A Meccano Demonstration of
Emergency Hand Steering Gear
and Rudder Crosshead Mechanism

By H. F. Lane

In this article our contributor describes with the help of Meccano some further interesting details of a ship's steering mechanism. Two articles of a similar character by Mr. Lane have already appeared in the "M.M." These were entitled "Ship's Helm Indicator in Meccano" and "A Meccano Demonstration of Hunting Gear," and appeared in the November and December issues respectively. In the near future we hope to publish an article from his pen dealing with the Flettner Rudder.

IN the November "*M.M.*" we considered the general arrangement of the gear employed in the steering of large ships by power, and the operation of the steering engine itself was briefly described in the article on "Hunting Gear" in the December issue. The Meccano model illustrated below demonstrates the method by which the steering engine imparts motion to the rudder, and shows how the latter may be controlled when necessary by means of a hand steering wheel. In this connection it may be recalled that reference was made in last month's Magazine to a stipulation in the regulations of the Board of Trade that all merchant ships must be fitted with some means of operating the rudder by hand as an alternative system of control in the event of failure of the power.

The rudder is represented in the model by two Sector Plates 1 (Fig. A) bolted together and attached to the stock or shaft 2 by means of two bolts, each of which passes through a hole in the surface of one of the Plates and is screwed into the flat face of an Octagonal Coupling mounted on the stock. It will be observed from the illustration that the rudder is of the partially balanced type—that is to say, it has a portion of its area on each side of the pivot. The advantages of this form of rudder over the earlier types, which were pivoted to the ship down the entire length of their leading edges, will be explained in the article dealing with the Flettner Rudder.

The stock passes through a lower guide bearing consisting of a Bush Wheel 3 representing a watertight stuffing-box and gland. This is packed with three Washers placed upon one of its bolts to maintain alignment of the stock where it passes through the sloping underframe of the vessel. The upper bearing is formed by a second Bush Wheel 4 bolted to the deck of the tiller flat or compartment. The rudder stock is free to rotate in both these bearings.

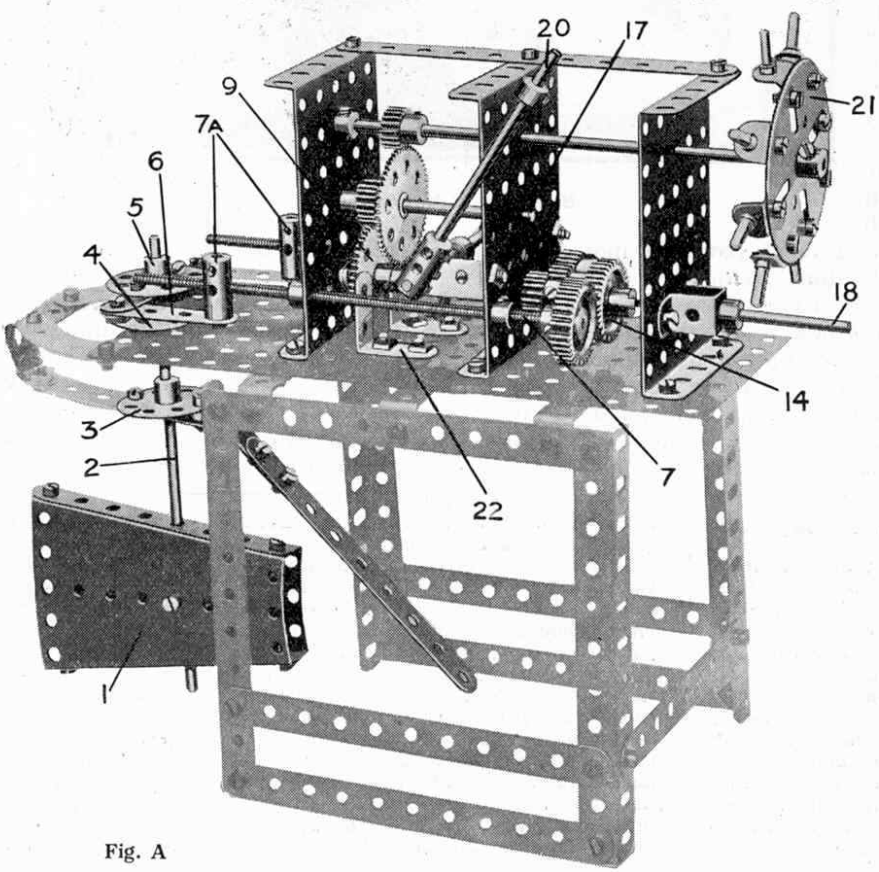

Fig. A

Arrangement of the Crosshead Mechanism

The upper end of the stock is secured in a further Bush Wheel 5, to which is bolted a 2½" Strip acting as the rudder crosshead. The crosshead is called upon to bear the whole weight of the rudder and stock 2; it must also transmit the turning movement to the stock. A link 6 is attached pivotally by means of bolt and lock-nuts to each end of the crosshead (see Figs. A and B). These links are connected in turn to the Threaded Couplings 7a mounted on parallel Threaded Rods 7 lying in a fore-and-aft direction.

The Rods 7 are prevented from moving longitudinally by Collars and set-screws placed on each side of their bearings, and they are so geared together that a rotation of one causes an equal but opposite rotation of the other. The effect of this is to cause one Threaded Coupling to move along its respective Rod towards the rudder head, and the other to move a corresponding distance away from the rudder head. The links convey this movement to the crosshead or, to use technical language, apply a "couple" to the stock and put helm on the rudder.

A special feature of the gear is that it cannot "walk back." The rudder is held rigidly in any position as soon as the "hunting gear" (described in the December "*M.M.*") has cut off the power. Moreover, no brakes or stops are required to prevent the rudder taking charge and threshing about due

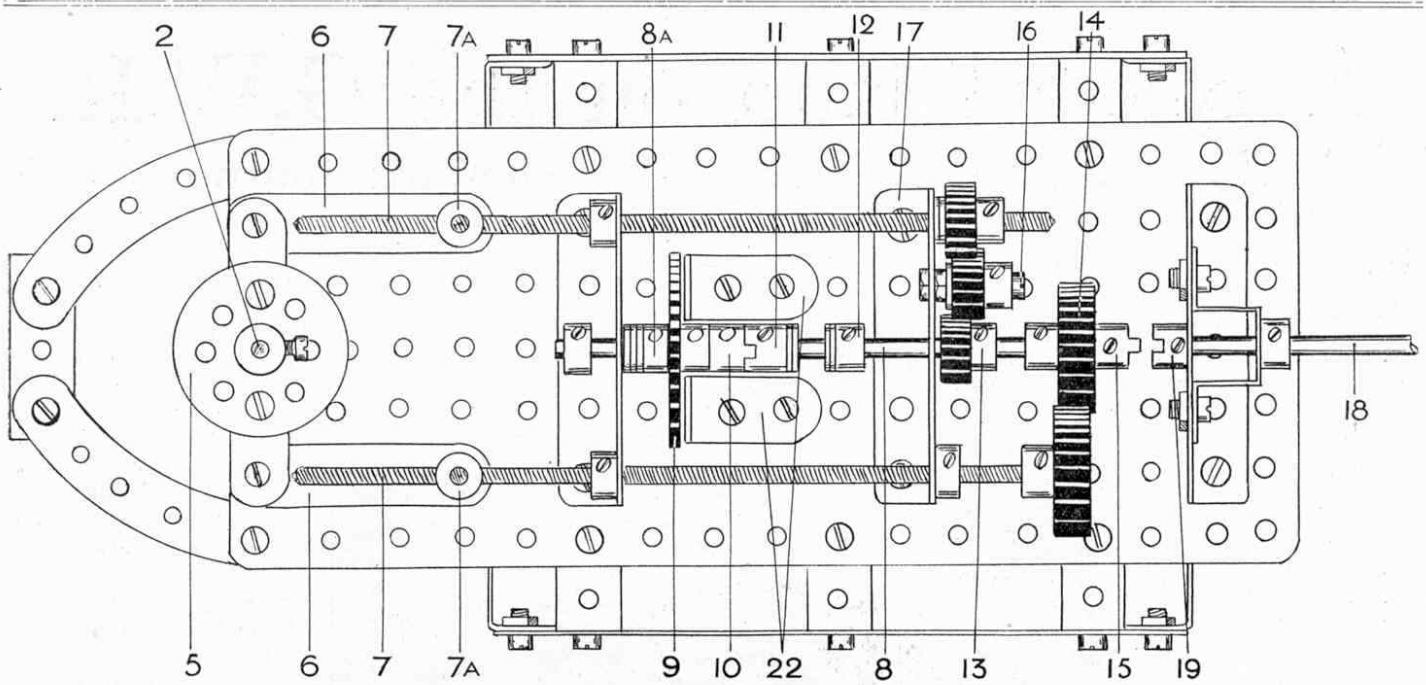

Fig. B. Plan of gearing, showing crosshead mechanism and clutch units, etc.

to the rolling of the ship, etc., when changing over to hand-gear or *vice versa*.

The plan shown in Fig. B clearly indicates the disposition of the Rods 7 in relation to the mechanism in the lower portion of the gear box. It will be seen that the Threaded Rods are connected by gearing to a central 4½" Axle Rod 8. This latter Rod carries the following units, commencing from aft:—a Collar, secured in the position shown; three Washers; a second Collar 8a, free on the Rod; a 57-teeth Gear Wheel 9 (free); the male portion of a Dog Clutch 10, free on Rod *but soldered to Wheel* 9; a female Clutch 11, secured to the Rod; four Washers; a Collar 12, ½" Pinion 13, 1" Gear Wheel 14, and another male Clutch 15, all secured to the Rod.

Connection with the Steering Engine

It will be seen that the ½" Pinion 13 and 1" Gear Wheel 14 are geared to the Threaded Rods, the Pinion 13 driving its respective Rod via another ½" Pinion that is free to rotate upon a ¾" Bolt 16 rigidly secured to the Plate 17, while the Gear Wheel 14 engages directly with a second 1" Gear Wheel secured to the other Threaded Rod. This arrangement provides that the Rods 7 will rotate in opposite directions. The steering engine is coupled to the shaft 18, which carries a female clutch member 19.

Alternative Power or Hand Control

The lever 20 (Fig. A) is rigidly connected to a transverse 3" Rod journalled in a 2½"×1" Double Angle Strip bolted to the Plate 17. This 3" Rod carries a Collar secured in place by a ¾" Bolt used in lieu of the set-screw. The head of the bolt is directed downward, so that the shank rests against the Rod 8 between the clutch 11 and Collar 12 (Fig. B). Consequently movement of the lever 20 imparts a sliding movement to the Rod 8, with the result that the clutches 11 and 15 may be engaged or disengaged, as desired, with their respective counterparts.

In both illustrations the lever is so placed that the clutch members 10 and 11 are engaged. As already stated the member 10 is rigidly secured to the Gear Wheel 9, which is connected through the gear train shown in Fig. A to the hand steering wheel 21; consequently in this position of the lever the rudder may be operated by rotation of the wheel 21, independently of the steering engine. If the lever 20 is thrown over to the opposite position the clutch members 10 and 11 are disengaged and 15 and 19 engaged. The unit 9 and 10 is now free to rotate idly about the Rod 8 and consequently the wheel 21 is put out of service, the rudder being operated from the shaft 18, which is driven from the steering engine.

The Gear Wheel 9 carrying the clutch member 10 is prevented from moving longitudinally by the Collar 8a on one side and the 1"×1" Angle Brackets 22 on the other.

It will be observed that the steering wheel 21 is constructed from a Face Plate having bolted round its circumference a number of Angle Brackets, to which are secured the Threaded Pins representing the spokes.

Joining the Clutch and Gear Wheel

The rudder is not built to scale and the details of the casing, bed-plate, etc., are approximate only. In actual practice these details vary in design according to the space available in the particular vessel and the shape of her stern, etc.

In a foot-note to last month's article on "Hunting Gear" it was mentioned that we hope to introduce in the near future a Meccano Sleeve Coupling. This part, when ready, will serve to connect rigidly together the clutch segment 10 and the Gear Wheel 9, and will thus obviate the necessity of reverting to the use of solder.

Meanwhile readers should experience little difficulty in soldering these pieces together. Before doing so, however, the ends of the two parts should be cleaned thoroughly by running a file over them, and during the process of soldering they should be secured in the required position on an Axle Rod.

In preference to the above method, some readers may decide to manufacture for themselves a part to serve the purpose of a Sleeve Coupling. As explained last month, such a part may be fashioned quite easily from a ½" length of metal piping.