A Working Model of a 300-ton

Mammoth Meccano Dragl

THERE can be little doubt that amongst the many Meccano achievements of the last few years, the production of the series of "Super" models ranks as one of the greatest. The series embraces a very wide variety of engineering subjects and includes such universally famous examples as the Meccano Block-setting Crane, the Chassis, and the Ship Coaler.

This month we commence the constructional details of yet another splendid Meccano Super Model—the Dragline. The instructions for building this model will be completed in a further instalment that will appear next month.

Machines that Make Canals and Railway Cuttings

The "dragline" type of excavator is used largely in such work as the making of canals and railway cuttings, etc. In construction it is somewhat similar to the steam shovel (or mechanical navvy, as it is sometimes termed), but differs considerably in its method of operation, as is shown clearly in the Meccano model.

The name "dragline" is derived from the fact that the digging bucket is dragged towards the machine on a flexible rope, instead of being mounted on an arm pivoted to a jib, as in the case of an ordinary steam shovel. While steam shovels excavate above the level of the ground on which they stand and advance into the excavation as the work proceeds, a dragline excavates below the level on which it stands and travels backwards when it has excavated all the material within reach. Owing to its construction and method of operation it is possible to place a dragline some distance away from the scene of the excavation, and because of this feature a dragline is of exceptional value where the ground is too soft to allow a steam shovel with its short jib to stand.

As an example of the great practical value of this type of excavating machine, it will be of interest to mention that during the construction of the Panama Canal, draglines, used in conjunction with steam shovels, did the work of thousands of labourers at a fraction of the cost. Apart altogether from the fact that their upkeep was nothing like the amount that would have been required for wages if men had been employed, they helped considerably in solving the difficult problem of housing and feeding. The Panama Canal was cut through a practically uninhabited zone, and it was therefore necessary to erect large numbers of shelters and temporary houses for the workmen. Even when every conceivable form of labour-saving device was used, it was still necessary to employ over sixty thousand men. These men, with their wives and families, had to be housed and fed in what was practically a desert area. This in itself was a very big task, but if it had not been for the employment of wonderful mechanical devices such as steam navvies and draglines, the number of labourers required would have been so enormous that it would have been practically impossible to find accommodation for them, which only goes to show how great a part mechanical devices really played in the construction of this famous canal.

The Prototype of the Meccano Model

The Meccano model has been designed to resemble as closely as possible the largest dragline in the world. Its huge prototype was built by Ruston and Hornsby Ltd. (Lincoln), for service in connection with irrigation schemes in India, and the following details of this machine will no doubt add interest to the construction of the model.

When fully equipped and in working order the machine weighs 300 tons. In less than one minute it will dig seven or eight cubic yards of material—a single bucket load—and deposit it 200 feet away from the point whence it was excavated. This means that it would nearly fill an 8-ton coal wagon in one cut! The jib is 120 feet in length and the drag-rope from the bucket 1¾″ in diameter. The main engines develop 400 h.p. and, in addition to these, separate engines of 200 h.p. are fitted for slewing the jib and superstructure. The machine may also be used as a crane, in which capacity it will lift a load of 22 tons at a radius of 125 feet.

The cycle of operations—i.e., digging, slewing, discharging, slewing back, and dropping the bucket in readiness for another cut—is completed in the short period of 45 to 55 seconds, according to the material being excavated.

Building the Model: The Base

The construction of the model dragline should be commenced by building the base (Fig. 3). Each of the sides are exactly similar; they are composed of four 12½″ Angle Girders 1 bolted to a

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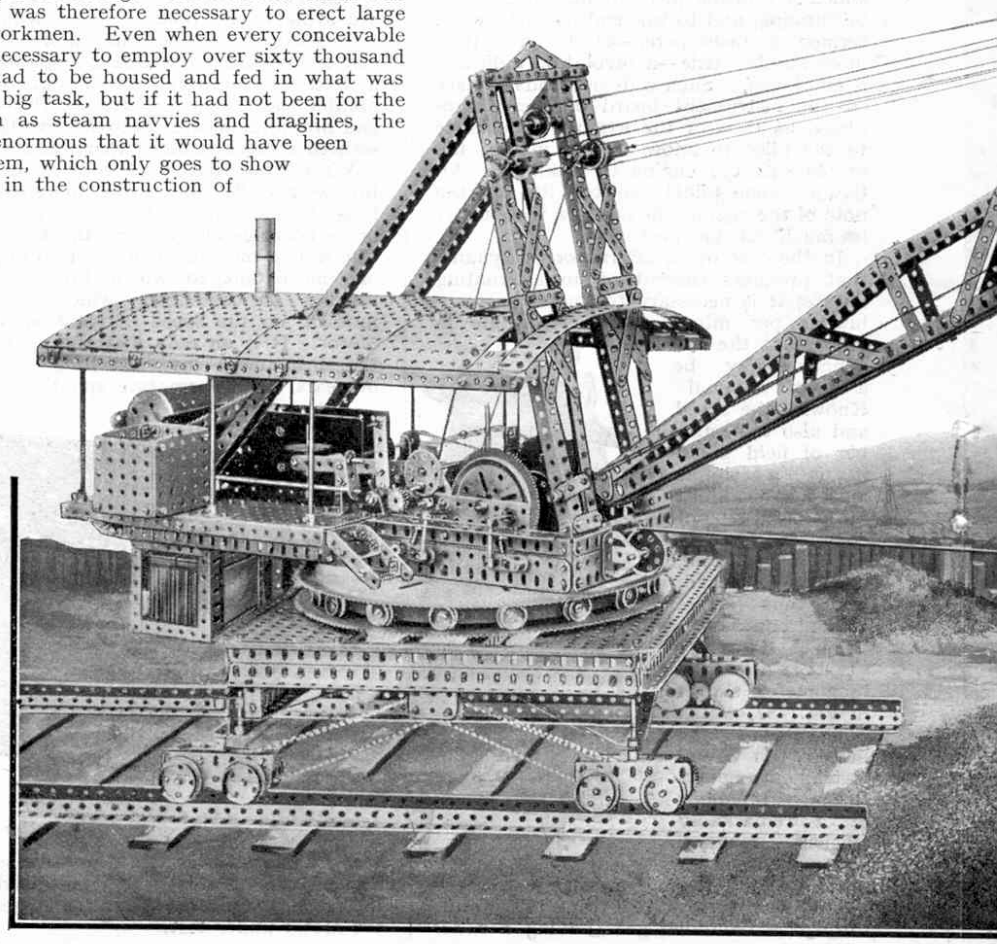

·ton Excavator in Use in India

gline Excavating Machine

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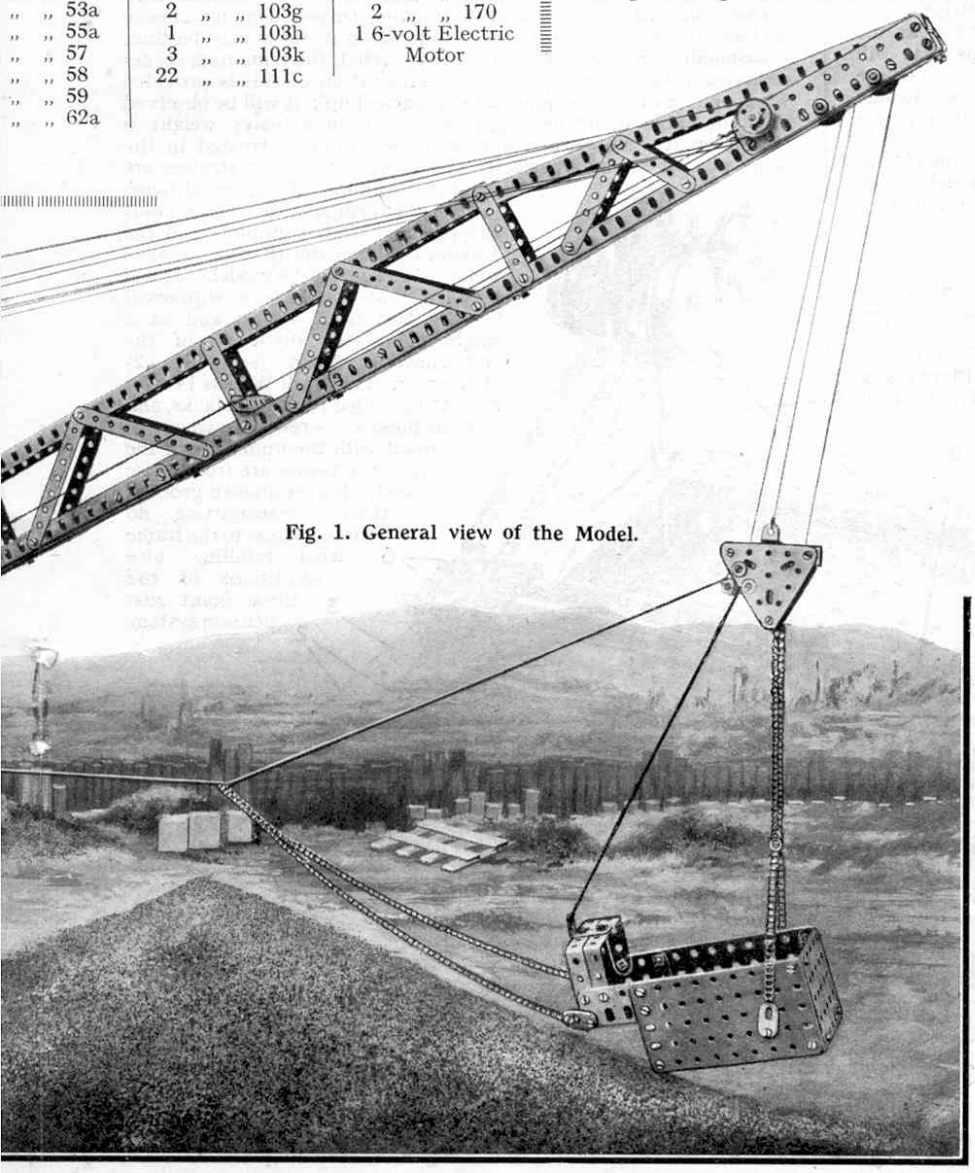

Fig. 1. General view of the Model.

$12\frac{1}{2}''$ Flat Girder so as to form an H-section girder of great strength, and they are connected together at the corners by $1'' \times 1''$ Angle Brackets.

Four $12\frac{1}{2}''$ Angle Girders 2 are secured to the top of the frame thus formed and a Geared Roller Race 3 is bolted thereto by means of $\frac{3}{8}''$ Bolts, three Washers being placed on the shanks of the bolts between the Angle Girders and the Race, for spacing purposes. A $5\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plate is attached at each corner in order to fill in the spaces left by the Race at the corners of the base.

The bogies at the front end of the machine (which is the far end in the illustration under consideration) are mounted on $3\frac{1}{2}''$ Rods 4 passed through the holes in the Angle Girders 1 at each corner and retained in position by Collars; the Rods are supported further by means of $5\frac{1}{2}''$ Strips bent as shown and bolted to the $12\frac{1}{2}''$ Girders.

Secured halfway along the Angle Girders 1 are two Channel Bearings placed one on either side; in each of these Channel Bearings is journalled two $1\frac{1}{2}''$ Rods carrying two $\frac{3}{4}''$ Sprockets 5 and two $\frac{1}{2}''$ Pinions 6. An $11\frac{1}{2}''$ Rod 7, also journalled in the Channel Bearings, is further supported near its centre by 2″ Strips that are bolted to Trunnions secured to a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate that is bolted across the centre pair of Girders 2 by $\frac{3}{8}''$ Bolts. The Trunnions are packed up with Washers so that the end holes of the 2″ Strips shall be in alignment with those in the Channel Bearings and allow the Rod 7 to turn freely. The latter Rod carries at either end a $\frac{1}{2}''$ Pinion that meshes with both the Pinions 6 on the Rods carrying the $\frac{3}{4}''$ Sprockets 5. A $\frac{7}{8}''$ Bevel, secured to the Rod 7, meshes with a second Bevel on the vertical Rod 8 that passes up into the gear box and forms the pivot about which the superstructure turns.

Compensating Beam and Bogies

Fig. 2 shows clearly the details of the compensating beam and the bogies attached thereto. As all four bogies are similar in construction, a description of one will suffice. The frame of the bogie consists of two $3\frac{1}{2}''$ Flat Girders held together by three Double Brackets, to two of which the Crank 9 is bolted. The drive for each bogie is taken off the $\frac{3}{4}''$ Sprocket 5 (Fig. 3) by means of Sprocket Chain to the 1″ Sprocket Wheel mounted on a short Rod that is journalled in the bogie side frames and which carries a $\frac{3}{4}''$ Pinion. The latter meshes with the 50-teeth Gear Wheels 11 secured on the wheel axles. By this means it will be seen that the drive is transmitted to all the sixteen wheels, a fact which ensures the maximum adhesion and reduces wheel slip to a minimum.

The compensating beam consists of two $12\frac{1}{2}''$ Angle Girders 12 between the flanges of which is bolted a $12\frac{1}{2}''$ Flat Girder. To the lower edge of the Flat Girder four $5\frac{1}{2}''$ Angle Girders are bolted flanges outward, the space between their centre ends being filled in by a $1\frac{1}{2}''$ Angle Girder on each side of the Flat Girder. As will be seen the Angle Girders are arranged on the slant, in order to give the maximum depth in the centre of the beam and a taper towards each end, this shape in practice giving a girder great strength and rigidity. Extra strength is given to the lower flanges of the compensating beam by the addition of a $12\frac{1}{2}''$ Flat Girder bolted along the bottoms of the $5\frac{1}{2}''$ and $1\frac{1}{2}''$ Angle Girders. A Threaded Crank 13, bolted to the underside of the flange of the Girder 12 at each end, carries in its bore a 1″ Threaded Rod having a Bush Wheel 14 secured to its upper end.

Construction of the Jib

The jib should next be constructed, this being shown clearly in the general view of the model (Fig. 1).

Each bottom longitudinal member of the jib is built up from two $18\frac{1}{2}''$ and one $9\frac{1}{2}''$ Angle Girder, each of the former overlapping the latter by four holes. Each top longitudinal member is composed

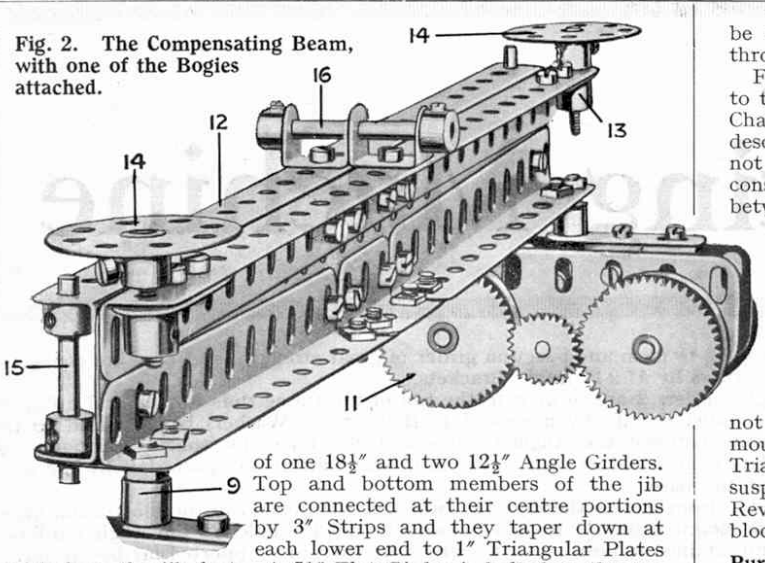

Fig. 2. The Compensating Beam, with one of the Bogies attached.

of one $18\frac{1}{2}''$ and two $12\frac{1}{2}''$ Angle Girders. Top and bottom members of the jib are connected at their centre portions by 3″ Strips and they taper down at each lower end to 1″ Triangular Plates which form the jib foot. A $5\frac{1}{2}''$ Flat Girder is bolted to the top and bottom members at each side of the jib head and these Girders form bearings for the jib head pulley spindles. The luffing cord Pulleys that can be seen mounted against the outside faces of the Flat Girders are secured on a $3\frac{1}{2}''$ Axle Rod, whilst the 1″ loose Pulleys secured between the Flat Girders at the jib head are mounted on $2\frac{1}{2}''$ Rods.

As will be seen the jib is adequately braced by Strips. The cords are attached to points halfway up the jib and near the jib head, their lower ends being secured to $1\frac{1}{2}''$ Strips that will eventually be placed on the jib pivot pin. The purpose of these cords is to prevent the swaying of the jib from side to side and thus take abnormal stresses off the jib pivot. In practice the cords are composed of very strong wire rope.

After the jib has been completed it should be laid on one side in readiness for the final assembly of all the units of the model, which procedure will be described in detail in the final instalment of this article.

The Drag Bucket and Pulley Block

The units that should next receive the builder's attention are the drag bucket and the pulley tackle that supports it, these parts being seen in the general view (Fig. 1).

The sides of the bucket are composed of $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates and a similar Plate is used for the bottom, this latter Plate being secured to the sides by means of $4\frac{1}{2}''$ Angle Girders. The back of the bucket consists of a $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate, $2\frac{1}{2}''$ Angle Girders being used to hold it to the sides.

Since in actual practice a machine of this type is often required to excavate material of a relatively hard and congealed nature, serrations or "tines" are provided on the front bottom edge of the bucket so that the latter can exert a "slicing" or cutting action on the work and thus increase the efficiency of the machine. These "tines" have been represented in the Meccano bucket by securing three 2″ Strips to the $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate, forming the bottom of the bucket, so that each Strip projects one hole.

A 2″ Flat Girder should next be secured to each side of the bucket and two $2\frac{1}{2}'' \times 1\frac{1}{2}''$ Double Angle Strips are secured between these Girders as shown in Fig. 1. A $1'' \times \frac{1}{2}''$ Angle Bracket should be bolted to the centre of the Angle Strips and a Flat Bracket pivotally attached in the end slotted hole of each Flat Girder (see Standard Mechanism No. 263).

The ends of a length of Sprocket Chain should next be attached to these Flat Brackets by means of bolts passed through the end loops of the Chain and held in position by nuts.

Flat Brackets are also attached by means of lock-nutted bolts, to the side walls of the bucket, and a further length of Sprocket Chain is attached to these Brackets in a similar manner to that described previously. In order that the supporting chain will not foul the upper walls of the bucket, a cross-piece or "yoke" consisting of a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip should be secured between the separate lengths of chain. This Angle Strip is held to the Chain by bolts forced through the links of the latter and secured by nuts. Washers should be placed under the head of each bolt to prevent damage to the links of the Chain.

The pulley block consists of two $2\frac{1}{2}''$ Triangular Plates, held apart by a Double Bracket bolted at each corner. Two 1″ Triangular Plates are secured to the $2\frac{1}{2}''$ Plates as shown, and form journals for a 1″ Axle carrying a $\frac{1}{2}''$ loose Pulley. The bolts used to hold the 1″ Plates in place should have Washers placed under their heads, so that their shanks do not foul the main sheave. This sheave consists of a $1\frac{1}{2}''$ Pulley mounted on a 1″ Axle Rod journalled in the centre holes of the Triangular Plates. The Pulley block is secured to the bucket suspension chain by means of a short piece of cord or wire, and a Reversed Angle Bracket is attached to the upper portion of the block to provide a fixing lug for the free end of the hoist cable.

Purpose of the Compensating Beam

Although the functions of the jib and drag bucket will be clear to readers, the purpose of the specially-constructed compensating beam will not be so obvious, and before concluding this month's instalment of the constructional details, we are appending a brief explanation of its principle.

If an object carrying a great weight and supported at each corner, such as the base of the dragline, travels over an uneven surface, abnormal stresses will be induced in it, for it may be that, occasionally, only three corners are supported, the remaining corner receiving little or no support. An illustration of this is provided when one leg of a four-legged table is packed up; it will be observed how the table is strained and twisted when a heavy weight is placed on it. Now when a three-legged table is treated in the same way, it remains perfectly steady and no undue stresses are exhibited under these conditions.

It is this principle of "three point suspension" that is employed in the Ruston Dragline and that has been so well brought out in the model. It will be seen that the base is supported by the two front bogies and at a single point—the pivot 16 of the compensating beam (see Fig. 2) at the rear. The Bush Wheels 14 with their 1″ Threaded Rods form jacks, and when these are screwed down out of contact with the underside of the base, the bogies are free to rise and fall over uneven ground, thereby transmitting no undue stress to the frame and fulfilling the conditions of the three point suspension system.

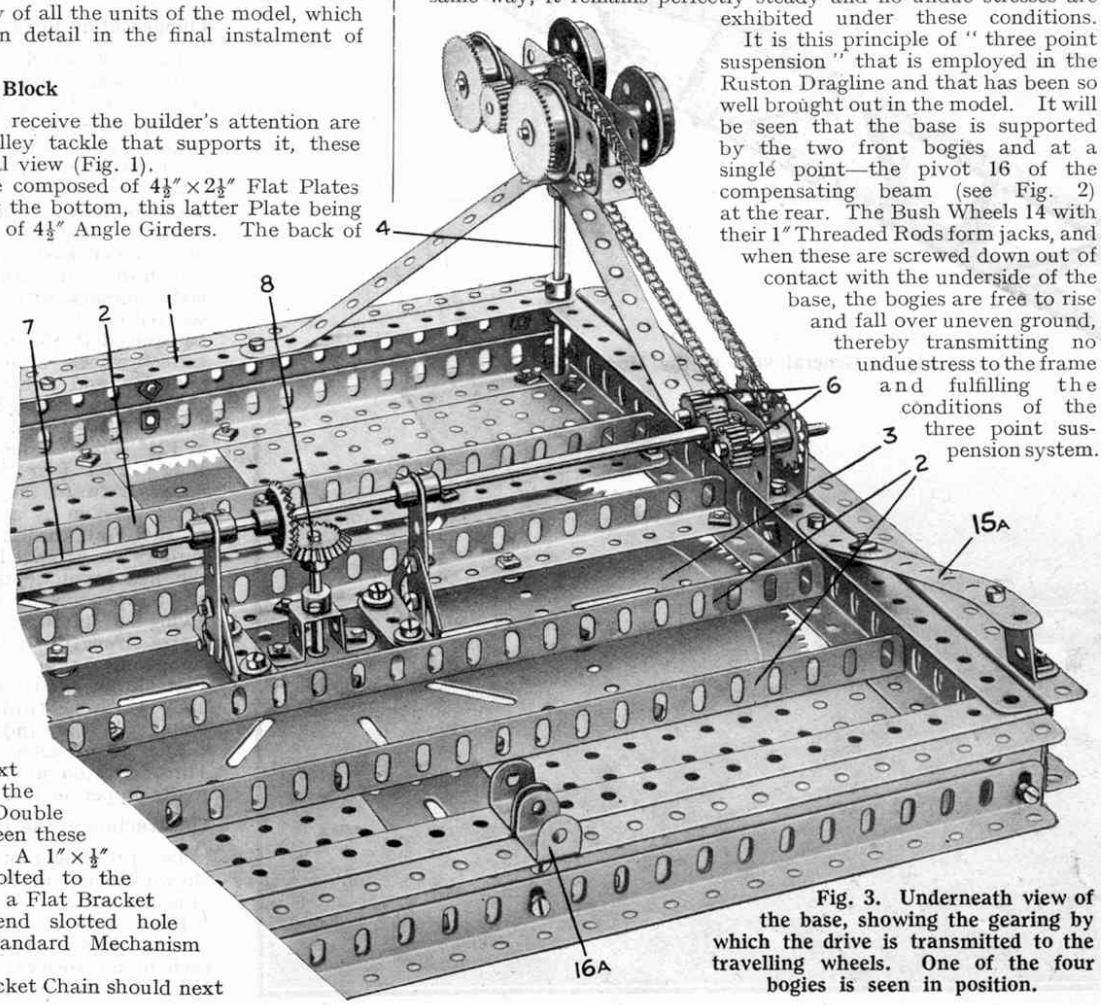

Fig. 3. Underneath view of the base, showing the gearing by which the drive is transmitted to the travelling wheels. One of the four bogies is seen in position.

Meccano Giant Dragline

Final Instructions for Building this Splendid Model

THE first instalment of this article describing the Meccano model of a 300-ton Dragline Excavating Machine, which appeared in last month's issue, dealt with the construction of the jib, travelling base, bucket, and pulley block of the model. Continuing the constructional details, we deal this month with the superstructure framework and gear box, and with the final assembly and operation of the Dragline.

The A-Frames and Superstructure

The A-frames or vertical members shown in Fig. 5 each consist of four 7½″ Angle Girders spaced apart in the centre by a 2″ Strip and at each end by a 1½″ Strip. Two "ties" 23, consisting of 18½″ Angle Girders bolted together to form channel girders, are connected to the top of each vertical member by means of 2″ Rods that are passed through the vertical members. The 1″ loose Pulleys 24 are mounted on 2½″ Rods that are carried by 1″ Triangular Plates attached to the 7½″ Angle Girders, and a further 1″ Pulley 25 is carried on a 3″ Rod inserted in the third hole from the top of each member.

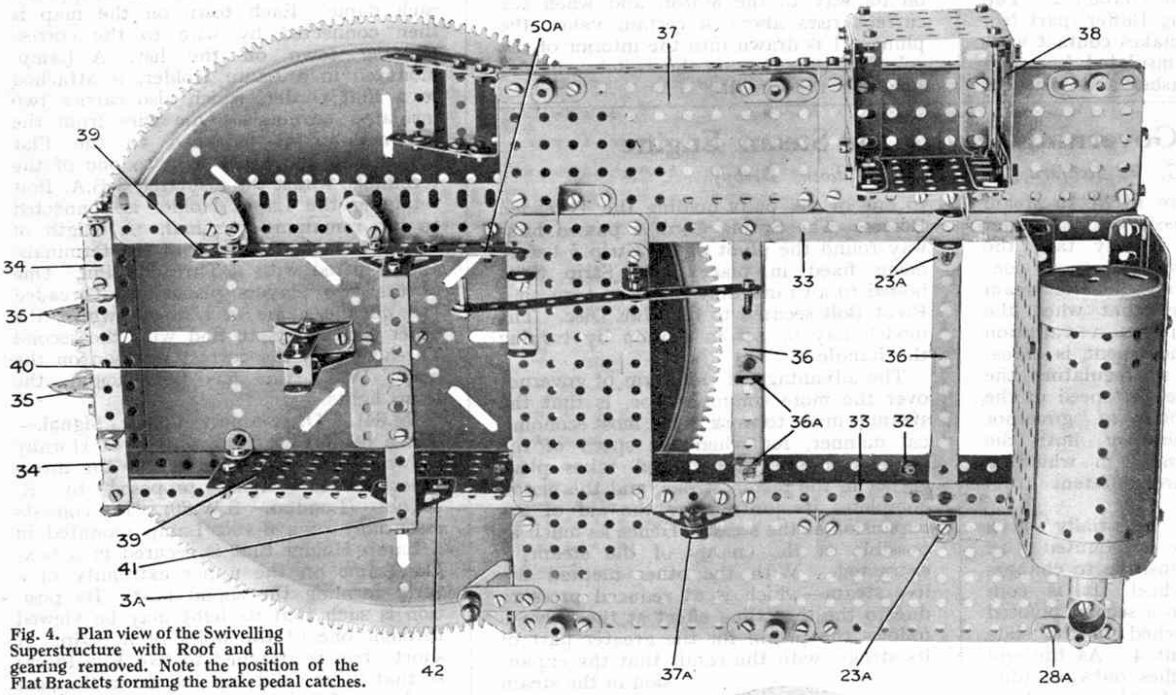

Fig. 4. Plan view of the Swivelling Superstructure with Roof and all gearing removed. Note the position of the Flat Brackets forming the brake pedal catches.

The framework to which the 5½″×3½″ Flat Plates forming the roof proper are attached, consists of two 18½″ Angle Girders 26 connected together at the rear end by two 7½″ Angle Girders, while two 2″ Angle Girders 27 are attached to the front ends of the Girders 26. Double Arm Cranks are secured in the positions indicated to provide the necessary means of attaching the Rods 28 that support the roof.

Fig. 7 shows the complete unit with Gears, Motor, etc., in place, whilst Fig. 4 gives a very good idea of the construction of the framework, with all gears removed. Each side member of the frame consists of two parallel 18½″ Angle Girders 32 and 33 (Figs. 4 and 7) spaced apart by two 9½″ Flat Girders bolted end to end. The front end of the members are joined together by two 5½″ Angle Girders and a 5½″ Flat Girder and are connected to the sides by means of 1½″ Angle Girders. Two 1½″×½″ Double Angle Strips 34 (Fig. 7) are bolted to the top 5½″ Angle Girder and two Trunnions 35 (Fig. 4) are secured to the 5½″ Flat Girder, a Washer being placed on the shank of each retaining bolt between the flange of the Trunnion and the Flat Girder.

The 5½″×2½″ Flat Plates 37 are attached to 5½″ Angle Girders that are bolted—flanges outward—to the Angle Girders 33, and 5½″ and 2½″ Angle Girders are attached to their outer edges to strengthen them. The coal bunker 38 is built up from 2½″×2½″ Flat Plates and 2½″ Angle Girders, and secured in position on the Plates 37.

The sides of the gear box proper consist of two 5½″×2½″ Flat Plates 39, secured to the Angle Girders 33 by 5½″ Angle Girders bolted to the underside of the former Girders. As will be seen from the illustration (Fig. 4) the entire structure is mounted on the upper, or movable, Geared Roller Race 3a, to which are bolted in the position shown, two Trunnions that carry the 2½″ Strips 40. The 4½″ Double Angle Strip 41 is bolted between 1½″ Strips secured to the Plates 39 by Flat Trunnions 42.

Details of the Gear Box

Fig. 7 is a plan view of the Swivelling Superstructure of the model with all the Gears, Motor, brakes, etc., in position.

The Motor is bolted to the Girders 36, its front end being attached to the Angle Brackets 36a (Fig. 4). A 2″ Rod, journalled in the side plate of the Motor, carries a 57-teeth Gear Wheel in mesh with a ½″ Pinion on the armature spindle, and also a ½″ Pinion that engages with another 57-teeth Gear on the 4½″ Rod 43a. This Rod also carries a Sprocket 43 and a Worm 64, and is journalled in the Motor side plates and in an additional bearing 37a (Fig. 4) consisting of a 1½″ Strip bolted to a Trunnion that is secured to the Angle Girder 33.

The hoisting winch consists of a 3½″ Gear 44 secured on a 2½″ Rod that is journalled in one of the Plates 39 and in the centre bearing 40. One Bush Wheel, one Collar, and three Washers are secured in place on the 2½″ Rod to represent the "hoist barrel." A 3″ Pulley 45 secured to the 3½″ Gear by means of ⅜″ Bolts, comprises the brake drum round which the brake band is passed. One end of the latter is fixed to a portion of the framework and the other end is attached to a Coupling that is secured at right angles to a short Rod journalled in both the side plate 39 of the gear box and in the 9½″ Flat Girder comprising the side member. The outer end of the Rod carries a Crank (see general view in last month's "*M.M.*") in the end holes of which a 1½″ Rod 46 is mounted pivotally by means of a Collar, a set-screw being passed through the end hole of the Crank and screwed home in the tapped hole of the Collar. The brake is kept in the "off" position by means of a short length of Spring Cord fastened by nuts and bolts to the Crank and to the 7½″ Flat Girder above it; the Crank is spaced away from the side by two Washers on the Rod. When it is desired to hold the brake on for any length of time, the Rod 46 or "brake pedal" is pushed down, thus applying the brake, and the pivoted Flat Bracket is swung over the end of the brake pedal to hold it down.

The details of the digging winch are exactly similar to that just described, with the exception that the brake-actuating

cranks are secured on a 6½″ Rod 47 that passes completely across the gear box and is journalled in the side frames.

The luffing winch consists of a 5″ Rod 49 to which is secured a 50-teeth Gear Wheel 49a, and a Ratchet Wheel. The Pawl 50 is mounted on a Pivot Bolt attached to the Strip 50a (Fig. 4). The Pawl carries a Threaded Pin in its tapped hole, by which it can be disengaged from the Ratchet.

Slewing and Travelling Motions

A Socket Coupling 58 carries at its upper end the male portion of a Dog Clutch and at its lower extremity a ½″ Double Width Pinion that is in constant engagement with the Worm on the Rod 48. The Socket Coupling is placed on the Rod 8 and should be perfectly free to revolve on it and only turn the Rod when pushed up into engagement with the female portion of the Dog Clutch that is secured rigidly to the Rod.

The lever 59 controls the travelling movement, and consists of a 3″ Strip that is attached by means of a Crank to a short Rod journalled in a 1½″ Double Angle Strip, which is bolted to the floor plates.

The special Pinion (Part No. 167c) engaging with the teeth of the lower fixed Race 3, is secured to a 4½″ vertical Rod 60 journalled in the 5½″ Angle Girder 36 and also in a second 5½″ Girder and Double Arm Crank that is bolted to the lower 18½″ Angle Girders 32 (Fig. 4). One portion of a Dog Clutch and a 57-teeth Gear Wheel are connected together by means of a Socket Coupling 61, the complete unit being shown in Fig. 7 removed from its Rod for the sake of clearness. Actually, of course, it is placed on the Rod 60 and operated by the lever 62, the ⅜″ Bolt in the end of which engages with the groove of the Socket Coupling.

A 1″ Gear 52 is secured to a short Rod carrying also a 1″ Sprocket Wheel that is connected by Sprocket Chain to the ¾″ Sprocket 43 on the shaft 43a driven by the Motor. A Coupling is secured to the inner end of the short Rod in such a manner that the other end of the Coupling may be fitted on to the projecting end of the Rod 49 and be free to turn thereon. This arrangement forms a convenient support for the inner end of the short Rod, and its outer end is journalled in a bearing consisting of a Handrail Support, which is secured in the boss of a Threaded Crank that is bolted to a Trunnion and to a 5½″ × 2½″ Plate that forms part of the flooring or "operating platform" of the superstructure.

Adjusting the Gear Box

To adjust the gears in the gear box, the 6½″ Rod 51 which forms the sliding primary shaft, should first be placed at the extremity of its travel to the left (looking toward the front of the model) and the 1″ Gears 52 and 56 so arranged as to be just in mesh with each other. (A Collar on the other end of the Rod will be secured in place when all the other movements have been adjusted to prevent any further movement of the Rod to the left). In this position of the Rod the ½″ Pinion 53 is in mesh with the 3½″ Gear Wheel 44a of the digging winch, as will be seen from Fig. 7.

A slight movement of the Rod to the right (caused by turning the gear selector wheel 57) should result in the Pinion 55 being brought into engagement with the gear 44 of the hoisting winch, and the Pinion 53 out of engagement with the Gear 44a. By continuing the movement of the Rod to the right, the Gear 44 will eventually become disengaged, at which point the 50-teeth Gear 48a on the Rod 48 should be in mesh with the ¾″ Pinion 54. At the extreme limit of the travel of the Rod to the right the ¾″ Pinion 54 comes into mesh with the Gear Wheel 49a on the luffing winch barrel 49.

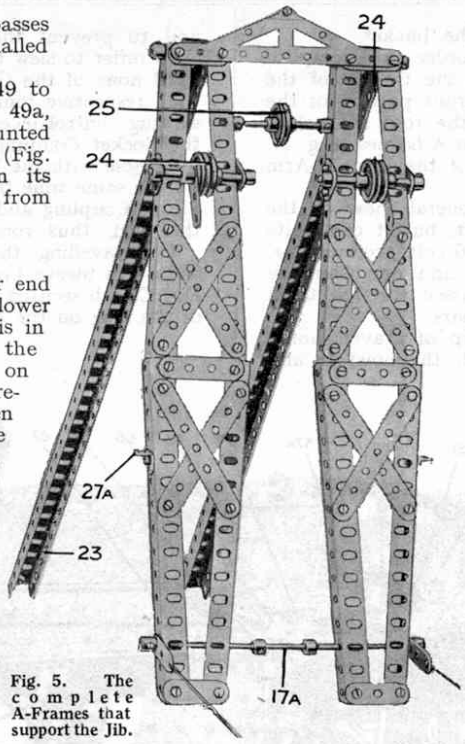

Fig. 5. The complete A-Frames that support the Jib.

It will most probably be found that the Gears 48a, 49a both remain in mesh with the ¾″ Pinion 54 in this extreme position of the Rod 51. This does not matter, however, so long as the Gear 48a comes into engagement with the ¾″ Pinion before the Gear 49a. It is necessary of course that the gears 52 and 56 are in mesh throughout the complete travel of the Rod 51.

The sideways movement of the Rod 51 when changing gear is effected in the following manner: A Threaded Crank runs on the end of the 5″ Threaded Rod 57a, which is journalled in the Trunnions 42 and restrained from sideways motion. The Rod 51 passes through the end hole of the Crank, which is retained in position on the Rod by Collars on both sides as shown. When the handwheel 57 secured to the Threaded Rod is rotated, the Threaded Crank advances or recedes along the Rod and so moves the Rod 51.

The Motor switch is operated from the central controlling position of the model by means of the Crank 63.

Final Assembly of the Model

The compensating beam 12 is placed in position by passing the Pin 16 through the Double Brackets 16a, which are bolted to the Girder 1 (see Figs. 2 and 3), and the Rods 15 through the end holes of the Strips 15a so that the Rods slide freely in them. The Strips 15a brace the beam and prevent it from twisting; they each consist of one 4½″ Strip and a 2″ Slotted Strip. The ¾″ Sprockets mounted on the base are connected to the Sprockets on the bogies by suitable lengths of Sprocket Chain.

The swivelling superstructure is now lowered on to the Ring Frame, the Rod 8 passing through the Bush Wheel bolted to the upper Race. At this juncture the Socket Coupling 58 (Fig. 7) is slipped on to the Rod 8, the end of which is then passed through the Flat Girder attached to the Double Angle Strip 41 (Fig. 4). (The latter Strip has been broken away in Fig. 7 to show the gearing more clearly).

The A-frames (Fig. 5) are secured to the 1½″ Double Angle Strips 34 (Fig. 7) and the rear ties attached to the Angle Brackets 23a. The 1″ Triangular Plates at the jib foot are pivoted on the 6½″ Rod 17a that is passed through holes in the Girders of the A-frames and held in place by Collars on the Rod; the 1½″ Strips attached to the ends of the ropes that form the stays for the jib are placed also on the end of this Rod.

One end of the luffing rope is attached to a 1½″ Strip on the Rod carrying the 1″ Pulleys 24, and is taken round one of the Pulleys at the jib head and back over one of the Pulleys 24. Thence it passes round the last Pulley at the head of the jib and then over the remaining Pulley 24 to the luffing winch barrel 49 (Fig. 7), on which it is secured by a Collar.

The hoisting rope is secured to the ½″ Reversed Angle Bracket on the Pulley Block from which the drag bucket is suspended, led over one of the topmost Pulleys at the jib head and rove through the sheave of the block; thence it passes over the other Pulley at the jib head and down to the hoisting winch barrel over the Pulley 25. The digging rope is secured to the digging winch barrel and is led over the 1½″ Pulley 35a, the Hook on its end being

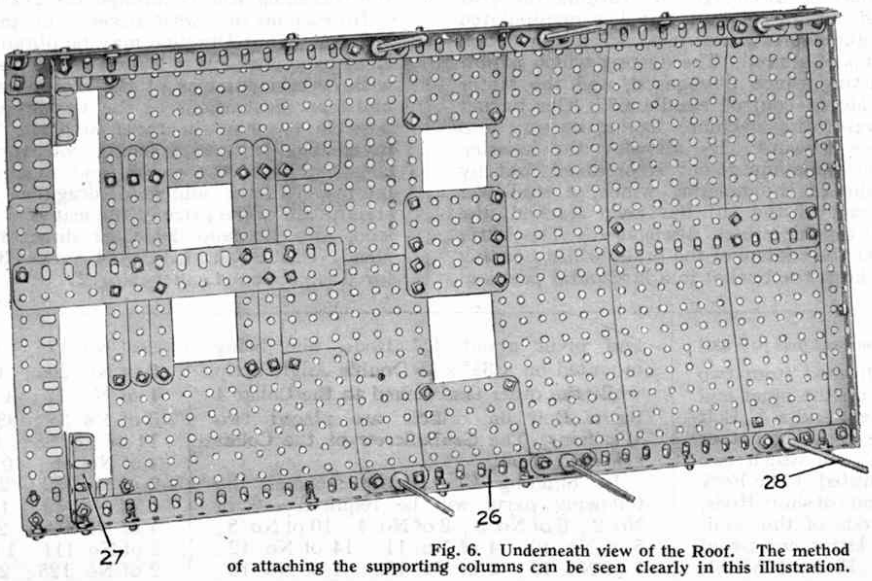

Fig. 6. Underneath view of the Roof. The method of attaching the supporting columns can be seen clearly in this illustration.

attached to the Sprocket Chain bridle of the bucket.

Lastly the roof is placed in position. In order to accomplish this, it is necessary to remove temporarily the ties 23 of the A-frames and the Flat Girders forming the front portion of the roof. The 2″ Angle Girders 27 (Fig. 6) of the roof are bolted to the Angle Brackets 27a on the sides of the A-frames (Fig. 5), and the Rods 28 are secured in the bosses of the Double Arm Cranks 28a.

The accumulator carrier shown in the general view of the model is designed for a 4-volt 8 ampere unit, but it can quite easily be enlarged so as to accommodate a 6-volt accumulator. The chimney consists of five Sleeve Pieces and one Chimney Adaptor attached to a 6½″ Rod by bolts passed through them and inserted in the set-screw holes of Collars.

In order to set the model to work, a heap of gravel should be deposited in front of the machine. Both the hoisting and digging winches should first be disengaged by turning the gear selector wheel 57, and the brakes of both winches manipulated so that the bucket lowers and comes to rest in a horizontal position at the far edge of the heap of gravel. The digging winch is now engaged, leaving the hoisting winch disengaged, and the Motor started by moving the Motor control handle 63. The bucket will now be dragged towards the machine, digging its way into the material as it moves forward. By allowing the hoisting winch to run out freely a maximum cut is obtained, but by lightly applying the brake of the hoisting winch, a shallower cut results. When the end of the cut has been reached, the hoist is engaged and the digging winch disengaged. The latter is allowed to run out under the control of the brake whilst hoisting is in progress in order to keep the bucket in a horizontal position, and to prevent the contents of the bucket being spilt.

In order to slew the model the gear selector wheel 57 is turned until none of the Gears 44, 44a, or 49a are in engagement with their respective Pinions on the Rod 51; this is "neutral." The slewing control lever 62 is then pulled upward, thereby lowering the Socket Coupling 61 and bringing the Gear attached thereto into mesh with the Worm 64 on the shaft 43 driven by the Motor. At the same time the portions of the Dog Clutch attached to the Sleeve Coupling and the Rod 60 come into engagement and turn the Rod, thus rotating the superstructure.

For travelling, the control lever 59 is moved backward. This slides the Sleeve Coupling 58 upward so that the portion of the Dog Clutch secured in its upper end engages with the other portion of the Dog on the Rod 8. The latter is thus rotated and drives the travelling wheels through the gearing shown in Fig. 3.

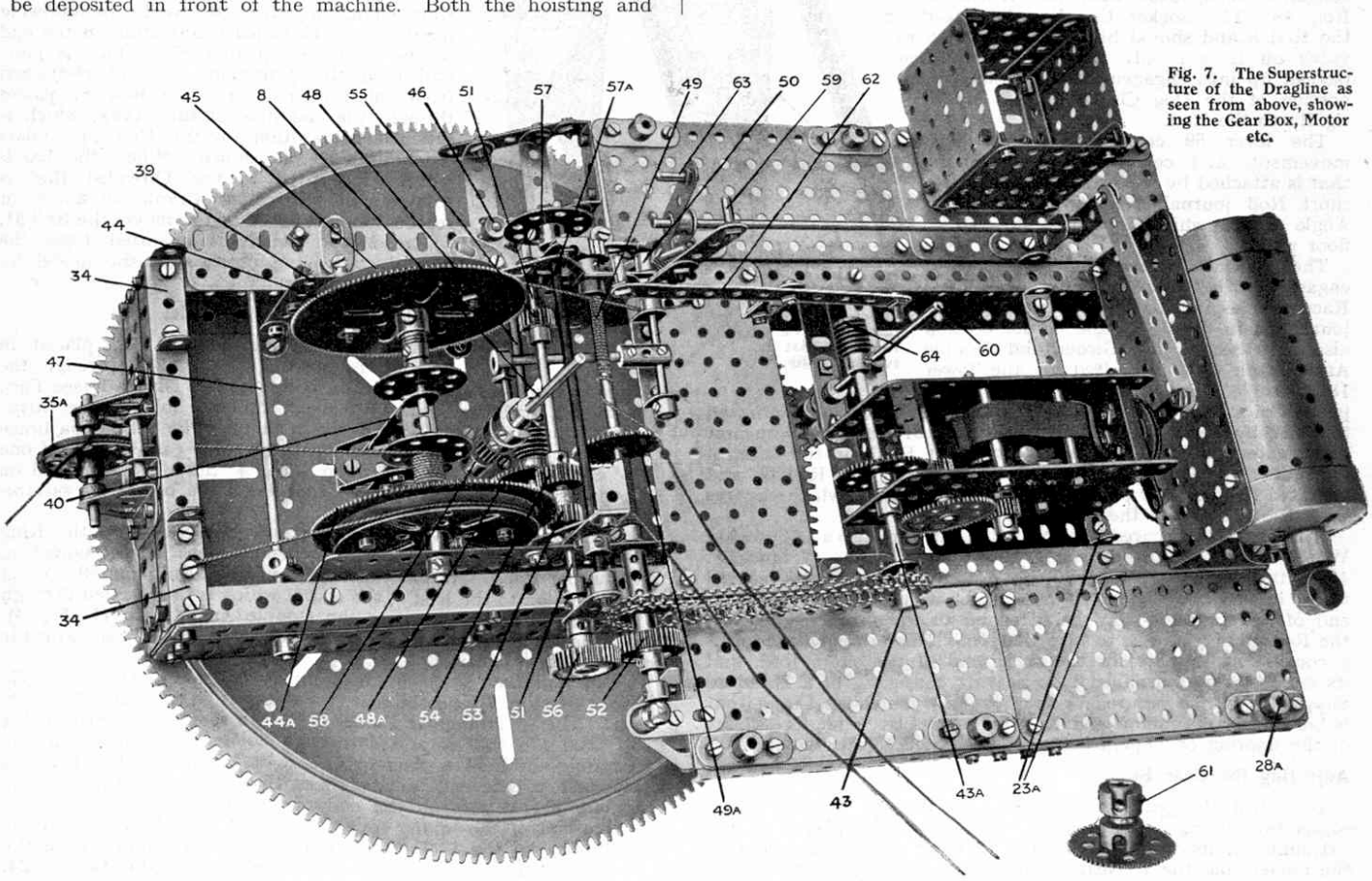

Fig. 7. The Superstructure of the Dragline as seen from above, showing the Gear Box, Motor etc.

Instructions in Leaflet Form—Full instructions for building the Meccano Giant Dragline may be obtained in the form of a special eight-page instruction leaflet. This leaflet deals at greater length with certain portions of the model and also contains additional half-tone illustrations of the various units that it has not been possible to show in these articles. The leaflet will be found invaluable, both as a handy constructional guide for intending constructors of the model, and as a work of reference for those interested in the subject of draglines from a general engineering standpoint. The price of the leaflet is 3d. and it may be obtained from any Meccano dealer or direct from Meccano Ltd., Binns Road, Old Swan, Liverpool, price 3d. post free. Please ask for Instruction Leaflet No. 27.

New Meccano Models—*(Continued from page 299)*

Each paddle wheel is formed from two 3″ Pulleys on a 3½″ Rod, on the inner end of which a 2″ Pulley is fixed, and a ¾″ Bolt 1 connects the 2″ Pulleys rigidly together and forms a "crank pin" on which two Small Fork Pieces are mounted. The Fork Pieces are secured to the ends of short Rods, representing the piston rods of the oscillating cylinders. The latter consist of Sleeve Pieces fitted with ¾″ Flanged Wheels and pivot about 4½″ Rods, one being mounted on a 3½″ × ½″ Double Angle Strip while the other is attached to the Collar 4 by a Bolt on which are placed two Washers. The Grub Screw of the Collar grips the Rod.

In building the paddle steamer the following parts will be required:—6 of No. 2; 6 of No. 3; 2 of No. 4; 10 of No. 5; 5 of No. 10; 4 of No. 11; 14 of No. 12; 1 of No. 13; 2 of No. 15a; 4 of No. 16; 2 of No. 17; 1 of No. 18a; 4 of No. 19b; 2 of No. 20a; 4 of No. 20b; 1 of No. 21; 1 of No. 22; 1 of No. 22a; 1 of No. 24; 6 of No. 35; 93 of No. 37; 4 of No. 37a; 14 of No. 38; 1 of No. 40; 1 of No. 45; 1 of No. 46; 10 of No. 48a; 1 of No. 48b; 2 of No. 52; 2 of No. 53; 1 of No. 54; 4 of No. 59; 1 of No. 62; 1 of No. 63; 4 of No. 90a; 2 of No. 99; 2 of No. 100; 2 of No. 111; 1 of No. 115; 1 of No. 116a; 2 of No. 125; 2 of No. 163; 1 of No. 165.