

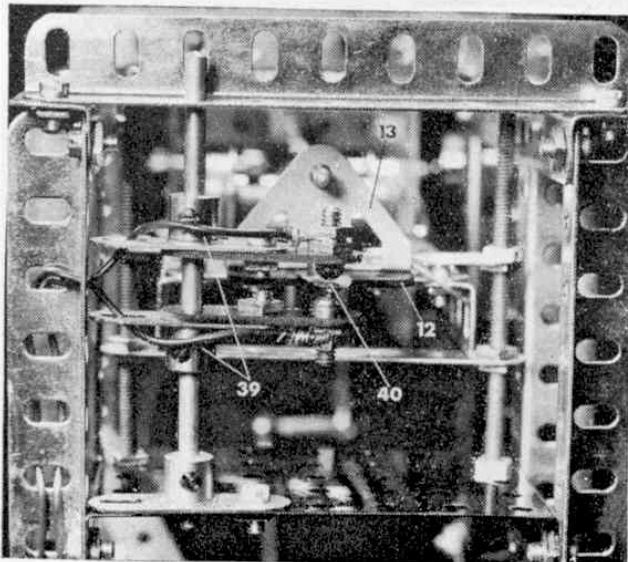
Among the Model Builders with SPANNER

A Weighing Machine with a Self-Balancing Steelyard by Ron Fail

Designed by Mr. Ron Fail of Bedford, this amazingly accurate Weighing Machine has the unique feature of a self-balancing steelyard or "weighbeam." The self-balancing action is controlled by a Power Drive Unit.

TRADITION HAS it that "Among the Model-Builders" be devoted to several items supplied by, or of interest to, readers. Traditions, however, can be broken from time to time, and this month I intend to do just that by devoting the entire article to one complete model designed by a reader, Mr. Ron Fail of Bedford. The model in question is a Weighing Machine; not an unusual Meccano subject in itself, but unique in this case in having a self-balancing steelyard! The steelyard, of course, is the balancing arm that carries the object to be weighed as well as the movable counterweight.

Mr. Fail is an extremely capable modeller who has the proven ability not only to design new models, but to design new models that are realistically useful. Already we have featured a superb Self-winding Clock produced by him and, having myself built his Weighing Machine, I can guarantee that its technical excellence is well up to standard. The model, in fact, gives a highly accurate reading once the exact weight of the counterweight has been determined, but it is important to remember that the counterweight is critical. When building the model, incidentally, study the photographs to see where elongated holes and where circular holes are used in the Girders.



Mainframe

To get down to business, the mainframe is built up from two $3\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plates joined by two $12\frac{1}{2}$ in. Angle Girders 1. Another three $12\frac{1}{2}$ in. Angle Girders 2, 3 and 4 are then bolted to each Girder 1 through its first, fifth and twelfth holes respectively, then a $9\frac{1}{2}$ in. Strip 5 is fixed, as shown, between Girders 2 and 4 for bracing purposes. At the top, Girders 2, 3 and 4 are connected by a $9\frac{1}{2}$ in. Angle Girder 6.

Bolted to Girders 2 and 3 at each side is a third $3\frac{1}{2} \times 2\frac{1}{2}$ in. Flanged Plate 7, the securing Bolts passing through the seventh holes from the tops of the Girders while Girders 6 are joined by two $4\frac{1}{2}$ in. Angle Girders 8 and a $4\frac{1}{2}$ in. Strip 9. Girders 4 at each side are braced by a $9\frac{1}{2}$ in. Strip, as shown.

Mainframe

The steelyard or weighbeam is the most complicated section of the model. Two $12\frac{1}{2}$ in. Angle Girders 10 are connected at one end by a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 11 and, at the other by a $2\frac{1}{2}$ in. Strip to which are bolted a $1\frac{1}{2}$ in. Insulating Flat Girder 12 (Electrikitt Part No. 508) and a Trunnion 13. Now fixed to one Girder 10 is a $5\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 14, so positioned that the end of the Girder protrudes a distance of four holes past the Plate. Fixed in a similar position on the other Girder 10 is a $5\frac{1}{2} \times 3\frac{1}{2}$ in. Flat Plate 15, the Plate protruding a distance of two holes beneath the Girder. The securing Bolts in both these Plates should be at the upper limits of the elongated holes in the Girders. The Plates, themselves, are joined by two $2\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips 16. Another Double Angle Strip 17 is also bolted between the Flat Plates, one lug coinciding with the centre hole in Plate 14.

Journalled in Plates 14 and 15 is a 4 in. Rod 18 carrying a $\frac{1}{2}$ in. Pinion between the Plates and another $\frac{1}{2}$ in. Pinion 19, as well as a 50-teeth Gear Wheel 20, outside Plate 15. Also journalled in the Plates, and held by Collars, is a 3 in. Rod, on which a Short Coupling 21 is mounted. A large Fork Piece, carrying a $3\frac{1}{2}$ in. Rod 22 in its boss, is pivotally attached to the Short Coupling by a 1 in. Rod fixed in one of its transverse bores. The weight pan will later be connected to Rod 22.

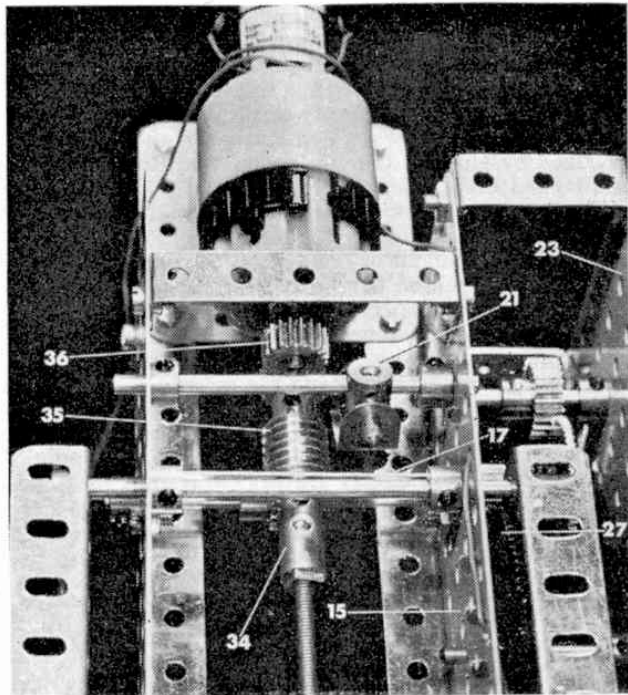
The electrical system fitted to the model is extremely simple, as this picture shows. Besides the spacing of the contacts, the only essential thing to remember is that the Contact Screws must be isolated from the metal parts of the model. This is done by fixing them to $1\frac{1}{2}$ in. Insulating Strips.

At this stage, however, a second $5\frac{1}{2} \times 3\frac{1}{2}$ in. Flat Plate 23 is attached to Plate 15 by four $1\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips, one at each corner. Mounted in these two Plates are two 2 in. Rods 24 and 25, both held in place by two Collars fixed one each side of Plate 23, each Collar carrying a $\frac{3}{8}$ in. Bolt 26 in one tapped bore. The Bolt in the outside Collar will serve as a pointer, while that on the inside is to counterweight it and so must point in an exactly opposite direction. In addition to the Collars, Rod 24 carries a $2\frac{1}{2}$ in. Gear Wheel 27, in mesh with Pinion 19, while Rod 25 carries a $\frac{3}{8}$ in. Pinion 28, in mesh with Gear Wheel 20. Note, incidentally, that the lower Double Angle Strips are fixed to Plate 23, not by Bolts, but by Handrail Supports 29. Mounted in these is a $5\frac{1}{2}$ in. Rod carrying a Collar to which a $\frac{3}{8}$ in. Pulley 30 is attached by a Pivot Bolt to form a zero adjusting weight. The Collar must be able to slide on the Rod.

Next we have the travelling counterweight which consists of eleven $1\frac{1}{2}$ in. Strips and four $1\frac{1}{2} \times 1\frac{1}{2}$ in. Flat Plates 31, bolted between two $2\frac{1}{2}$ in. Strips. Journalled in one end of these $2\frac{1}{2}$ in. Strips is a $1\frac{1}{2}$ in. Rod carrying two $\frac{3}{8}$ in. Flanged Wheels 32, each spaced from its Strip by two Washers. Journalled in the other end of the $2\frac{1}{2}$ in. Strips is a 1 in. Rod carrying a Coupling 33, the Rod passing through the lower smooth bore of the Coupling. Screwed into the upper tapped bore of the Coupling is an 8 in. Screwed Rod extended, via a Threaded Coupling 34, by a 2 in. Rod. This is journalled in Double Angle Strip 17, while the Screwed Rod is journalled in the apex hole of Trunnion 13. Flanged Wheels 32, of course, run on Angle Girders 10.

Mounted on the 2 in. Rod are a Worm 35 and a $\frac{1}{2}$ in. Pinion, the former in mesh with the Pinion between Plates 14 and 15 on Rod 18. The latter, on the other hand, is meshed with a $\frac{1}{2}$ in. Pinion 36 on the output shaft of a Power Drive Unit, bolted in the centre of Flat Plate 11. The 12 : 1 ratio should be in use.

The weight pan is provided by a $2\frac{1}{2} \times 2\frac{1}{2}$ in. Flat Plate 37 to which a Double Arm Crank is bolted. Fixed in the boss of this Crank is a $6\frac{1}{2}$ in. Rod, to the top of which a Handrail Coupling 38 is secured. Another Handrail Coupling is mounted on the lower end of Rod 22, then the two are joined by a $1\frac{1}{2}$ in. Rod.

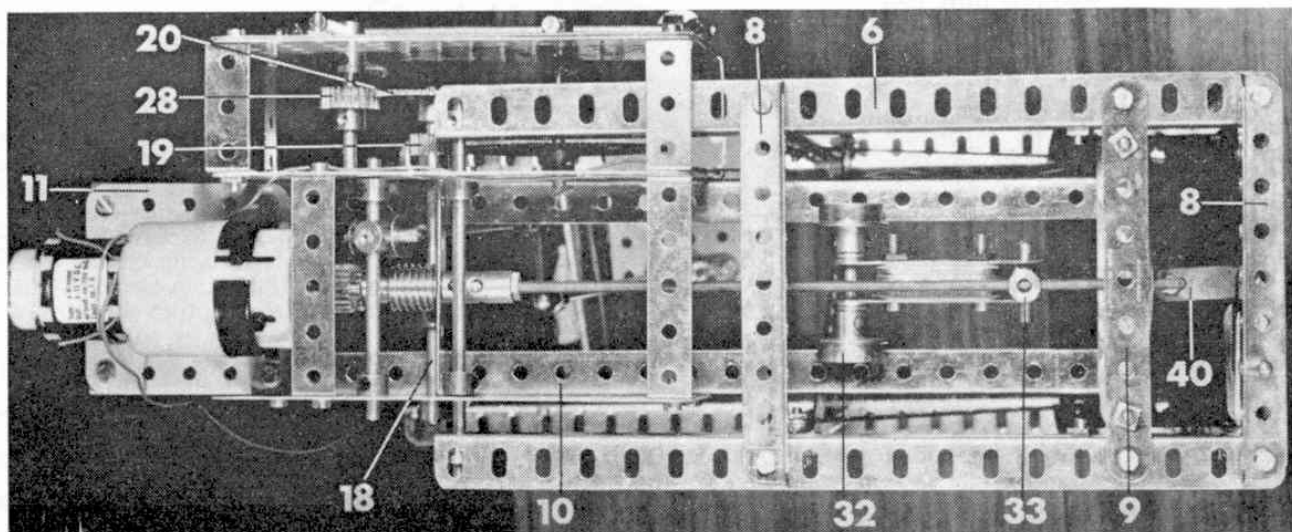


In this close-up view of the motor mounting, the method of transferring the drive both to the travelling counterweight and the weight indicators is clearly shown.

Electrics

You will have realised that the self-balancing action of the model is controlled by the Power Drive Unit, for which an electrical contact system is required. This, I am pleased to say, is not complicated. A $3\frac{1}{2}$ in. Rod is mounted in a Double Arm Crank bolted to Flanged Plate 7. Fixed on the Rod are another two Double Arm Cranks 39, each extended one hole by a $1\frac{1}{2}$ in. Insulating Strip (Electrikrit Part No. 503), to which a Contact Screw (Electrikrit Part No. 543) is attached. Located between the Contact Screws is a 1 in. Wiper Arm 40 (Electrikrit Part No. 531) which is bolted to Insulating Flat Girder 12.

A plan view of the Weighing Machine showing the layout and construction of the steelyard as well as its position in relation to the mainframe.



Double Arm Cranks 39 are adjusted so that the Wiper Arm has a vertical movement of only $1/64$ in. each way from the balanced position, while the actual steelyard should be allowed a movement of no more than $1/8$ in. each way. Stops to prevent further movement are provided by a $3\frac{1}{2}$ in. Strip 41 and Fishplates 42, fixed by Nuts on two $3\frac{1}{2}$ in. Screwed Rods mounted in Flanged Plate 7 and Strip 9.

To operate the model, two batteries of at least $4\frac{1}{2}$ volts each are required. (I used Ever Ready 126's.) The positive terminal of one battery is connected to the negative terminal of the other and to either of these terminals is also connected one of the motor leads. The other motor lead is connected to Wiper Arm 40, while the remaining battery terminals are connected, one each, to the Contact Screws in the model.

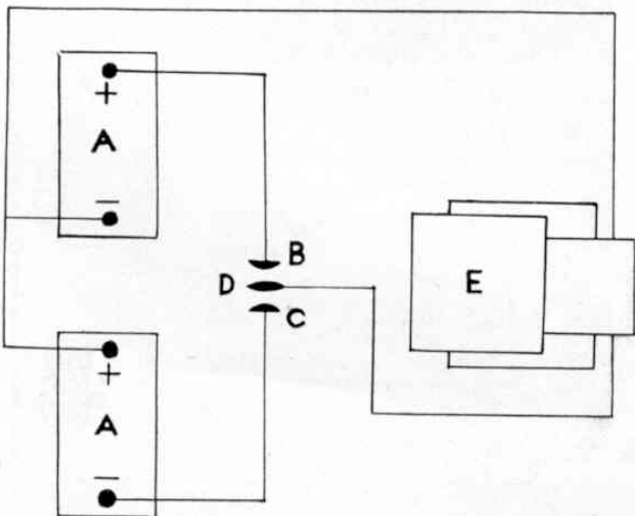
Finally, a scale is prepared from cardboard and attached to Flat Plate 23, Rods 24 and 25 protruding through holes made in the cardboard. Calibration is not difficult. Two circles are drawn around the holes through which the rods will protrude, then each of these circles is marked into ten equal parts and numbered 0-9. With the scale in place, the dial for Rod 24 indicates ounces and that for Rod 25, tenths of ounces.

PARTS REQUIRED		
2-1a	2-20b	1-63c
2-1b	1-23a	1-70
2-2a	1-25	2-72
1-3	3-26	4-74
3-5	1-27	1-79
11-6a	1-27c	2-80a
10-8	1-32	6-111
2-8a	75-37a	1-111c
2-9a	96-37b	1-116
2-10	9-38	1-126
1-14	2-38d	1-128
1-14a	4-48	2-136
1-15a	3-48a	2-136a
2-15b	2-52a	1-147b
1-16	3-53	2-503
3-17	12-59	1-508
2-18a	3-62b	1-531
2-18b	1-63	2-543

I Power Drive Unit

In operation, Mr. Fail's Weighing Machine is amazingly sensitive. As I have already said, however, the counterweight is critical and, while the unit as described will give pretty accurate results, you will probably find it necessary to add one or two Bolts to

WIRING DIAGRAM: A— $4\frac{1}{2}$ volt batteries. B—upper Contact Screw. C—Lower Contact Screw. D—Wiper Arm. E—Power Drive Unit.



get the weight exactly right. You will know when this is so, of course, when the dials show the correct reading for a known weight placed in the pan. If you do not have a commercially-produced "known" weight, then use British silver coins. Five shillings worth equal one ounce!

A last word now about the zero adjusting weight. Assuming the main counterweight is correct, you may find, after weighing something, that the scale pointers do not return exactly to zero, owing to backlash in the gears. This is where the zero adjusting weight comes in as it enables the pointers to be easily re-set before anything else is weighed.

Special Display Model

MECCANO MOTOR CHASSIS

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in Fishplate 58 and into the boss of another Large Fork Piece 62. Lock-nutted to the lugs of the latter Fork Piece are two shaped $2\frac{1}{2}$ in. Strips 63, attached to Girder 1 by one right-hand and one left-hand Corner Angle Bracket. A Long Threaded Pin is screwed into one tapped bore in the boss of Crank 61 and on this is loosely mounted a $4\frac{1}{4}$ in. Road Wheel to which a Wheel Flange 64 is bolted. A Collar holds the Road Wheel in place. Note that the Threaded Pin must not grip the Rod in the boss of Crank 61 and is prevented from doing so by adding an extra Bolt to the Pin.

To the front end of the right-hand Girder 1 a $1\frac{1}{2}$ in. Angle Girder 65 is fixed, the front securing Bolt also fixing a right-hand Corner Angle Bracket in place. The upper lug of this Bracket is bent forward slightly to provide one bearing for an 8 in. Rod which serves as the steering column and which carries a Worm 66. The other bearing for the Rod is provided by a $1\frac{1}{2}$ in. Strip 67, attached to Curved Strip 13 by Obtuse Angle Brackets. Collars hold the Rod in place.

Bolted to Angle Girder 65 is a 1 in. Triangular Plate, extended by a $1\frac{1}{2}$ in. Strip 68, to the top of which a $1 \times \frac{1}{2}$ in. Angle Bracket overlaid by a Fishplate is secured. Journalled in this Angle Bracket/Fishplate is a 2 in. Rod, held in place by a Crank 69 and a $1/8$ in. Pinion 70, the latter in mesh with Worm 66. A lower mounting for the Rod is provided by a Collar attached to Angle Girder 1 by a Bolt passed through the Girder and into one transverse tapped bore of the Collar. Lock-nutted to the arm of Crank 69 are two Rod and Strip Connectors which are connected to further Rod and Strip Connectors, lock-nutted to Cranks 61, by a 1 in. Rod and a 4 in. Rod respectively.

A radiator is now built up from two $1\frac{1}{2} \times \frac{1}{2}$ in. Double Angle Strips 71, the lugs of which are joined by two 2 in. Strips held by two 2 in. Screwed Rods 72. Mounted on these Rods are eleven 2 in. Strips, each spaced from the next by two Washers. A shaped $2\frac{1}{2}$ in. Strip 73 is added to the top as shown, then the finished radiator is attached to front Strip 53 by one left-hand and one right-hand Corner Angle Bracket. Two Rod and Strip Connectors joined by a 1 in. Rod represent a water hose running between the top of the radiator and the engine.

NEXT MONTH: We conclude the Motor Chassis with constructional details of the rear axle, differential and working brake.