. 34 and 35 the shank of a bolt forms a journal for the sheaves, which consist in both cases of ½ in. loose Pulleys. It will be noticed also that the Strips in S. M.34, and the Flat Trunnions in S.M. 35, are held at a proper distance apart by means of Washers placed on the shanks of the combining bolts.

In each of these three arrangements the mechanical advantage is two, that is to say, a 100 lb. weight should be lifted (theoretically) with a force of 50 lb., for the pulley blocks would move at a speed only half as great as that at which the hoisting cord moves. (See Example 2, page 636, December "*M.M.*")


S.M. 33


S.M. 34


S.M. 35

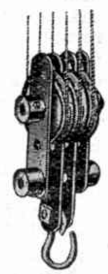


Pulley Blocks in Jib-head

S.M. 37

From this illustration (S.M. 37) it will be seen that the pulley blocks (4) are bolted to the tie-rods (2) by means of Fork Pieces. The tie rods are pivotly attached to the head of the jib (2A), the method of connection consisting of two Collars mounted on each tie-rod and secured one on either side of an Angle Bracket pivotly carried from the end of the jib. A strut (3) constructed from a short Rod mounted between Couplings, holds the tie-rods in position.

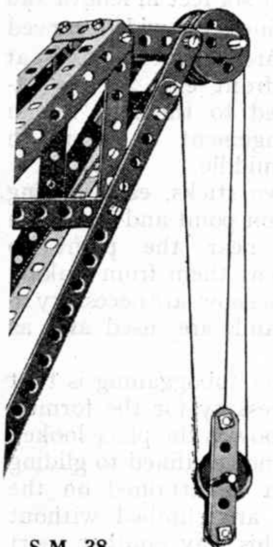
Each pulley block contains three sheaves (5). Two separate hoisting cords (1 and 1A) are employed, the running ends of each being secured to the winding-drum in the model. Each cord is led from the winding drum over a sheave in its respective fixed pulley block secured to the model. Thence it passes round one of the sheaves (5) of the corresponding moveable pulley block, then round the second "fixed" sheave, back to the second "moveable" sheave, then over the third "fixed" sheave, and back once more to the moveable pulley block, where it passes round the third sheave. The end of the cord is then secured to the "tail" of the fixed pulley block.


S.M. 36

The operation of the cords (1, 1A) is similar to that shown in S.M. 31 (page 637, December "*M.M.*") Although the jib is supported by twelve lengths of cord instead of six, the mechanical advantage also is the same as in that example. This is explained by the fact that the running ends of the two continuous cords employed are hauled in together, therefore raising the jib at a similar speed to that obtained if only one continuous cord is used, as in S.M. 31. By duplicating the mechanism it is possible to use increased power and consequently raise greater loads with safety. S.M. 37 reproduces a portion of the Meccano Dragline, but the mechanism described above may be employed wherever it is necessary to raise an exceptionally heavy load.

Three-Sheave Pulley Block

S.M. 36 illustrates another type of pulley block having the same mechanical advantage as those shown in S.M. Nos. 31 and 37, and suitable for the larger types of cranes. It is constructed from two 2 in. and two 2½ in. Strips held together by short Rods and Collars with Set-screws. Four Washers should be placed on the lower Axle Rod between each pair of Strips, in order to obtain sufficient clearance for the rotating sheaves. The Hook is suspended from a bolt passed through the end holes of the centre 2½ in. Strips. The arrangement of the hoisting cord for this pulley block is similar to that already described (S.M. Nos. 31 and 37).

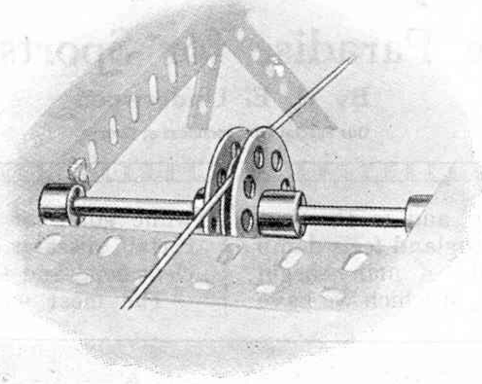


S.M. 38

Single-Sheave Pulley Block

The hoisting-cord shown in S.M. 38, is led over one of the pulleys in the jib-head, around the sheave of a moveable pulley block, over a second jib pulley, and back again to the moveable pulley block, where it is secured. In this way, although only one moveable sheave is employed, a theoretical mechanical advantage of three is obtained, for the moveable pulley is supported by three cords, and the running end of the hoisting-cord must therefore move through a distance three times as great as that traversed by the pulley block.

Guide Pulleys



S.M. 39

The deep-grooved pulley shown in S.M. 39 is a marked improvement over the ordinary Meccano pulley when used for the purpose of guiding travelling ropes, hoisting cords, etc. It is constructed by clamping a 1 in. loose Pulley Wheel between two Bush Wheels. If desired, sufficient "play" may be left to enable the 1 in. Pulley to revolve freely on the shaft, while the latter, together with the Bush Wheels, remain stationary. With such a pulley, there is little fear of the cord escaping from its groove, even when it is used in models in which the cord is subjected to uneven jerks and strains.

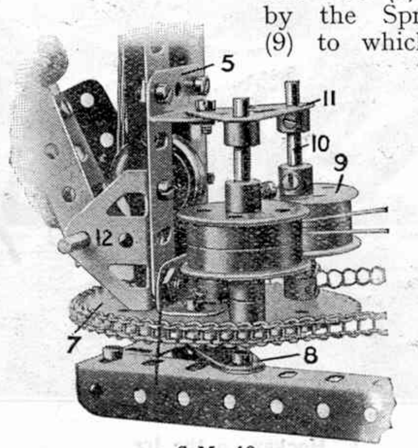
A larger deep-grooved pulley may be constructed from a Wheel Flange and two Face Plates. The Wheel Flange is bolted to one Face Plate, while the other, mounted on the same shaft as the first, is secured with its surface flush against the protruding edges of the Wheel Flange. With this arrangement the cord is led round the periphery of the Wheel Flange and is held in place by the protruding edges of the two Face Plates. If desired, the whole unit may be secured more rigidly by passing ½ in. Bolts completely through both Face Plates, and securing with nuts on their ends. (S.M. 39A).

This type of pulley will be found very suitable for such models as large Cranes, Derricks, Pit-head Gear, Lift mechanisms, etc.

Rope-Guides on Rotating Models

Hoisting-cords, etc., may be connected and retained in line with a swivelling portion of a model by means of the device shown in S.M. 40. The illustration represents the rotating base of the jib and upright column of the Stiff-Leg Derrick. The guide pulleys (9), constructed by butting two Flanged Wheels together, are mounted on shafts (10) journalled in a Corner Bracket (11) and in two holes of a 3 in. Sprocket Wheel (7).

As the column (5) swings about its pivot (8) the cords, one of which raises or lowers the hoisting-block, while the other operates the jib-arm, are retained in line with the 1 in. Pulleys shown by one or other of the guides (9).

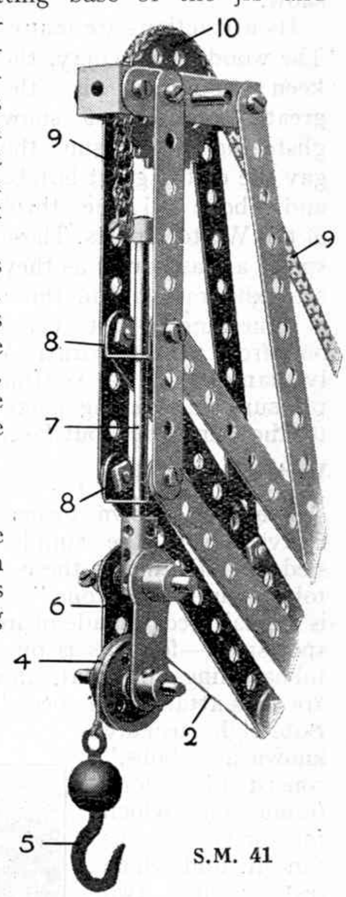


S.M. 40

Variable Pulley-Block

S.M. 41 illustrates a simple but ingenious mechanism which automatically registers the weight of a load bearing upon a pulley.

A 1 in. Pulley (4) from which a load hook (5) is suspended, is carried in two Cranks (6) connected to a 3½ in. Rod (7) slideable in two Double Brackets (8). The Rod (7) is supported by the Sprocket Chain (9) to which it is connected by a Collar and Set-screw.



S.M. 41

By attaching the other end of the chain to some resistance, such as a Meccano Spring, the weight of a load on the Hook (5) may be calculated by noting the distance through which the Chain is pulled. The movement of the Chain may be employed to operate a pointer with graduated dial similar to that provided in Model No. 627, Automatic Weighing Crane. In this model, immediately the hoisting mechanism is brought into operation, the pointer swings round and indicates the extent of the load suspended from the crane hook.

MECCANO STANDARD MECHANISMS

Section IV. LEVERS

This article is the fourth of a series explaining some new and interesting aspects of Meccano Model-building practice. Gear ratios, Belt and Rope Mechanism, and Pulleys have been dealt with already, and the following article consists of a simple demonstration of the principle of the Lever.

LEVER OF THE FIRST ORDER

THE lever is the simplest and perhaps most valuable of the various mechanical powers, for it forms a useful medium for increasing or changing the direction of a force in cases where it would be impracticable to employ pulleys. The lever is classed in three distinct groups, and is said to belong to the first, second, or third "order," according to the relative position of the fulcrum, or point at which the lever pivots, to the "power" and the "load."

A lever of the first order is illustrated in Fig. 1. The upright member of this model is constructed from two $5\frac{1}{2}''$ Angle Girders (1) secured to the base (2) by $1'' \times 1''$ Angle Brackets (3) and held together at their tops by two $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets. A short Rod, which supports the lever, is passed through the upright and rigidly secured in a Crank bolted to the rear $5\frac{1}{2}''$ Angle Girder.

As will be seen, the fulcrum A is situated between the load D and the power F. In order to experiment with the properties of the lever, we must first counterpoise the weight of the arm AP. This may be done by adding a weight E to the arm AC, and in the example illustrated, which shows the beam pivoted in its fifth hole, 125 grammes and two $2\frac{1}{2}''$ Strips form the necessary counterbalance to AP.

Example 1

It will now be found that a power load of 50 grammes at B is sufficient to balance a load of 200 grammes at C; therefore this arrangement of the simple lever gives a mechanical advantage of four. The arm AB is 8″ in length and CA only 2″. As the radius of the point B from the fulcrum A is four times as great as that of the point C, point B must move through a distance four times greater than that through which the point C moves. This explains the mechanical advantage obtained in our model, for we have already seen in Example 2, Section III. (December *M.M.*), that a power is increased proportionally to the distance through which it moves.

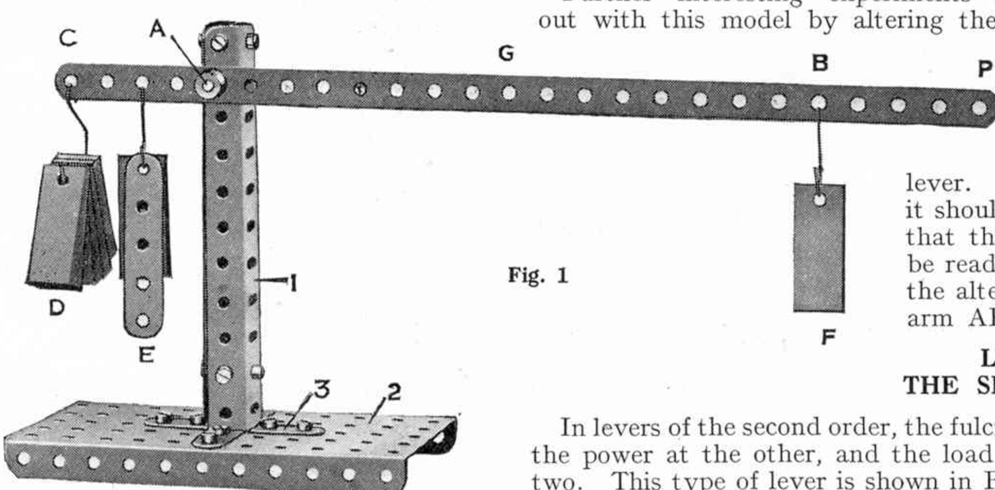


Fig. 1

Example 2

We may further prove this rule by changing the position of the power F to the point G, which is four inches from the fulcrum A. A power of 100 grammes is now found necessary to balance the load D, for G moves through a distance only twice as great as C.

Example 3

The rule may be expressed more generally by stating that the power is to the load as the distance of the load from the fulcrum is to the distance of the power from the fulcrum. By applying the rule, we may ascertain the power required to raise any given load, providing we know the lengths of the two arms of the lever.

Suppose for example, that it is desired to raise the load at C (200 grammes) by applying a power at the point P in the lever. The distance of the load (C) from the fulcrum (A) is 2″, and the distance of the power P from the fulcrum (A) is 10″. Therefore CA is only one fifth as great as AP; and since the power is to the load as CA (the distance of the load from the fulcrum) is to AP (the distance of the power from the fulcrum), then the power required is only one fifth as great as the load. Hence we find that 40 grammes at P will balance 200 grammes at C.

Further interesting experiments may be carried out with this model by altering the positions of the power and load, or by moving the fulcrum in either direction along the lever. In the latter case, it should be remembered that the weight E must be readjusted to balance the altered length of the arm AP.

LEVER OF THE SECOND ORDER

In levers of the second order, the fulcrum is at one end, the power at the other, and the load lies between the two. This type of lever is shown in Fig. 2, in which A is the fulcrum, B the point at which the load D is applied, and C is the power.

The upright column (1) in this example is constructed in a similar manner to that shown in Fig. 1, but in this case the Girders are $9\frac{1}{2}''$ in length. The Pulley (2) runs freely on a short axle, and is held in place by a Collar (3). A $12\frac{1}{2}''$ Strip represents the lever, and pivots about a short axle journalled in a Fork Piece (4) carried from a Coupling (5) which may be secured by its set-screw in any position on the Rod (6). The latter passes through the upright Girders (1) and is secured in Cranks (7).

Example 4

The weight of the lever AC is balanced by placing 100 grammes and one 2″ Strip on the load-hook at D. In addition to these weights, the hook D carries a further 150 grammes to represent the load. The load-hook is suspended from a cord passing over the 2″ Pulley (2) and attached to the lever at B.

The power C is 12″ from the fulcrum A, and the point B, at which the load D takes effect, is 2″ distant. Therefore AC is six times as great as AB, and by applying the rule set out in Example 3 in this Section, we know that the power required at C to balance the load D is one sixth of 150 grammes, that is, 25 grammes. It will be found, however, that a slight addition must be made to the power C in order to actually raise the load D, the weight added representing the force lost in friction.

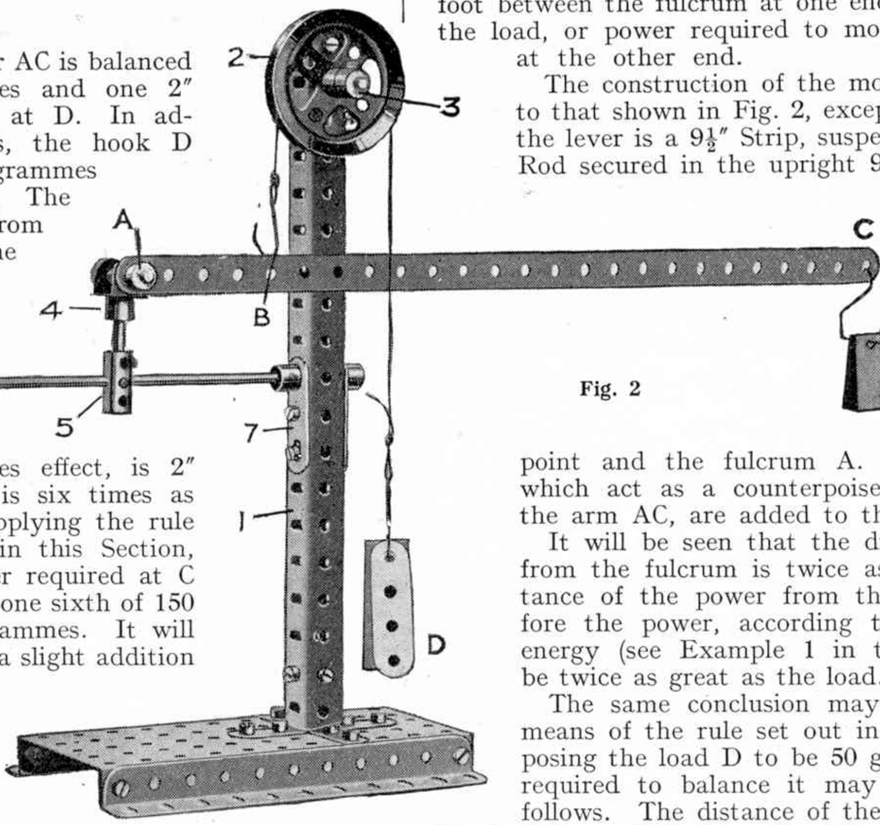


Fig. 2

Further experiments may be carried out with this model by sliding the Coupling (5) along the Rod (6) and altering the position of the point B, or by diminishing the distance of the power C from the fulcrum. In each case the rule set out in Example 3 will be found equally applicable.

It should be noted that whenever the distance of the point B from the fulcrum is changed, it will also be necessary to alter the counterpoise on the load-hook.

LEVER OF THE THIRD ORDER

In levers of the third order the fulcrum is at one end, the load is at the other end, and the power lies between the two.

This type of lever, which is illustrated in Fig. 3, is never employed when it is required to increase power; whenever it is used the power must always exceed the load. The advantage gained in its use is the fact that the power moves through a smaller space than the load. For this reason levers of the third order are usually employed as foot-treadles in such machines as lathes, grind-stones, etc., where the power is applied by the foot between the fulcrum at one end of the lever, and the load, or power required to move the crankshaft, at the other end.

The construction of the model is very similar to that shown in Fig. 2, except that in this case the lever is a 9½″ Strip, suspended from an 11½″ Rod secured in the upright 9½″ Girders.

Example 5

The load D is suspended from a cord passing over a 2″ Pulley and attached to the lever at C, the power B lying between this point and the fulcrum A. Three 2½″ Strips, which act as a counterpoise to the weight of the arm AC, are added to the load hook at D.

It will be seen that the distance of the load from the fulcrum is twice as great as the distance of the power from the fulcrum. Therefore the power, according to the principle of energy (see Example 1 in this Section), must be twice as great as the load.

The same conclusion may be arrived at by means of the rule set out in Example 3. Supposing the load D to be 50 grammes, the power required to balance it may be ascertained as follows. The distance of the point C (at which the load is applied) from the fulcrum is 9″, and that of the power B is 4½″; therefore AC is twice as great as AB. The rule states that the power is to the load as AC (the distance of the load from the fulcrum) is to AB (the distance of the power from the fulcrum). As the power must therefore be twice as great as the load, the power required is 100 grammes.

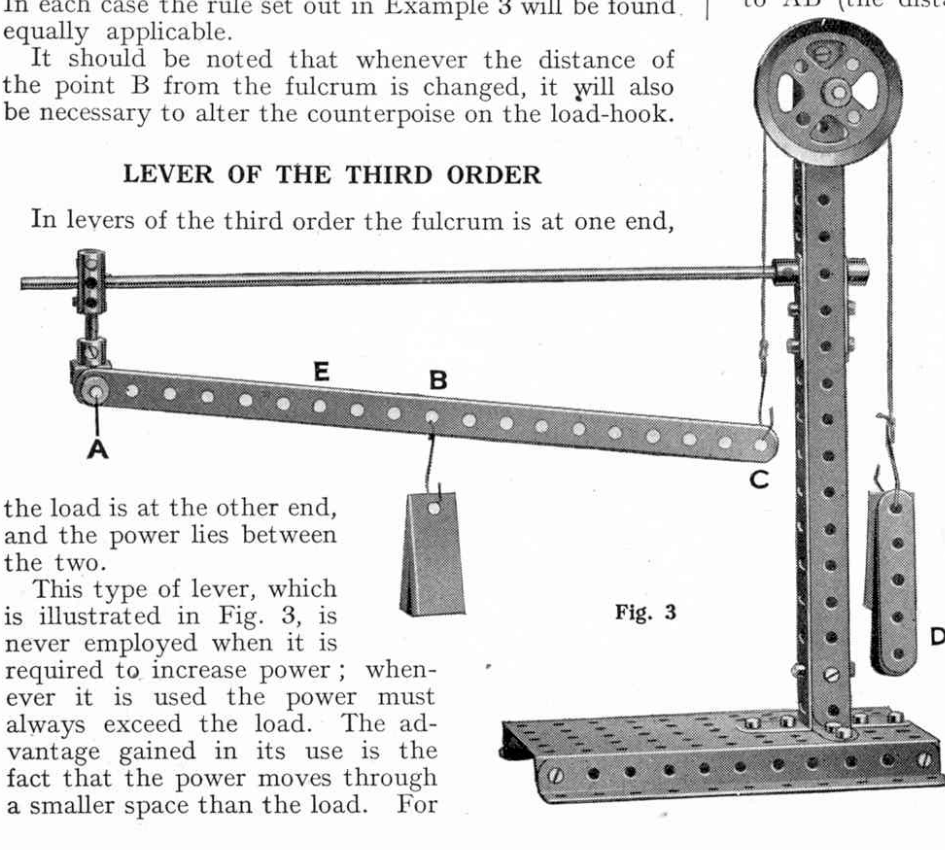


Fig. 3

Example 6

Again, we will assume that the load D of 50 grammes is to be raised by a power applied at a point E in the lever. As the distance from A to E is 3″ and that from A to C 9″, AC is three times as great as AE. Hence, by the same calculation as above, the required power is found to be 150 grammes.

Actual experiments will prove that the results arrived at from these simple deductions are perfectly correct.

Note. It may be mentioned that the weights used in these experiments are included in the Meccano Accessory Parts list. They are supplied in two sizes, 25 and 50 grammes (Parts Nos. 66 and 67, price 1s. each). Great care is expended in their manufacture to ensure absolute accuracy.

NEXT MONTH:—

EXAMPLES OF THE LEVER AS ADAPTED TO MECCANO MODELS

MECCANO STANDARD MECHANISMS

Section IV. LEVERS—*(Continued)*

This article is the fifth of a series explaining some new and interesting aspects of Meccano Model-building practice. Gear ratios, Belt and Rope Mechanism, and Pulleys have been dealt with already, and the following article concludes a simple demonstration of the principle of the Lever, which was commenced in last month's "M.M."

EXAMPLES OF THE LEVER AS ADAPTED TO MECCANO MODELS

THE properties of the lever have been known and appreciated by man since the earliest times. Indeed, the fundamental laws of mechanics probably all trace their origin from deductions arrived at from the first observations of its characteristics. Even as long ago as 200 B.C., man was fully aware of the capabilities of the lever. This is shown by the famous boast of Archimedes, the greatest mathematician and inventive genius of antiquity: "give me a fulcrum on which to rest it (the lever) and I will move the Earth."

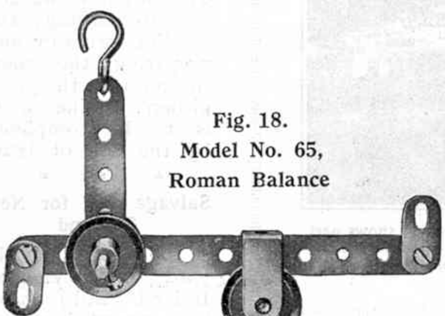


Fig. 18. Model No. 65, Roman Balance

Amongst the earliest forms in which the lever was brought to the service of man may be included the Roman Balance, or simple steelyard. This consists of a lever of the first order, with which a heavy load attached to the short arm may be balanced by a smaller weight sliding on the longer arm (Fig. 18). This simple contrivance has been employed throughout the ages, and at the present time forms the basis of the most elaborate and sensitive weighing machines.

Levers in Platform Scales

S.M. 51 shows the arrangement of levers in the base of the Meccano Platform Weighing Machine. The weight of the platform, which, for demonstration purposes, we will call the power, bears upon the first levers at C and D, between the load—represented by the force required to pull down the Sprocket Chain at A—and the fulcrum on a Hook B. In the smaller levers the fulcrum E is at one end, the load (or force required to pull down the centre link G) is at the other end F, and the power—i.e., the weight of the platform—bears upon H.

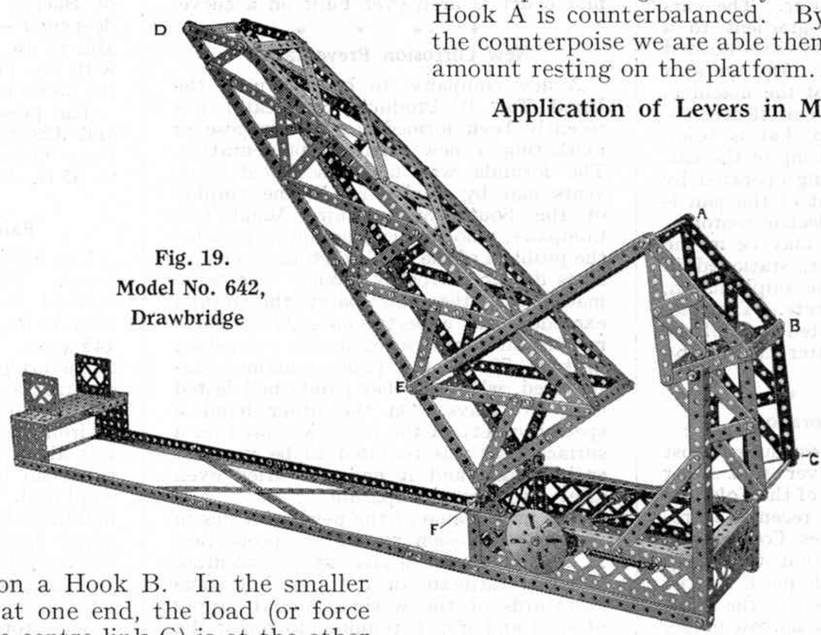
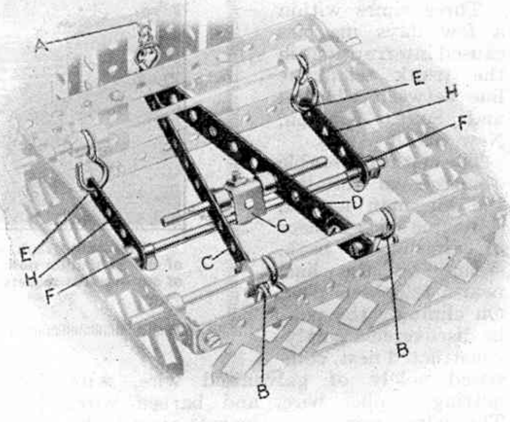


Fig. 19. Model No. 642, Drawbridge

From this it will be seen that all these levers are of the third order and therefore the power must be greater than the load before they can be operated, as explained in last month's "*M.M.*" (see "Lever of the Third Order," page 87). Hence the Hook A must move through a greater distance than the power, and the pull upon the Hook (which we have taken as representing the load) must always be less than the weight, or power, imposed upon the platform of the scales.



S.M. 51. Levers in Platform Scales

The use of the apparatus therefore enables us to weigh a heavy load with accuracy by merely moving a small counterpoise along the steelyard until the pull upon the Hook A is counterbalanced. By noting the position of the counterpoise we are able then to determine the exact amount resting on the platform.

Application of Levers in Model of Drawbridge

The various applications of the lever as a means of modifying or transforming power are shown very clearly in a number of Meccano models, and the consideration of even the most obvious of its adaptations should be of no little interest to all keen model-builders.

An interesting example of the use of levers in bridges is furnished in the Meccano Drawbridge, Model No. 642.

As will be seen from

Fig. 19, there are two kinds of levers included in this model. A lever of the first order is shown at ABC, the fulcrum being at B, the load at A, and the power at C. DEF represents a lever of the third order, in which F is the fulcrum, E the power, and the load is represented by the weight of the arm DE. It will be noticed that with this arrangement of levers the bridge DF moves through a much greater distance from that traversed by the power C. The lever ABC merely transposes the force from C to A.

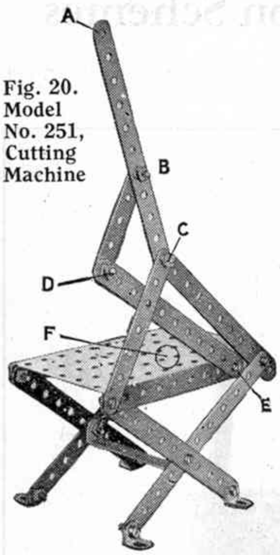


Fig. 20. Model No. 251, Cutting Machine

Cutting Machine

Two levers of the second order ABC, DE, are included in the Cutting Machine (Model No. 251 in the Instruction Manual). In the first lever ABC (Fig. 20) the power is applied at A, the fulcrum is at C, and the load lies between the two at B. In the second lever DE, the power is applied at D, while the fulcrum is at E. The load in this case is represented by the pressure of the lever arm against the material to be cut, which is placed in position at F.

A large increase in power is obtained from this combination of levers, and the model illustrated resembles the type of apparatus used in many workshops for the purpose of cutting through soild bars of metal by hand power.

Bale Press

Two pairs of levers of the second order are used in Model No. 430, Bale Press (Fig. 21), increasing the power applied at the points AB to a considerable extent.

These levers move about a common fulcrum at C and are all pivotly connected to a vertical sliding Rod D. The latter Rod presses the Plate E against the bale and this pressure represents the load on the levers.

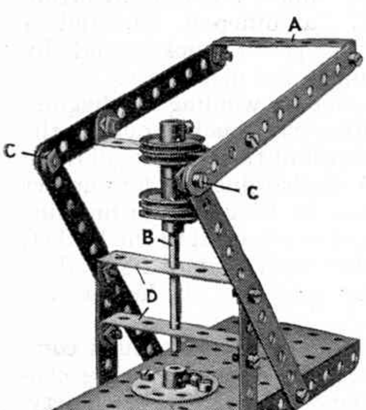


Fig. 22. Model No. 52, Punching Machine

There are many types of presses in use to-day by which cotton and other fibrous materials are compressed into bales of great density ; this, of course, results in big reductions in freight costs. The machines range in size and power from the hand-operated type, of which Fig 21 is a good example, depending upon simple leverage for their strength, to huge hydraulic presses, such as that illustrated in the *"M.M."* for August, 1925 (page 381). The latter, it will be remembered, is capable of exerting a pressure of about 2,000 tons, and itself weighs 90 tons.

Punching Machine

A single pair of levers of the second order are employed for a similar purpose to that described in the previous example in the Punching Machine, Model No. 52 in the Instruction Manual, (Fig. 22). A power applied at A is brought to bear with increased force on a vertical shaft B, representing the punch.

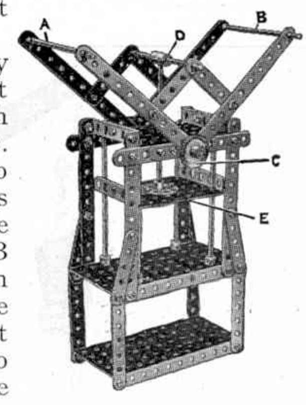


Fig. 21. Model No. 430, Bale Press

The levers are pivoted by means of bolts and lock-nuts at the points C, and the punch slides in Double Angle Strips D.

Supposing a power equal to 3 lbs. is applied at A in this model, we can determine the resulting pressure on the Rod B by the following calculation. In Example 3 in this section (see page 86, February *"M.M."*) it was stated that the power is to the load as the distance of the load from the fulcrum is to the distance of the power from the fulcrum. In Fig. 22, it will be seen that the load, represented by the force required to press down the punch B, is applied, through a Double Angle Strip, to the fourth holes in the levers—that is, 1½ ins. from the fulcrum C. The power is applied at a distance of 5 ins. from the fulcrum, or 3⅓ times the distance of the load from the fulcrum. Therefore, according to the rule, the load is three-and-one-third times as great as the power, and since the power is 3 lbs. the load—that is, the pressure on the punch B—must be exactly 10 lbs. if we ignore altogether the very small amount of friction that is present in the model.

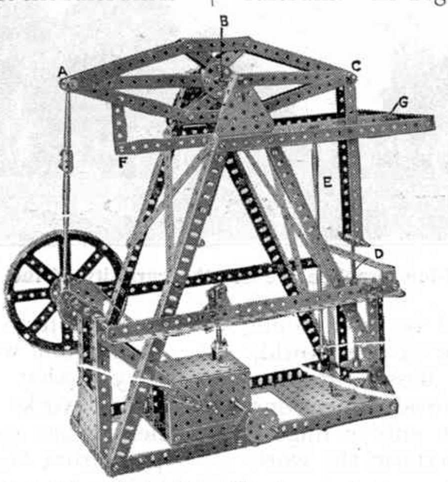


Fig. 23. Model No. 609, Beam Engine

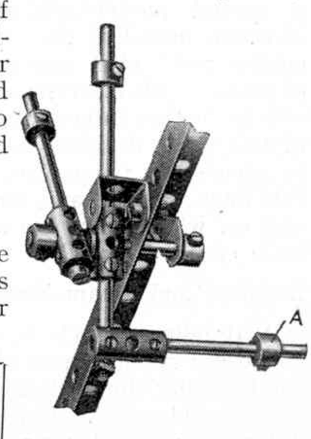
Beam Engine

A very interesting expression of lever mechanism is also found in the Beam Engine, Model No. 609. As will be seen from Fig. 23, a lever of the first order, ABC, is used in this model to transmit a reciprocating force at D to a circular force acting about a crank-shaft.

The valve rod E is operated by means of a lever of the second order FG. In the latter, F represents the power, derived from the movement of the first lever ABC, while the fulcrum is at G, to which the lever is pivoted by means of bolt and lock-nuts. The force required to move the valve rod E up and down represents the load.

Hand Levers

S.M. No. 52 illustrates the gear-change and brake levers fitted to the Meccano Motor Chassis.



S.M. 52. Gear-Change and Brake Levers in Chassis

NEXT MONTH :—

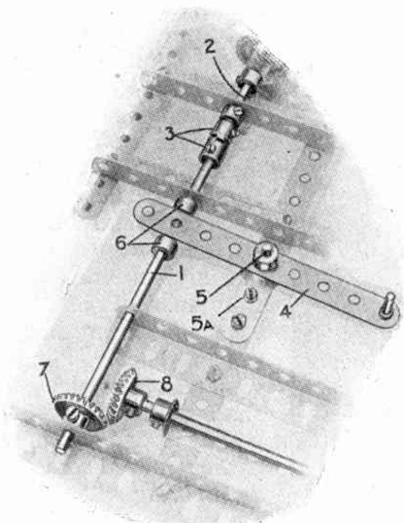
Clutches, Reversing, and Drive-Changing Mechanism

MECCANO
STANDARD MECHANISMS

Section V. Clutches, Reversing and Drive-Changing Mechanism

This article is the sixth of a series explaining some new and interesting aspects of Meccano model-building practice. Gear Ratios, Belt and Rope Mechanism, Pulleys, and Levers have been dealt with already, and the following article describes some simple examples of Meccano Clutches and Drive-changing Mechanism. These movements may be adapted with advantage to numerous Meccano models, and will enhance both their appearance and efficiency in operation.

THE Meccano Dog Clutch (Part No. 144) lends itself to a number of useful movements, and forms an excellent method by which the driving power of a model may quickly be thrown in or out of gear with the driven mechanism while it is in motion. Examples of its use are given in Standard Mechanisms Nos. 61 and 63.



S.M. 61

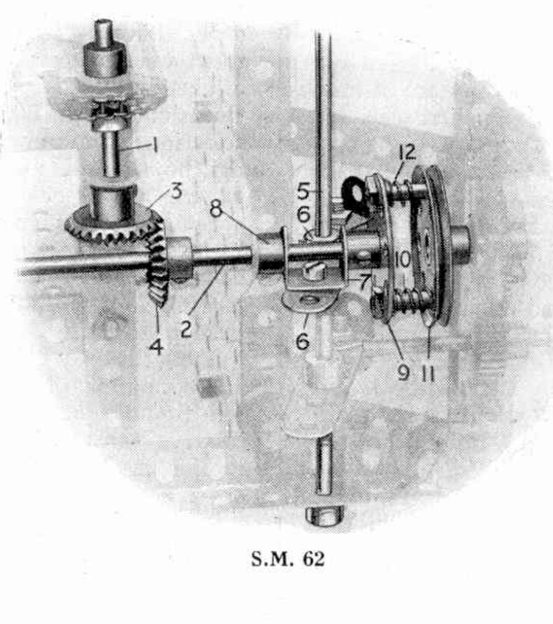
In S.M. 61 the jaws of the Dog Clutch 3, carried on the ends of the two Axle Rods 1 and 2, are brought into engagement on operation of a lever 4, which is pivotally mounted on a short Rod 5 secured in a Crank 5A.

The lever rests between two Collars 6 mounted on the shaft 1. This shaft slides in its bearings, and its movement, in addition to combining the clutch members 3, throws a Bevel Wheel 7 in or out of gear with a similar wheel 8.

S.M. 62—Clutch

This type of clutch is shown fitted to the Meccano Chassis. The clutch is operated by means of the foot pedal 6 pivoted on the shaft 5, which on being pressed down, slides the Rod 2, to which it is connected by the Double Bracket 7 journalled between the Collar and set-screw 8 and the boss of the Bush Wheel 9.

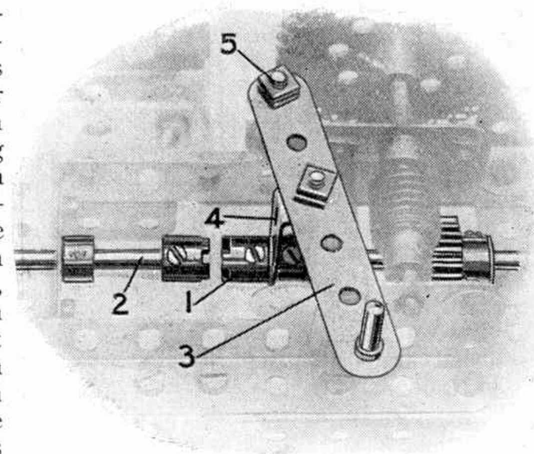
As the Rod 2 slides in its bearings the Threaded Pins 10 bolted to the Bush Wheel 9 are thrust further into the holes of the 1½″ Pulley 11, and at the same time the Bevel Wheel 4 is drawn out of gear with a second Bevel Wheel 3 on the driving shaft 1. This allows the engine to revolve freely, while the chassis remains stationary. Immediately the pressure relaxes on the pedal 6 however, the counter-shaft 2 is pushed back into its former position by the springs 12 (extracted from the Meccano Spring Buffers), and the bevel drive 3 and 4 is brought into gear again.



S.M. 62

S.M. 63—Dog Clutch

This standard mechanism provides another illustration of Dog Clutch mechanism. The clutch member 1, carried on a short Rod which slides in suitable bearings, is brought into engagement with the clutch jaws mounted on a further Rod 2, by means of a lever 3. The latter is pivoted (by bolt and lock-nuts) to an Angle Bracket at 5, and also to a Single Bent Strip 4 loosely held between the clutch segment 1 and a Collar and set screw.



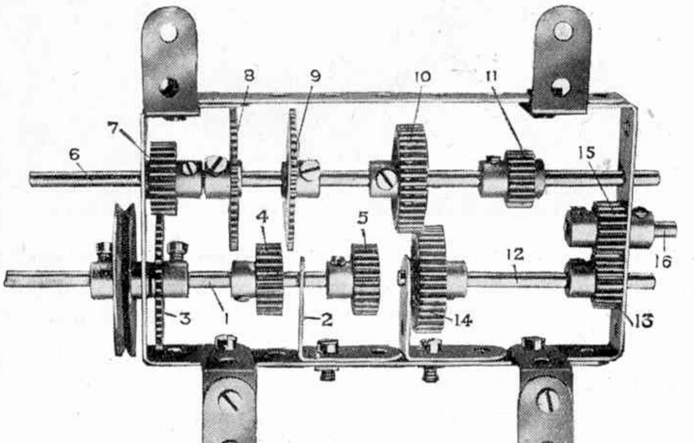
S.M. 63

A considerable improvement is effected by connecting a Spring to the lever 3, in such a manner that it normally holds the clutch members together. This Spring re-engages the shaft 2 immediately pressure is relaxed on the lever 3.

S.M. 64—Drive-Changing and Reversing Gear

S.M. 64 illustrates a compact example of gear box, which provides two speeds and a reverse gear. The model serves well in demonstrating the type of gear box usually fitted to automobiles.

The shaft 1 takes up the drive from the engine. This shaft, which is journalled through one end of the gear box and further supported by a 1″×1″ Angle Bracket 2, carries a 50-teeth Gear Wheel 3 and two ¾″ Pinions 4 and 5. A secondary shaft 6 is also inserted in the gear box and carries one ¾″ Pinion 7, two 50-teeth Gear Wheels 8 and 9, one 1″ Gear Wheel 10 and one ½″ Pinion 11. A further shaft 12 is next mounted in position, and its outer end carries the drive to the road wheels. The Rod 12 carries a ½″



S.M. 64

Pinion 13 and a 1″ Gear Wheel 14. A ½″ Pinion 15 secured to a 1″ Rod 16 gears with the Pinion 13.

A lever should be next assembled, and serves to slide the shaft 6 in its bearings. A suitable lever for this purpose will be found in S.M. 52 (see last month's "*M.M.*") and on reference to this detail it will be seen that the Rod A, connected at right angles to the lever by means of a Coupling, may readily be mounted so as to lie transversely across the shaft 6, with its Collar engaging between the Gear Wheels 8 and 9. A movement of the lever will then push the Rod 6 in either direction as required.

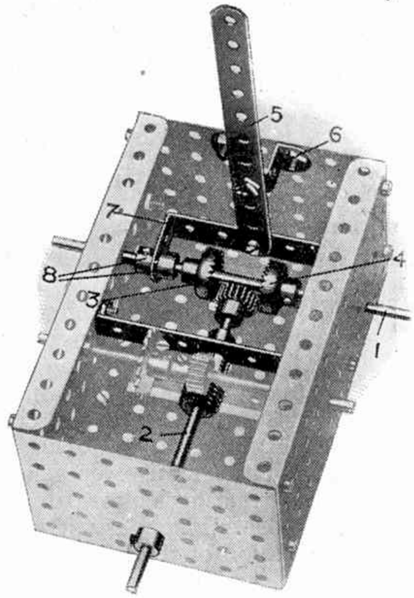
The first position of the Rod 6 provides for a "top" speed, and in this position the Pinion 7 is in engagement with the Gear Wheel 3, Gear Wheels 10 and 14 are in engagement, while the Gears 8, 9 and 11 are all free. In this manner the Gear 3 causes the Pinion 7 on the secondary Rod 6 to revolve twice as fast as the primary Rod 1, and the propeller shaft 12 rotates at the same speed as the shaft 6, since it is driven from that shaft through the one-to-one gear 10 and 14. The Pinion 15 revolves idly in this position.

For slow speed the shaft 6 is moved along until the Pinion 7 is out of engagement with the Gear Wheel 3 and the Gear 8 meshes with the Pinion 4, while Gear Wheels 10 and 14 are still engaged. With this arrangement the driving shaft 1 will revolve twice as fast as the driven shaft 12.

A reverse gear is obtained by sliding the Rod 6 still further, until the Gear Wheel 9 is in engagement with the Pinion 5 and the Pinions 11, 15 and 13 are all in mesh.

S.M. 65—Drive-Changing and Reversing Gear

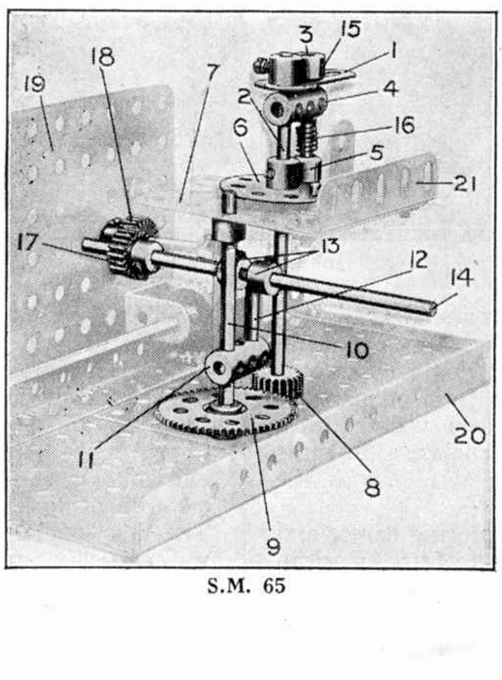
A Crank 1, secured to the vertical shaft 2, carries a short Rod 3 loosely journalled in a Coupling 4 also secured to the shaft 2. The short Rod 3 protrudes slightly from the lower Collar 5 and enters a hole in the Bush Wheel 6 bolted to the Plate 7. The Rod 2 is loosely journalled through this Bush Wheel 6 and engages, by means of the Pinion and 57-teeth Gear Wheel 8 and 9, a further Rod 10. The latter carries in a Coupling 11 a short Rod 12 which engages between two Collars 13 on an intermediate driving shaft 14. This shaft 14 is thus moved to and fro in its bearings by lifting the Collar 15 and moving the Crank 1 to left or right until the Rod 3, actuated by a small spring 16 (extracted from the Meccano Spring Buffer, Part No. 120A), snaps home into the next hole of the Bush Wheel 6. The central position of the Rod 3 enables the shaft 14 to revolve freely, but the movement of the Rod to the next hole in the Bush Wheel brings the Pinion 17 into gear with another Pinion 18, whilst a move of one hole in the opposite direction brings further Pinions (not shown in the photograph) secured to shaft 14 into engagement with Gear Wheels carried on a further driven shaft (also not shown).



S.M. 66

Thus this movement may be utilised (a) to throw the Motor out of gear with—say—the road wheels of a tractor, (b) to drive the same forward at reduced speed, and (c) to reverse the direction of their rotation.

It should be noted that in our illustration a side plate corresponding to that shown at 19 has been removed in order to disclose the mechanism. Normally this plate is bolted to the Girders 20 and 21 and so forms a bearing for the shaft 14.



S.M. 65

S.M. 66—Reversing Gear

The driving shaft 1 is caused to engage a ½″ Pinion on the secondary shaft 2 through one or other of the ¾″ Contrate Wheels 3 and 4. The change is effected by a lever 5 pivoted to a Double Bent Strip 6 and carrying a 2½″×1″ Double Angle Strip 7, through which the driving shaft 1 is journalled. The Double Angle Strip is held in place on the Rod 1 by means of Collars and set-screws 8. The direction of rotation of the Rod 2 varies according to the Contrate Wheel which drives it.