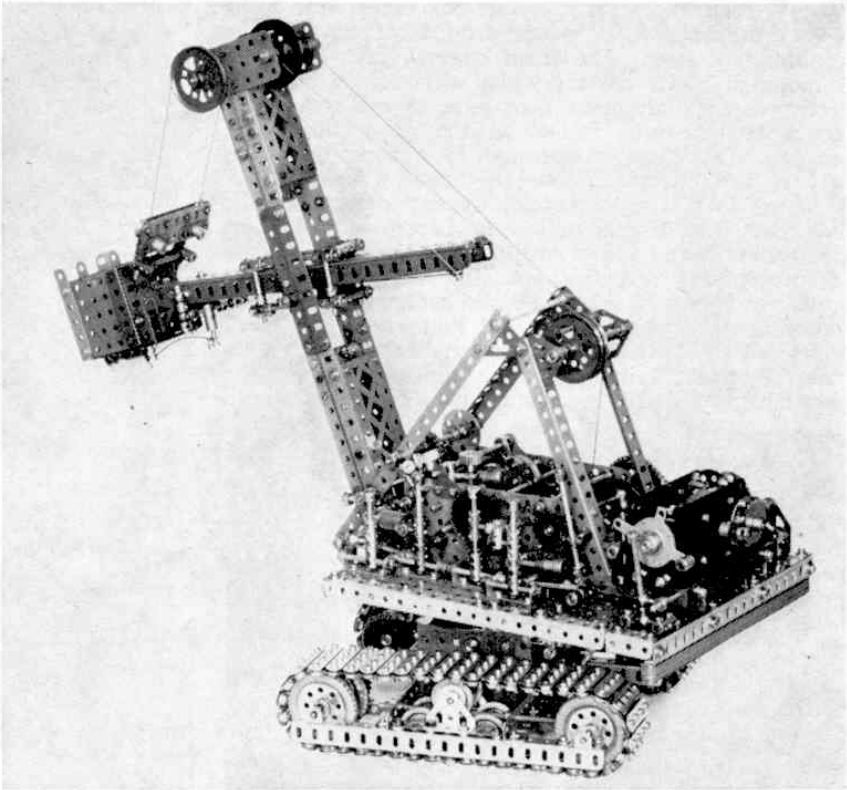
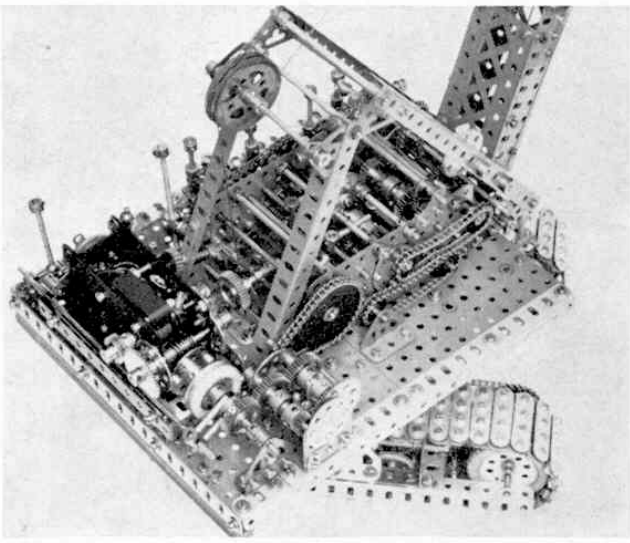
'Spanner' introduces a superb model of advanced construction designed, built and described by Patrick Lewis



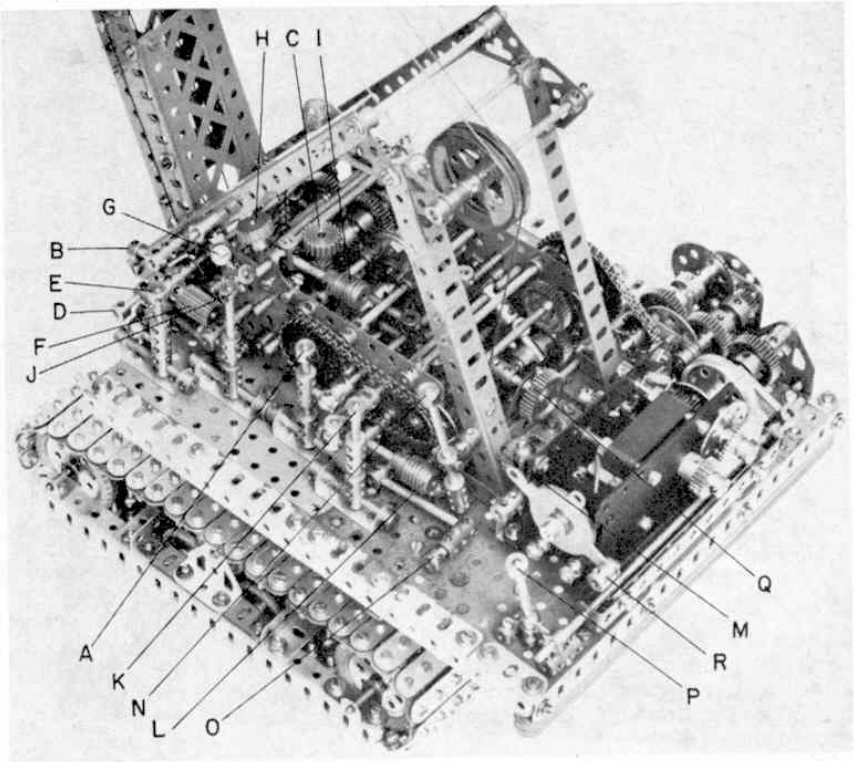
FACE SHOVEL EXCAVATOR

PAT LEWIS OF FORMBY, LANCASHIRE, has been employed as a model-builder at the Meccano Tri-ang factory in Liverpool for the past three years, now, but he has been a keen Meccano modeller for very much longer than that—ever since he was a young boy in Yorkshire, in fact. From time to time we have featured ideas from Pat in "Among the Model-builders", but on this occasion we are going much further and presenting a really excellent model he has built: a fully-working Face Shovel Excavator which qualifies as one of the most complicated pieces of Meccano engineering I have seen for a long time. Indeed, the complexity of the model prevents me from giving full step-by-step building instructions, but the accompanying photographs, coupled with Pat's following description, give a very good idea of just how outstanding the model undoubtedly is. Before getting to the description, however, and in order to show that working for the Company did not give Pat an unfair advantage, I should mention that he started to build the Excavator more than six years ago, finishing it before he joined Mecano. In other words, although Pat now works for the Company, his model qualifies as a private production!



A close-up view of the Excavator body showing the initial drive from the E15R Motor. Note the constant-mesh gearbox in the foreground which is similar to a unit featured in a recent "Among the Model-builders" article.

The machine (writes Pat) realistically performs all the motions of a real excavator, actuated by no less than 18 controls, all located on the left side of the superstructure and governing the clutch, gearbox, reversing clutches, slewing, travelling, steering, luffing, raising and lowering the bucket arm, retracting and extending the bucket arm and opening the bucket door which closes and locks automatically. Powered by an E15R Meccano Electric Motor mounted at the rear of the superstructure, the drive is transmitted by reduction gearing to a two speed constant-mesh gearbox via a clutch. A $\frac{3}{4}$ in. Sprocket Wheel on the output shaft drives the superstructure machinery that motivates the model. The entire gear complex is a constant mesh system.



This close-up view looking into the body of the machine clearly shows the large amount of operating machinery built into the model. All movements are controlled by the levers in the foreground.

Dog clutches are employed to engage drives independently to the drums, tracks and turntable. Two additional dog clutches are used in the reversing clutches operated by control lever A on the accompanying photograph. Two multi-jawed dog clutches in the undercarriage machinery control the direction one track rotates in relation to the other which enables the excavator to be steered whilst travelling. Socket Couplings are used as dog clutches to engage the drive to all the other motions. One cup of the Coupling is fixed over the boss of a gear by two Grub Screws but the gear, itself, is free on the shaft. In order to engage drive to the shaft the Coupling/gear unit is moved over by rod-operated selectors so that the open-ended socket slides over a Collar or wheel boss which is secured to the shaft by a Grub Screw. The protruding Grub Screw head engages with the waist of the Socket Coupling forming an effective dog clutch.

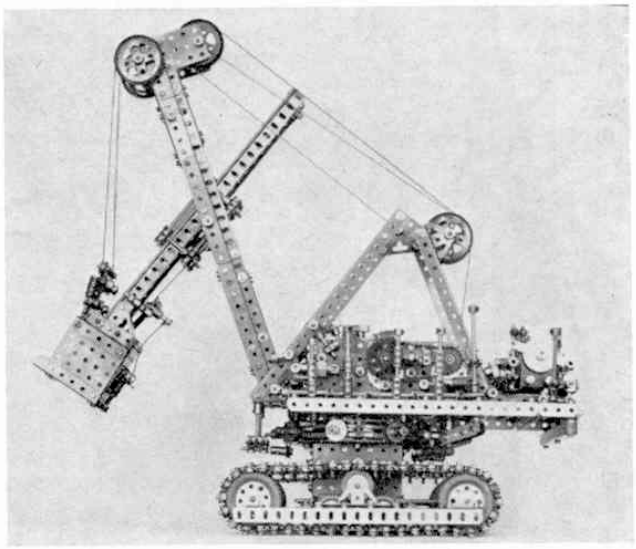
Simple yet powerful screw-operated friction brakes are used on the drum shafts together with ratchet brakes which prevent the drums from unwinding when the drive to them is first disengaged. To lower either the boom or the bucket arm the appropriate ratchet brake is disengaged and then the friction brake is eased off so that the drum is allowed to unwind slowly. The friction brake is re-applied to arrest the downward movement of the boom or the bucket arm whichever the case may be. When the brake has halted the drum, the Pawl is allowed to re-engage with the Ratchet Wheel on the drum shaft. Weighted levers control the engagement of the Pawls with the Ratchet Wheels.

Before engaging the dog clutch drive to any of the drum shafts the friction brake is released. The ratchet brake prevents the drum from unwinding pending engagement of the dog clutch. Unlike the crowding drum, the boom and bucket arm drums are driven one way only so that the Ratchet Wheels are allowed to revolve in that direction while the Pawls are engaged with them.

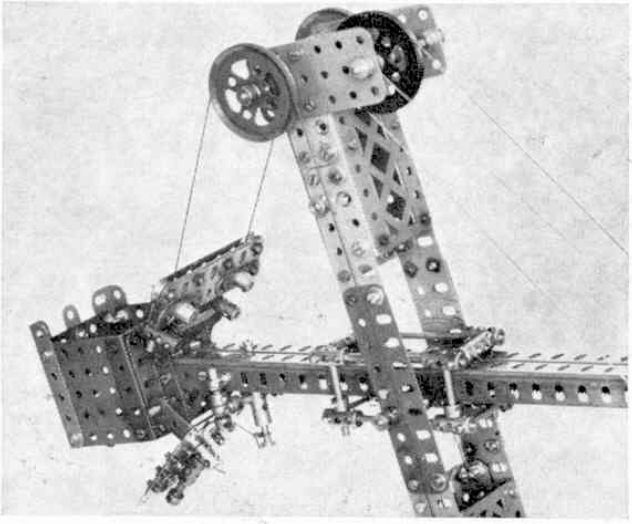
The superstructure platform is immensely strong and is stiffened further by the 6 in. turntable plate attached to, but spaced from the platform by numerous Threaded Bosses and Collars. The centre of the platform is unplated, to make room for the drives to the undercarriage machinery and turntable.

To ensure correct alignment of the bearings, eight fixed shafts connect the side plates of the machinery box. Three of these cross shafts incorporate Coupling bearings which locate the centre post, slewing pinion shaft and the drive shaft between them. Two more fixed shafts locate the centre bearing in which the shaft carrying the reversing clutches revolves. This shaft is chain driven from the layshaft which is in turn driven from the gearbox. The Sprocket on the other end of the reversing clutch shaft drives the bucket arm drum layshaft, the Chain beneath being driven indirectly from the nearer of the two 50-teeth Gear Wheels which rotate with 1 in. Bevel Gears on the fixed shaft below the reversing clutches shaft. This Chain drives the crowding drum layshaft. The reversing clutches have a neutral position on the shaft and either one can be engaged with the Collars on either side of the centre bearing.

The crowding drum shaft, operating the retraction and extension of the bucket arm, drives another drum shaft which controls the bucket door release catch. As both drums are equal in diameter and rotate at the same speed, the cord operating the bucket door release catch does not slacken when the bucket arm is extended. To open the bucket door, control B is turned clockwise. A friction brake acts on the bucket door trip-



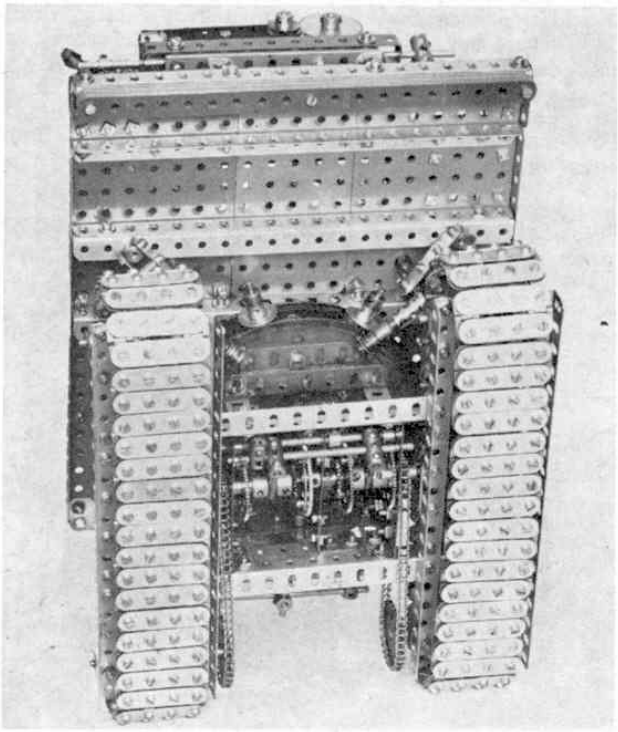
A side elevation showing the turntable roller and movement control levers.



A close-up view of the bucket arm showing the heavy-duty nature of the constructional methods used.

control shaft and, as this shaft and the crowding drum shaft are connected by Sprocket Chain, the brake also affects the crowding drum shaft. Similarly, a ratchet brake on the crowding drum shaft affects the bucket door drum shaft.

Built into the boom is the saddle block, pivoted amidships. A Rack Strip incorporated in the sliding dipper arm meshes with a ½ in. Pinion on the cross shaft on which the saddle block pivots. On each side of the Pinion is a ½ in. Pulley Wheel because, at present, the machine is fitted with a cord-operated crowd. It can, however, be adapted for Sprocket Chain drive from the crowd drum shaft. The cords pass under ½ in. Pulleys on the shaft serving as the boom pivot. One of the cords is reeved over and the other under the divided crowd drum so that, when the drive is engaged, one of the cords is wound in while the other unwinds. The bucket door trip-cord passes over a Pulley on the end of the saddle block cross shaft and under a ½ in. Pulley on the boom pivot shaft. As the distance between the saddle block cross shaft and the boom pivot shaft is constant, the boom can be raised or lowered without affecting the tension of any of these cords.



In this underside view of the Excavator, the detailed construction of the track and the track-drive gearing are clearly shown.

Three hook rollers effectively counteract digging stresses on the superstructure. A Gear Ring is fixed by Threaded Bosses to the lower turntable plate, the slewing pinion meshing with the outer teeth on this Gear Ring. Wheel Discs bolted to the centre of the turntable plates serve as bearings for the centre post on which a free-running ¾ in. Pinion is mounted, being held, with Washers, between the turntable plates. Meshing with this Pinion are two 50-teeth Gear Wheels, one of which is on the end of a shaft projecting through the top turntable plate, while the other is on the end of a shaft projecting through the bottom turntable plate. When the superstructure revolves on the turntable during slewing the Gear on the upper shaft can pass over the Gear on the lower shaft. Thus, when the upper shaft is driven, actuated by control C on photograph, the Gear on the end of the shaft turns the Pinion on the centre post, which in turn drives the other Gear on the lower shaft. A Pinion on the other end of this shaft, inside the undercarriage, shifts a Worm Gear on the rack and pinion principle. Selectors on the Worm shaft operate the steering clutches.

Carried in the track frames are the driving wheels, idler wheels and track rollers, the idler wheels running freely on fixed axles which can be moved back to take up any slack in the track. Although tyres on the driving wheels transmit a friction drive to the tracks, the grip is extremely powerful by virtue of the track design and double driving wheels. The track plates are spaced from the hinges by Nuts so that the plates do not rub on the hinge joints thereby causing considerable friction.

I hope the above details give some idea of the model, but in view of the complexity of the machine, I regret I am unable to enter into correspondence with readers on matters of construction.

CONTROL LEVER KEY

A. Reversing Clutches control.
B. Bucket door trip control.
C. Steering clutches control.
D. Track drive control.
E. Bucket arm crowd drum drive control.
F. Crowd drum ratchet brake.
G. Crowd drum friction brake.
H. Bucket arm friction brake.
I. Bucket arm ratchet brake.
J. Bucket arm drum drive control.
K. Boom drum drive control.
L. Boom drum ratchet brake.
M. Boom drum friction brake.
N. Initial drive gearbox control.
O. Slewing drive control.
P. Primary clutch control.
Q. Superstructure locking brake.
R. Motor switch.