

**FAC**

*Sole Agents for the*  
*British Isles*  
**WEYCO (SALES) LTD.**  
**18-20, DAMES ROAD,**  
**LONDON, E.7.**

MARYLAND ~~4324~~

# THE FAC SYSTEM

*a manual*

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MARK SYLWAN AB

STOCKHOLM



**FAC IS MANUFACTURED IN SWEDEN BY**

**AB O. MUSTAD & SON  
GOTHENBURG**

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## FAC

*Preface by Professor Edy Velander*

*Director of The Royal Swedish Academy  
of Engineering Sciences*

*When FAC first came on the market in 1952 it caused great attention because it so essentially differed from previously well known construction kits.*

*After several years of experimenting FAC has now reached a new stage in its development and will no doubt, in its present widened form, appeal also to the adult amateur. FAC will now seem to be quite without competitors on the world market.*

*Because of its logical evolution FAC is particularly instructive and should arouse technical interest even in very young enthusiasts and thus help to attract those engineering qualities from our reserves of talent, which are becoming more and more invaluable because of the rapid technical expansion of our day.*

*Furthermore FAC can serve as an excellent aid for demonstrations and experiments during technical courses at various levels, because, with the FAC parts, it is easy to build basic machine assemblies and technical constructions in a way which makes it simple to demonstrate how the mechanical loads are distributed and the movable parts arranged.*

*Quite apart from its instructive value, FAC has already begun to be made use of in laboratory circles, where, by availing oneself of the prefabricated parts, one can construct stands, gears, stirring machines and other aids to experimental procedures, and do so more quickly and easily than in the workshop, the specialized machines of which may perhaps become worthless after a short period of use.*

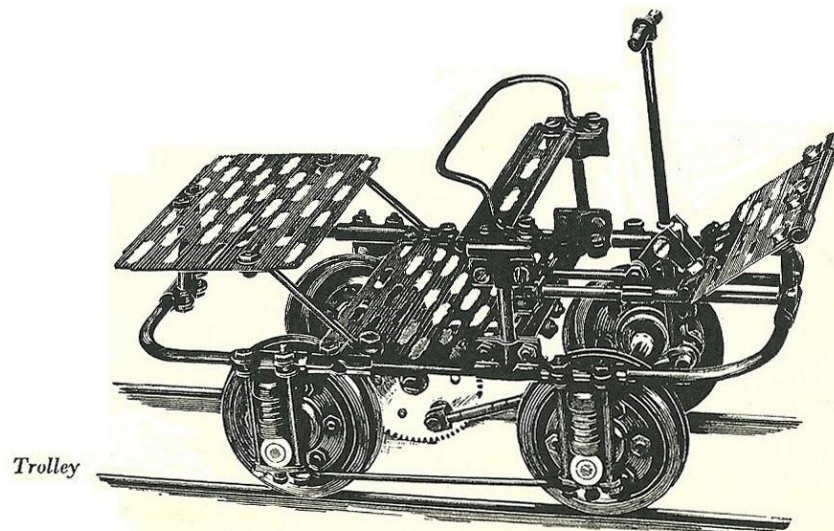
*It is also possible that FAC will be of good help in the workshops of industrial production, e.g. precision mechanics and electronics.*

*Edy Velander.*

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Trolley

FAC is a medium for those who are interested in the solution of mechanical problems and wish to see them realized. To satisfy the demands of an adult public in regard to genuine craftsmanship, a system has been developed, which is radically different from the manner of building inherent to the usual construction kits, more or less toys, which are the only systems capable of comparison.

Inasmuch as it is not possible to draw a definite line between people with engineering as a hobby and professional engineers, it is also difficult to determine whether FAC is a hobby or a medium for technicians wishing to work with models. FAC is, in fact, used by both groups.

This manual is a detailed introduction to the method of construction adopted in the FAC system. It is directed to a public, which wishes to work according to its own wishes and needs. The models, which are shown in varying degrees of completion, should therefore be considered as work-

ing examples, roughly analogous with exercises in a foreign language with a grammar and syntax of its own. Providing one has learned how to command it, there is nothing one cannot express with it.

FAC is limited to purely mechanical constructions, viz. that field which people find it difficult to master without costly and bulky tools. FAC dispenses with all finish, such as coachwork, bodywork, driver's boxes, etc. Thus the steel plates, which are part of the system, are intended as foundations and not as housing. These limitations are fully compatible with the endeavour to retain the realism which distinguishes mechanical constructions. Precisely because of its realism the FAC model encourages a finish in other media, such as wood, thin sheet-metal, plastics, etc. Thus the constructor has the possibility of putting his own, very personal, signature to the completed work.



### THE PRINCIPLE OF FAC

FAC has been developed, simply and logically, on the basis of a fundamental conception. It is a complete system in the sense that no changes are to be expected in the principal constructional elements. A number of items from the great universal storehouse of technology may, indeed, be adopted in the system and included in the standard kits when necessary, but the constructional skeleton is complete.

The skeleton consists of the framework and rigid constructions, which support the moving parts. The framework can be diversified within wide limits, from airy, graceful mast constructions to compact girder and plate structures. Framework parts should, furthermore, be able to creep into exceedingly limited spaces, where they form solid bearings for axles fitted close together in different directions and guiding devices for hook-ups and backward and forward motions.



1

The actual backbone of FAC consists of the round iron rod, fig. 1. This profile has been selected because of its excellent mechanical qualities, such as rigidity in all directions and facility in working, that is to say, in this connection, ease in cutting and bending. These rods are to be found in the FAC system in a great number of fixed lengths.

The rods are coupled together by means of a coupling device, consisting of small, stamped plates with grooves for the rods and holes for the screws squeezing the plates together (see the FAC system list of parts).

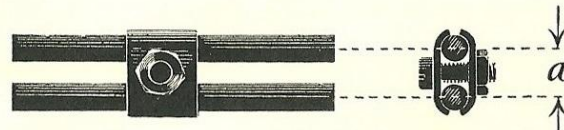
In other words, the rods are clipped together. This method of construction brings about several advantages, among which the foremost to be



2



mentioned are great durability and locking nut effect, created by the elasticity of the coupling plates, which prevents screws and nuts working loose, in spite of lengthy and powerful vibration.

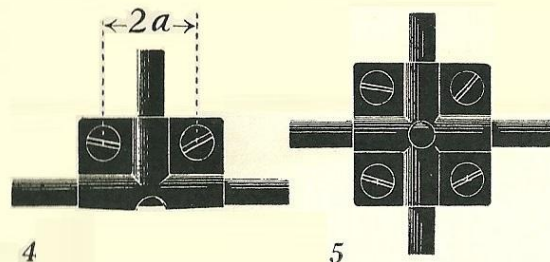


3

The diameter of the screws is somewhat less than that of the rods, making it possible to include externally and internally threaded rods in the system, fig. 2. These threaded rods are excellent for use in highly compressed constructions, as they greatly diminish the number of the more bulky coupling plates. All the threads in the FAC system are metric and of the same diameter, viz. 3 mm (M 3 thread).

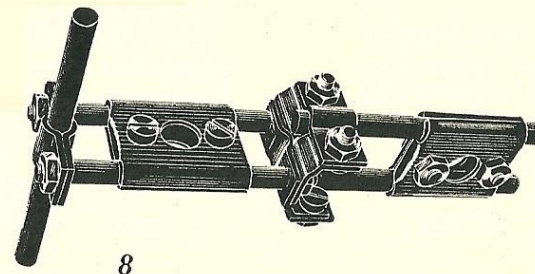
The simplest way to couple two rods is parallel with clamps, fig. 3. The screw passing through thus forms the distance between the rods, and the measurement between the centre of the rods is equal to the diameter of the rods plus that of the screw. This measurement has been called  $a$  and is the modulus on which the whole system has been based.

Among the other coupling devices the cross- and T-plates may be chosen



as suitable examples. These permit the coupling of rods at right angles on the same plane, figs. 4 and 5. The distance between the centres of two opposite screw holes is defined by  $2a$ . In these diagrams the plates cover each other completely and the rods originate from a point in the middle of the coupling.

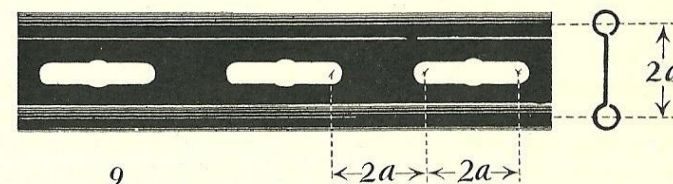
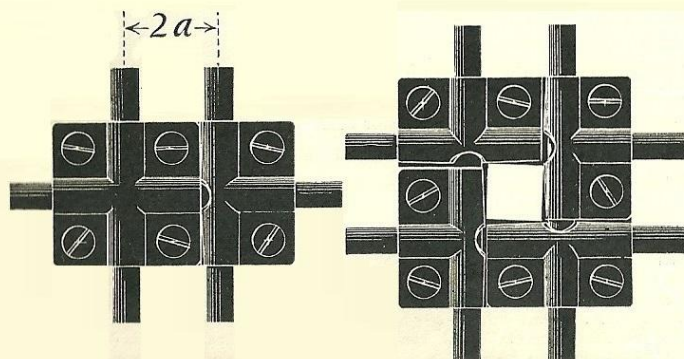
On the other hand, if the cross-plates are allowed to shift in relation to each other and T-plates are screwed fast to the protruding parts, we ob-



tain a coupling with parallel rods opposite one rod, fig. 6. The distance between the centres of the parallel rods is equal to that between the screw holes, viz.  $2a$ . Fig. 7 shows a coupling thus assembled, it is made up only of overlapping T-plates.

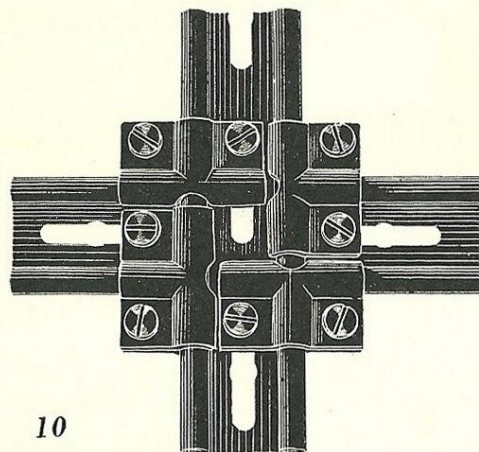
There is a similar possibility of overlapping in respect of straps and angle-plates, fig. 8.

The occurrence of parallel rods starting from the same coupling has been



the origin of other parts, for example the double bearing plate (i. e. bearing plate for double rods). This may be used as a bearing as well as an ordinary coupling part (see the list of FAC system parts).





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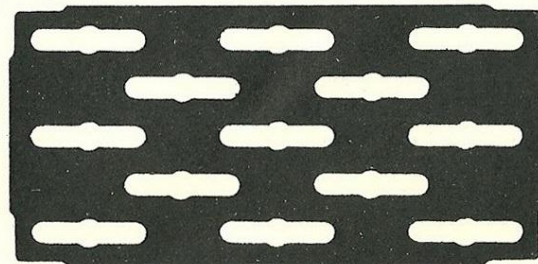
The beam in fig. 9 is an immediate development of the parallel rods, which have been joined in a single constructional part. The "rods" are formed by the curled edges of the web of the beam, and the thickness of the web is less than the permissible play between the coupling plates, so that a satisfactory clamping effect on rods and beams is assured. Along its centre line the beam is perforated with slots, the length of which and distance from each other are equal to  $2a$ . Because the width of the slot is equal to the diameter of the screws, it has a notch in the middle to permit the passage of a rod or axle (see the note on this page). A coupling of beams is shown in fig. 10, comparable with the rod coupling in fig. 7.

The plates (fig. 11) have been evolved from the beam web, which may be described as a metal strip, guided lengthwise by two rods. Similarly the plate in sheet metal assemblies is either entirely or partly built-in with rods or beams. As in the case of the beam, the thickness of the plates

is less than is permissible between the coupling plates, and the perforation is the same (see Plate Constructions on page 25 for further particulars).

The plate is affixed between the couplings. The combination of plates and framework endows the panel constructions with extraordinary strength.

Thus it will be noted that the foundation of the FAC system consists of parts, which form the links of a logical chain of reasoning. Combined,



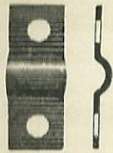
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the parts make an unlimited number of alternative solutions of any constructional problem whatsoever possible, thus giving rise to a purely intellectual stimulus, reminiscent of chess. As in chess, so with FAC, it is a question of finding the most satisfying solution with few, but correct, moves.

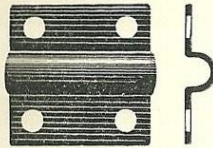
This notch is missing in the first lot of beams to be marketed in Sweden. It was necessary in the plates, because it is not desirable to neutralise a large surface without making the passage of axles and moving parts possible. The plates are among those parts most recently introduced into the system.

As a consequence, the notch was also introduced in respect of the beam, in the case of which, however, its practical use is limited. The passage of an axle through a beam does not occur in any of the constructions described in this manual. The notch can easily be made with a drill, after the fastening of some three-hole links 1/31 on the gap as a guide.

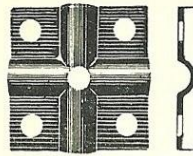




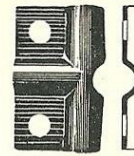
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1/02



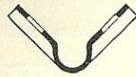
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1/04



1/05



1/06



1/07



1/08



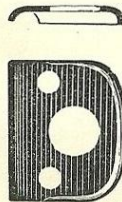
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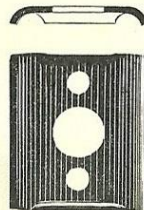
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1/11



1/20



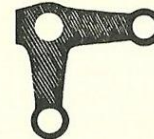
1/21



1/30



1/31



1/35

## FAC SYSTEM PARTS

Each part of the system has its own code number, composed of a number for the group to which the part belongs and a number for its order within the group.

Below the parts are shown drawn to scale, with exception of those in Group 3, which are reproduced in slightly over half-scale.

### GROUP 1

#### COUPLINGS

- 1/01 Strap
- 1/02 Saddle-plate
- 1/03 Cross-plate
- 1/04 T-plate
- 1/05 Inner angle-plate
- 1/06 Outer angle-plate
- 1/07 Single clamp
- 1/08 Double clamp
- 1/09 Plain clip
- 1/10 End clip
- 1/11 Coupling clip

#### BEARING BRACKETS

- 1/20 Single bearing bracket
- 1/21 Double bearing bracket

#### LINKS

- 1/30 Two-hole link
- 1/31 Three-hole link
- 1/35 Toggle link

**GROUP 2****RODS 4 mm Ø***The following lengths:*

2/1 18 mm	2/12 190 mm
2/02 30 mm	2/13 218 mm
2/03 40 mm	2/14 246 mm
2/04 50 mm	2/15 274 mm
2/05 60 mm	2/16 302 mm
2/06 70 mm	2/17 330 mm
2/07 78 mm	2/18 359 mm
2/08 90 mm	2/19 386 mm
2/09 106 mm	2/20 500 mm
2/10 134 mm	2/21 1000 mm
2/11 162 mm	

**THREADED RODS 4 mm Ø***10 mm M3 thread on each end.**The following total lengths:*

2/30 30 mm	2/34 70 mm
2/31 40 mm	2/35 80 mm
2/32 50 mm	2/36 90 mm
2/33 60 mm	

**TIE RODS 2.5 mm wire***Lengths between tie centres:*

2/40 18.5 mm	2/44 110 mm
2/41 51 mm	2/45 131 mm
2/42 70 mm	2/46 150 mm
2/43 91 mm	2/47 170 mm

**AXLES 6 mm Ø***The following lengths:*

2/51 68 mm	2/55 180 mm
2/53 120 mm	

**GROOVED AXLE 4 mm Ø**

2/61	length 80 mm
------	--------------

**SLOTTED TUBE 6/4 mm Ø**

2/65	length 18 mm
------	--------------

**CHISEL TUBE 6/4 mm Ø**

2/66	length 12 mm
------	--------------

**UNIVERSAL JOINT steel**

2/90	bushings for 6 mm axle
------	------------------------

**GROUP 3****BEAMS**

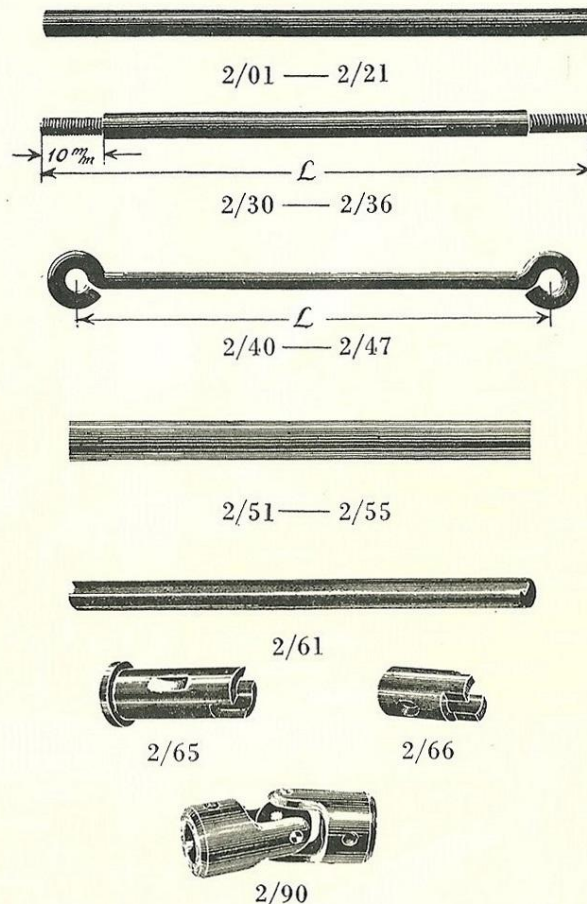
3/01	1 hole, length 23 mm
3/02	2 holes, length 51 mm
3/03	3 holes, length 78 mm
3/04	4 holes, length 106 mm
3/05	5 holes, length 134 mm
3/06	6 holes, length 162 mm
3/07	7 holes, length 190 mm
3/08	8 holes, length 218 mm
3/09	9 holes, length 246 mm
3/10	10 holes, length 274 mm
3/11	11 holes, length 302 mm
3/12	12 holes, length 330 mm
3/13	13 holes, length 358 mm
3/14	14 holes, length 386 mm
3/15	15 holes, length 414 mm
3/16	16 holes, length 442 mm
3/17	17 holes, length 470 mm
3/18	18 holes, length 498 mm
3/19	19 holes, length 526 mm
3/20	20 holes, length 554 mm

**BEAM JOINTS**

3/30	S-shaped beam joint
3/31	Adjustable beam joint

**PLATES**

3/50	rectangular	66 × 108 mm
3/51	rectangular	80 × 136 mm
3/52	rectangular	38 × 80 mm
3/53	rectangular	38 × 136 mm
3/54	quadrangular	136 × 136 mm
3/60	corner joint	(38 × 80 mm)



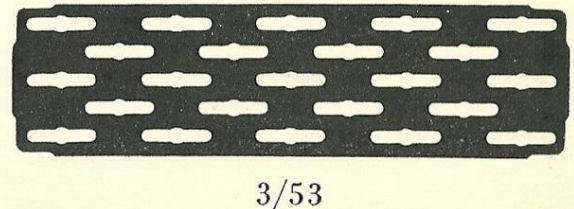
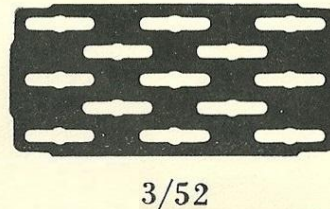
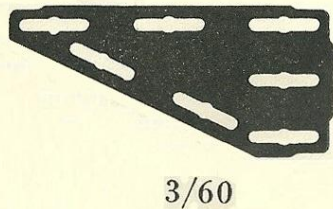
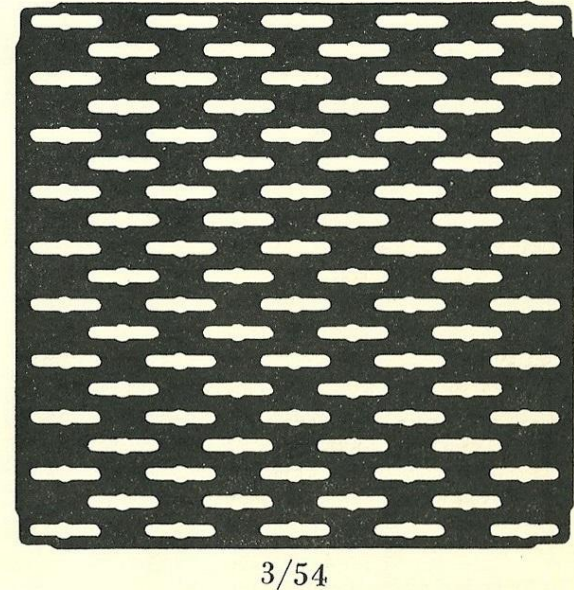
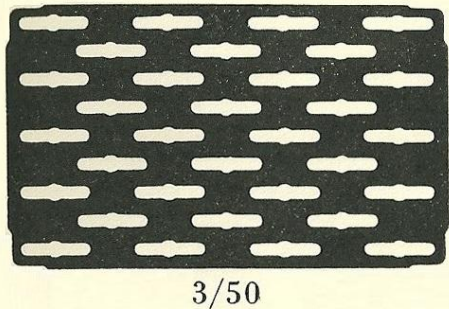
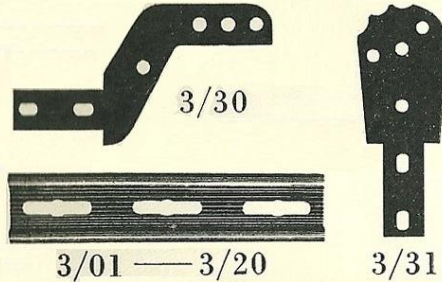


The parts on this page are reproduced in slightly over half-scale. See footnote on page 8 in regard to the slots in the beam.

The adjustable beam joint 3/31 has three notches in the edge for locking with washers at angles of 180°, 150° and 120° to each other. The location of the holes, furthermore, makes locking possible at angles of 90° and 60°.

The plates are intended to be built into framework of beams and rods.

If a relatively long deck, or the like, is made by joining together several plates, the division of holes is maintained in unbroken sequence the length and width of the whole deck, and corresponds to the slots in the beams of the framework. Providing framework of the type shown in fig. 7 on page 24 is used, the notches in the corners of the plates make room for inner angleplates 1/05.





## 12 THE FAC SYSTEM

**GROUP 4****COLLARS** *Brass*

- 4/01 for 6 mm axle  
4/02 for 4 mm axle

**BUSHES** *Brass*

- 4/03 for 6 mm axle  
4/04 for 4 mm axle

**TUBES** *Brass*

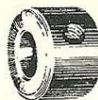
- 4/05 length 5 mm  
4/06 length 12 mm  
4/07 length 20 mm

**RING**  $8/6 \text{ mm } \varnothing$  *Brass*

- 4/08 length 2 mm

**SPLIT TUBE**  $6/4 \text{ mm } \varnothing$  *Brass*

- 4/09 length 12 mm



4/01



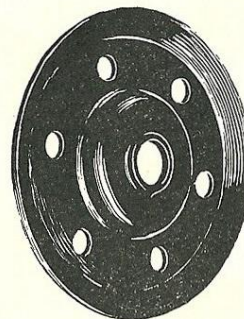
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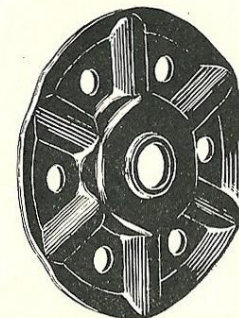
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4/04



5/01



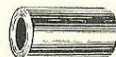
5/02

**GROUP 5****WHEELS**

- 5/01 Flanged wheel 42 mm  $\varnothing$   
5/02 Flanged wheel with radial grooves 42 mm  $\varnothing$   
5/05 Grooved wheel for 4 mm axle  
5/06 Grooved wheel for 6 mm axle  
5/10 Stepped grooved wheel for 6 mm axle  
5/20 Rail wheel plate. Roll diameter 54 mm



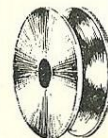
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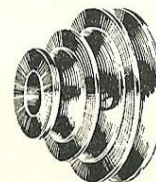
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5/05



5/06



5/10

**ROUNDELS**

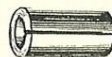
- 5/30 91/45 mm  $\varnothing$   
5/31 142/106 mm  $\varnothing$

**PERFORATED DISC**

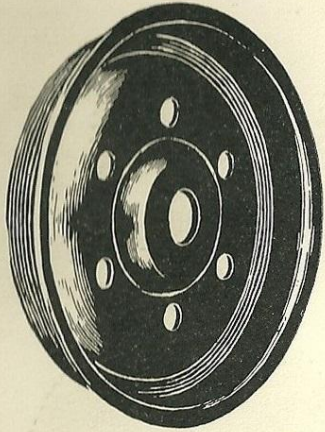
- 5/40 63/20 mm  $\varnothing$



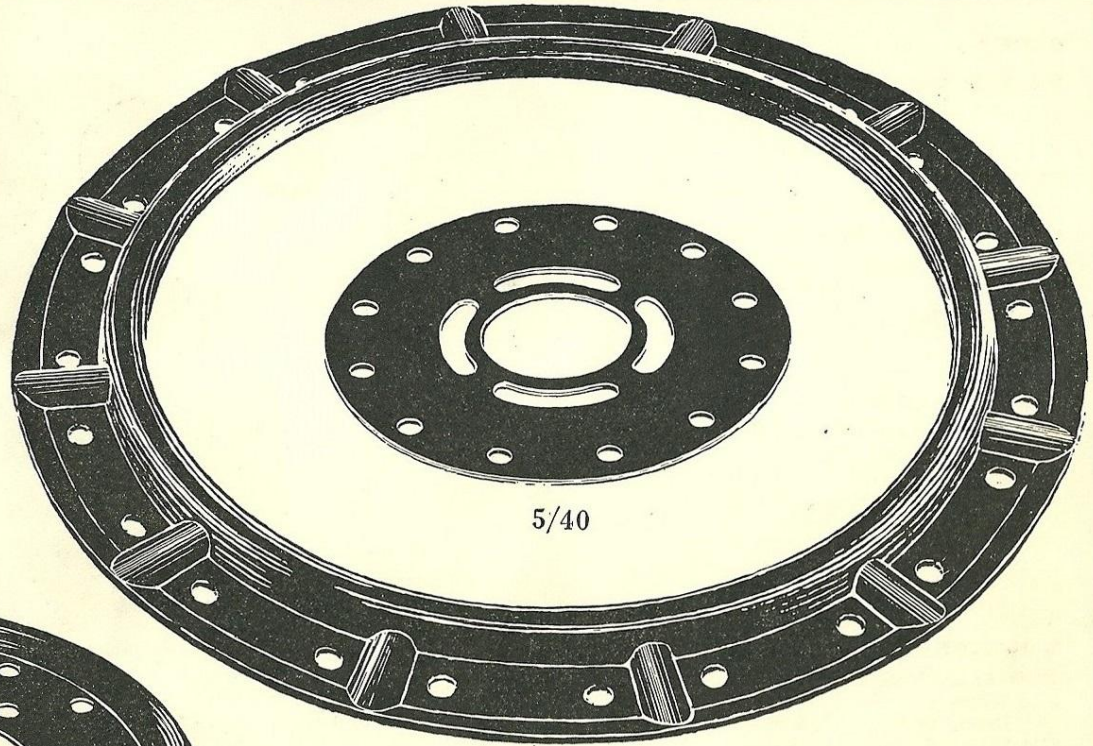
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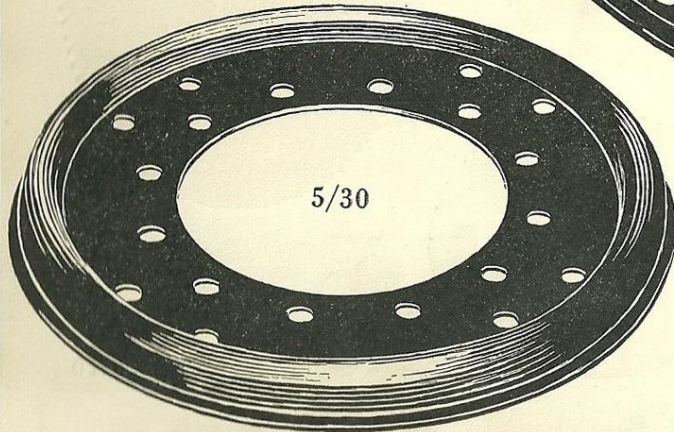
4/09



5/20



5/40



5/30

5/31



**GROUP 6**

**BOSSED WHEEL** 2 mm steel  
6/01 46.2 mm  $\varnothing$  for 6 mm axle

**RATCHET WITH SPRING**

6/05 Ratchet  
6/06 Ratchet spring

**BEVEL-GEARS** Brass

Ratio 1 : 1 Modulus 0.80  
6/10 for 6 mm axle

Ratio 1 : 3 Modulus 0.80  
6/11 for 6 mm axle  
6/12 without hub

**SPUR-GEARS** Steel

Modulus 0.70. Tooth width 3 mm  
Pitch diameters, see Page 36

6/16 16 teeth, for 4 mm axle -  
6/24 24 teeth, for 6 mm axle  
6/32 32 teeth, for 6 mm axle  
6/48 48 teeth, for 6 mm axle  
6/64 64 teeth, for 6 mm axle -  
6/80 80 teeth, for 6 mm axle -  
6/96 96 teeth, for 6 mm axle

**WORM-GEAR** Brass and steel

Ratio 1 : 22. Modulus 0.70  
6/50 Worm wheel, for 6 mm axle  
Brass. Tooth width 5 mm  
6/51 Worm, for 4 mm axle  
Steel. Two entrances.

**CHAIN WHEELS** 2 mm steel

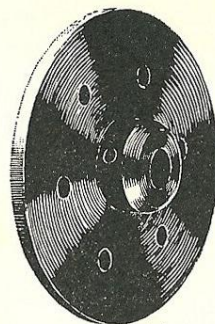
6/70 14 teeth, for 6 mm axle  
6/71 28 teeth, for 6 mm axle

**CHAIN** 0.9 mm iron wire

6/75 220 links per meter

**FEED ROLL** 25/6 mm  $\varnothing$ 

6/81 length, including hub, 45 mm



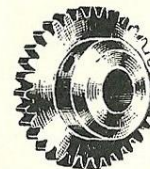
6/01



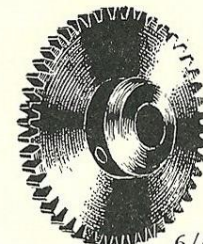
6/16



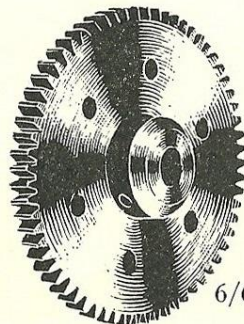
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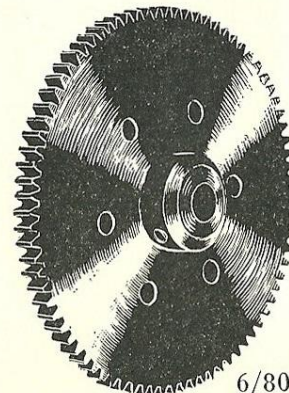
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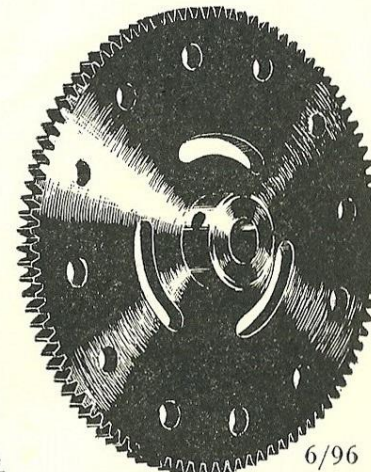
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6/64



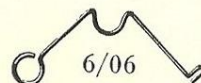
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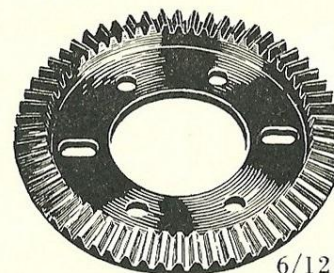
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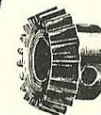
6/05



6/06



6/12



6/11



6/10

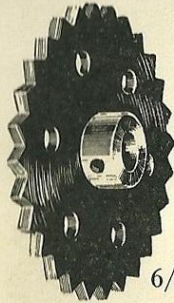




6/51



6/50



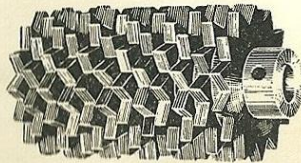
6/71



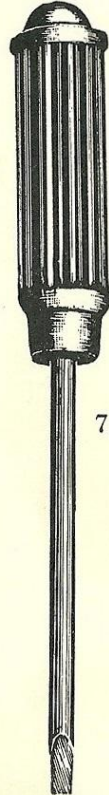
6/70



6/75



6/81



7/01



7/02



7/03

**GROUP 7****TOOLS**

7/01 Screw driver

7/02 Spanner

7/03 Combined spanner and screw driver

**GROUP 8****MACHINE SCREWS M3 thread**

8/01 length 6 mm

8/02 length 8 mm

8/03 length 12 mm

8/04 length 19 mm

**GRUB SCREWS M3 thread**

8/08 length 5 mm

8/09 length 2.5 mm

**NUT M3 thread, hexagonal**

8/10 height 2 mm

**WASHER 8/3.15 mm Ø**

8/20 thickness 0.8 mm

**EYE-BOLT Eye diameter 4 mm**

8/31 12 mm M3 thread

**THREADED SLEEVES Internal M3 thread**

8/40 4 mm Ø, length 5.2 mm

8/41 4 mm Ø, length 12.2 mm



8/04



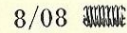
8/03



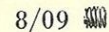
8/02



8/01



8/08



8/09



8/10



8/20



8/31



8/40



8/41

**GROUP 9****CRANK** Rod material 4 mm  $\varnothing$ 

9/01 length 10 cm

**HOOKS**

9/02 big 1.3 mm plate

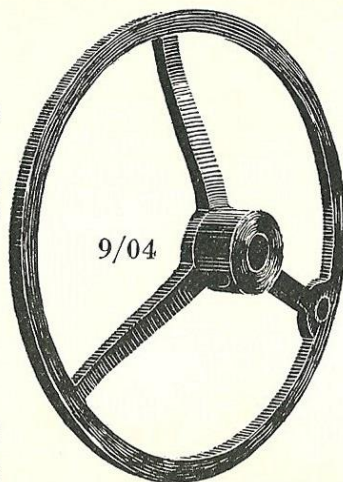
9/03 small 2 mm plate

**STEERING WHEEL** Nickel-plated9/04 for 4 mm axle, 63 mm  $\varnothing$ **RUBBER TYRES**9/09 26/13 mm  $\varnothing$ , fitting grooved wheel 5/05 or 5/069/10 58/37 mm  $\varnothing$ , fitting a pair of flanged wheels 5/01 or 5/029/11 104/54 mm  $\varnothing$ , fitting a pair of rail wheels 5/20**HELICAL SPRING** Ground

Rectangular profiled wire

9/30 10 mm  $\varnothing$ , length 15 mm**SPRING CUP**

9/31 for the helical spring 9/30

**PLASTIC CORD**9/41 3 mm  $\varnothing$ 

9/02



9/03

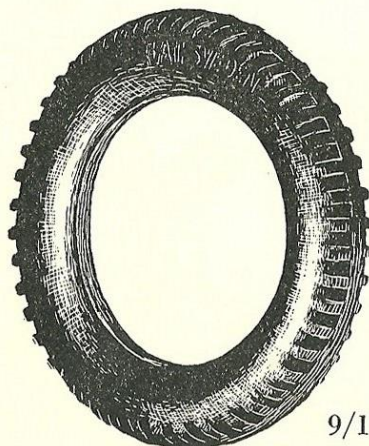
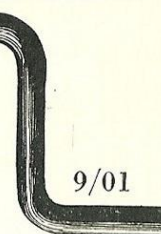


9/30

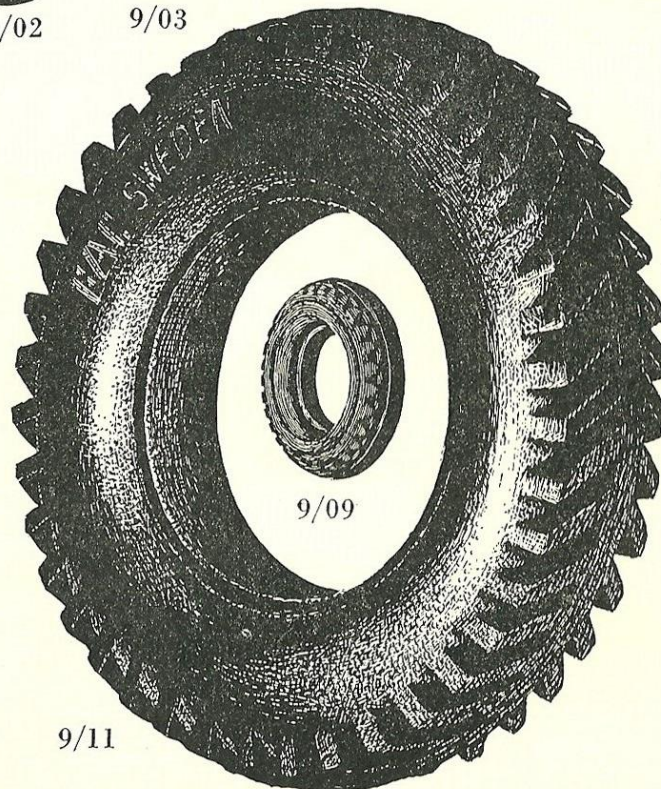


9/31

9/01



9/10



9/11



9/09



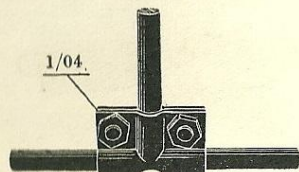
## ROD COUPLINGS

To facilitate identification of the parts shown in the illustrations, the code numbers have usually been set forth. This is also the case even when there can be no doubt as to which part is referred to. It is intended that in this way the code numbers of these parts may be more easily and quickly learned. When studying the more complicated constructions, it is a relief not to have to refer to the chapter on parts continuously.

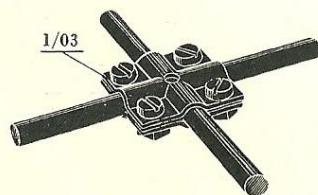
On this and the following page a start is made with rod couplings. This

constructional fundamental has already been described in the chapter on the FAC principle, and the figures 1 to 21 set forth below should be regarded as a short introduction to a numberless variety of possible couplings.

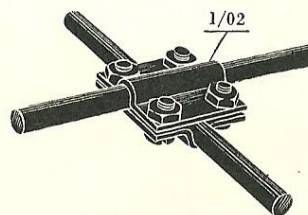
The pictures mainly speak for themselves, but a few comments are in order. Rods with end clips 1/10 or tie-rods 2/40 to 2/47 may be attached to the screws in the couplings, thus forming diagonals in frame structures. Note fig. 13, in which the eye-bolt 8/31 is a part. Three rods coupled in this manner form a mast of great rigidity and innumerable ways of attachment.



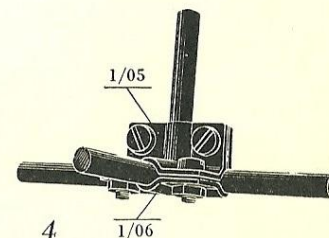
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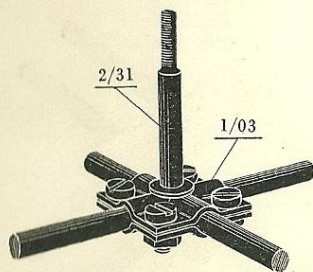
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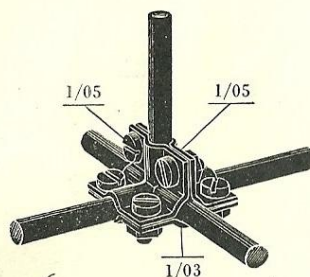
3



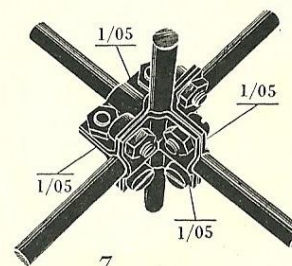
4



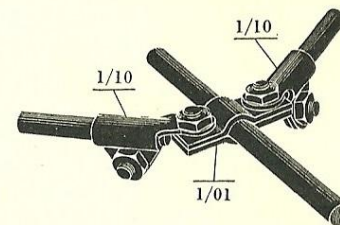
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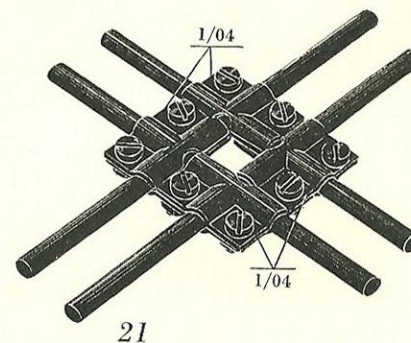
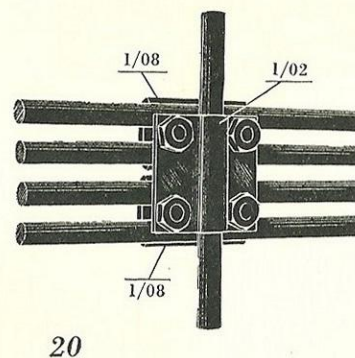
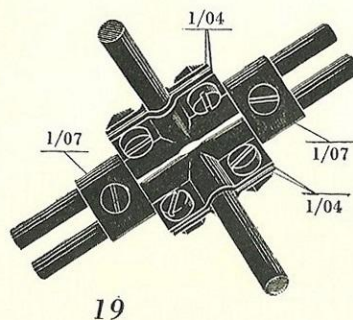
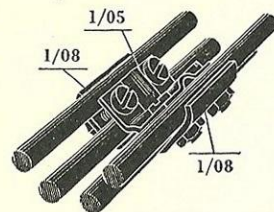
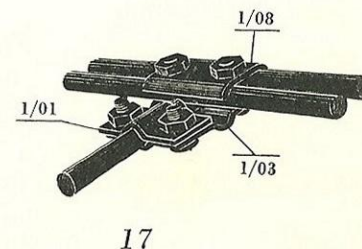
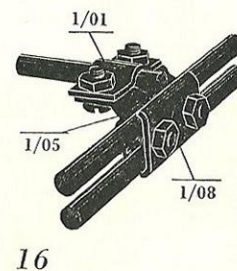
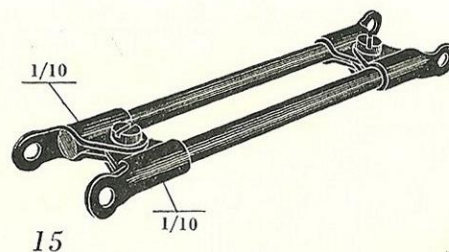
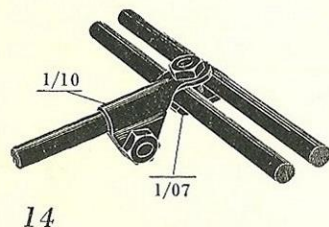
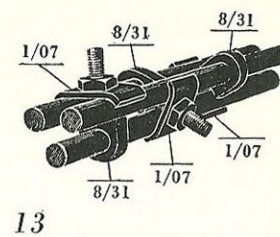
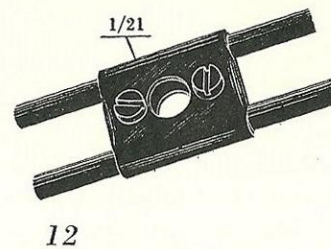
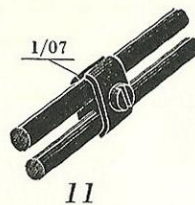
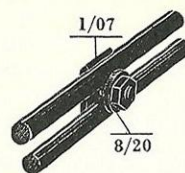
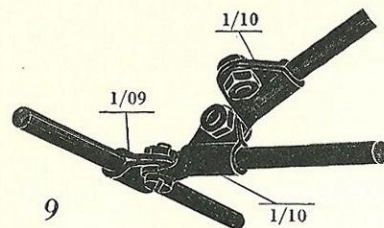
6



7



8

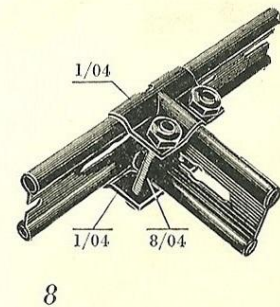
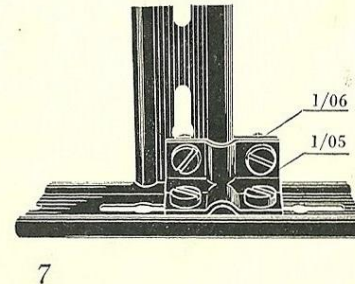
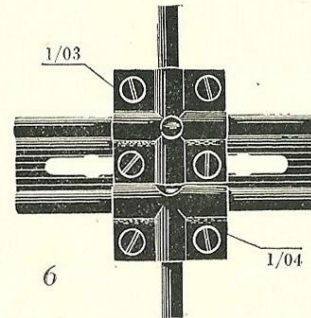
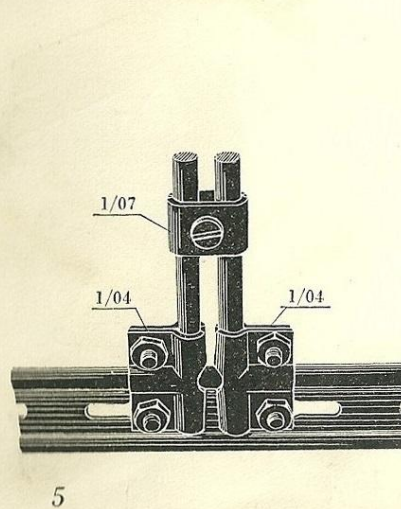
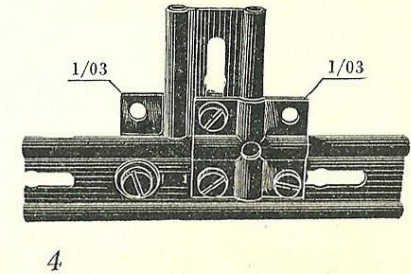
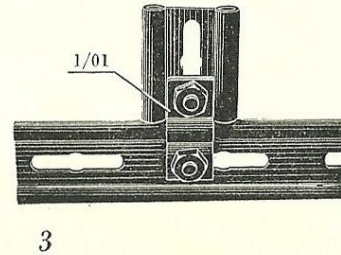
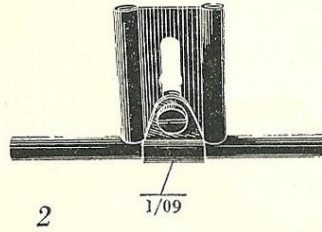
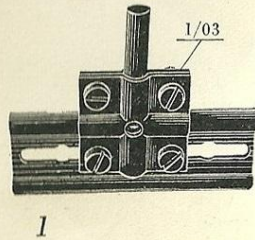




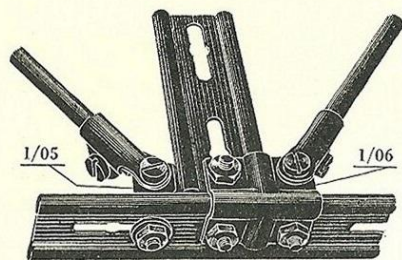
## BEAM COUPLINGS

When coupling beams to each other, or with rods, you use the same coupling plates as for rod couplings. In fact, the beam is nothing but two rods with an intermediate web of sheet metal. Owing to the three possible places of attachment along its whole length, the two rounded edges and the slots down the middle, the beam is a particularly useful building part.

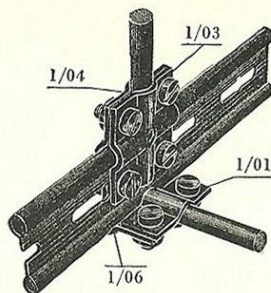
As in the case of the rod couplings, the examples shown are by no means exhaustive. It is difficult to make a review of the number of combinations possible. Figures 19 to 28, however, should be particularly noted. Parallel coupled beams, in these instances, form new profiles useful in cases where a simple beam would be too weak, or offer insufficient possibilities of attachment. Thus two beams coupled as shown in fig. 20 have eight possibilities of attachment along the whole length, see fig. 11, page 29.



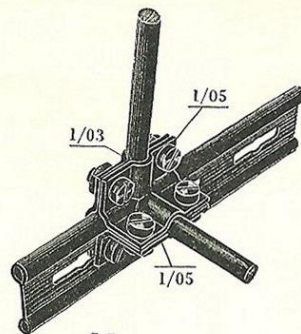




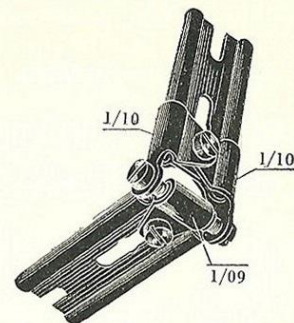
9



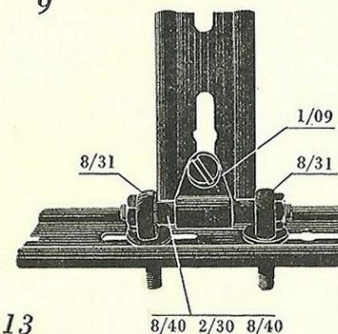
10



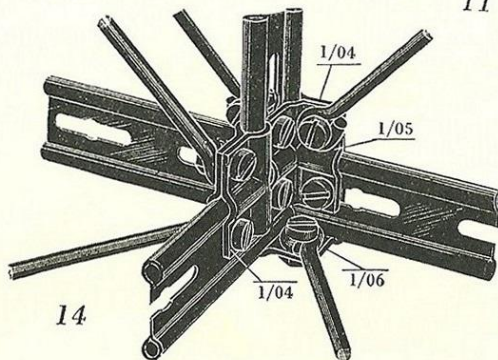
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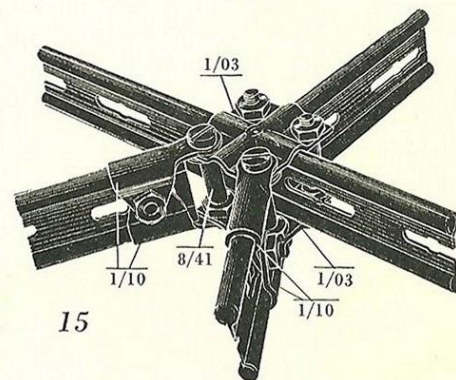
12



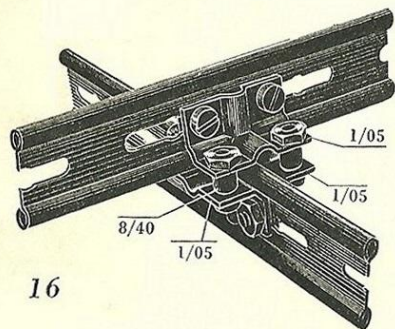
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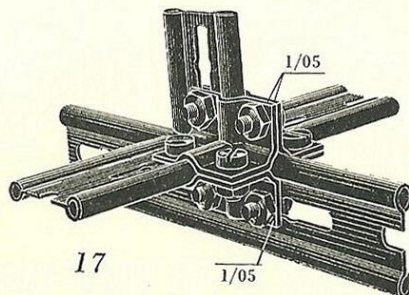
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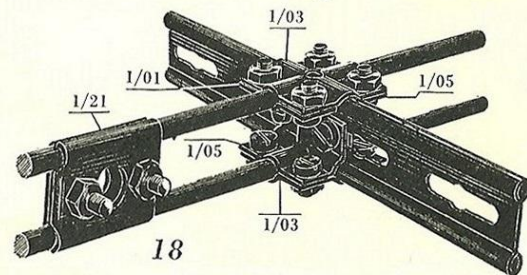
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16

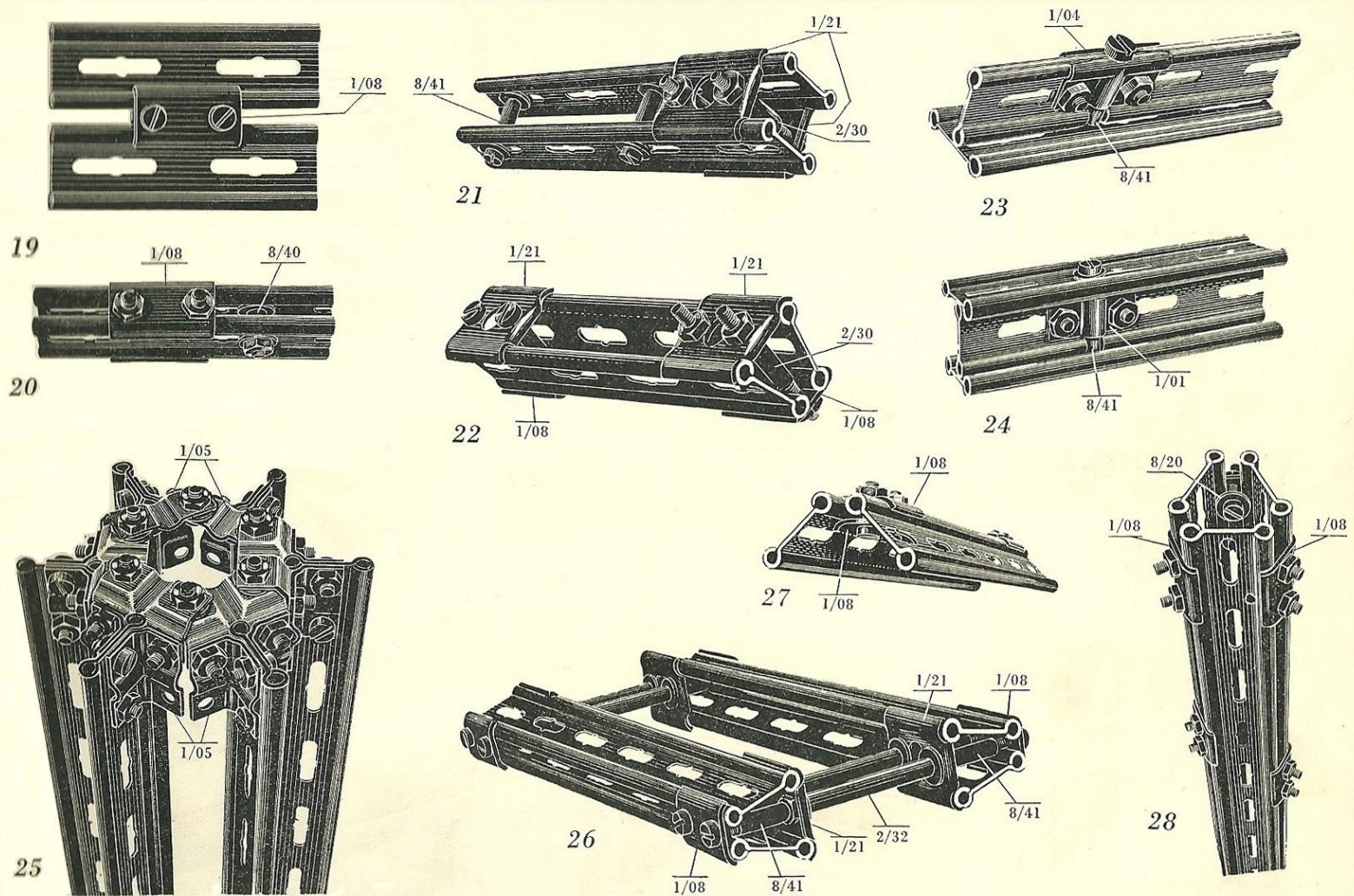


17



18







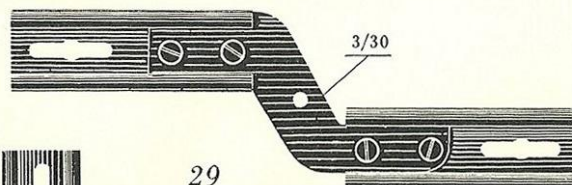
### Beam joints

As a complement to the beams, a couple of beam joints have been evolved, the use of which is shown in figs. 29 to 38. The S-beam joint 3/30 hardly needs any comment. Its use is, inter alia, apparent from figs. 29 to 31 on this page, as well as fig. 11 on page 29 and pictures 1, 3, 4, 5, 17 and 18 in the illustrated supplement.

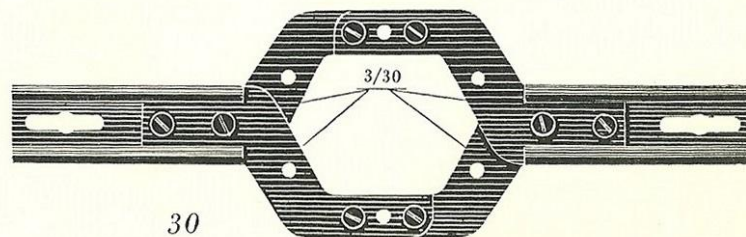
In regard to the adjustable beam joint 3/31, particular note should be taken of fig. 32. The beams have been attached at an angle of  $150^\circ$  by means of washers 8/20, which lock with the notches in the edge of the beam joint.

By means of these notches the beam joints may be locked at angles of  $120^\circ$ ,  $150^\circ$  and  $180^\circ$ . Using only one screw in the centre of the beam joint, you may obtain a great number of unspecified angles in statically determined figures. The horizontal upper beams in figs. 33 to 35 are obviously not continuous, but consist respectively of two and four beams coupled together.

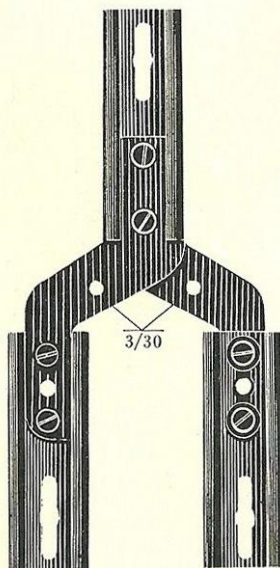
For the coupling of one beam to another at an angle of  $30^\circ$  the corner joint 3/60 should be used, as shown in fig. 36. This part is very useful for reinforcing corners in beam constructions, fig. 38. Further reference is made to pictures 7, 11, 12 and 13 in the illustrated supplement.



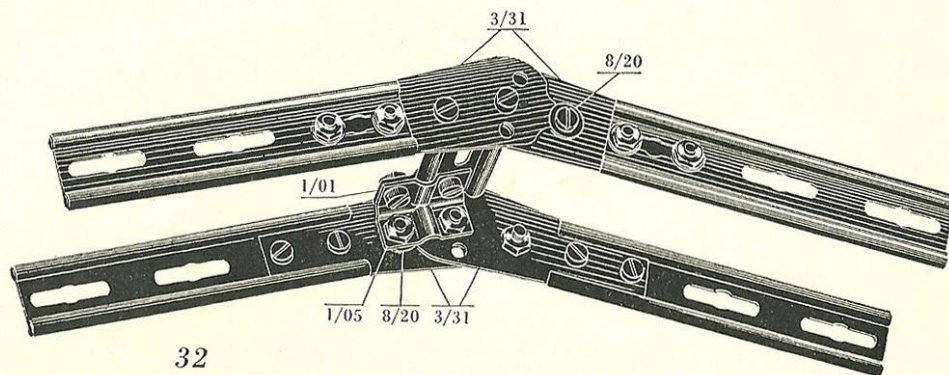
29



30

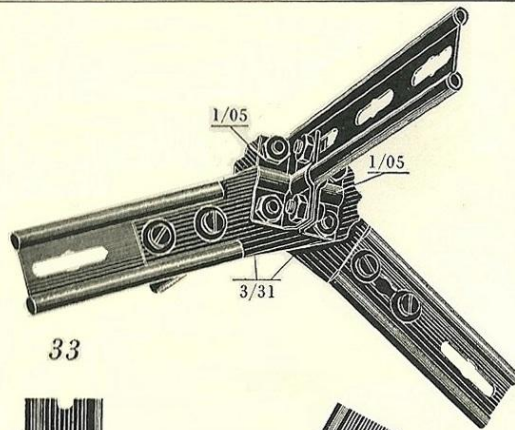


31

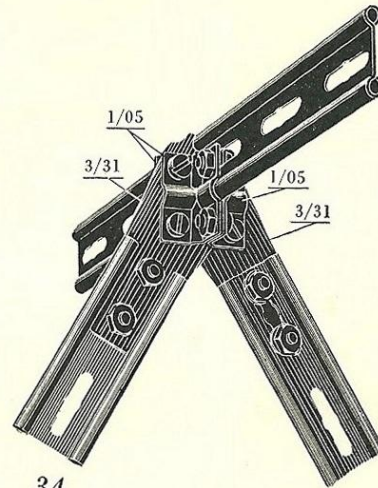


32

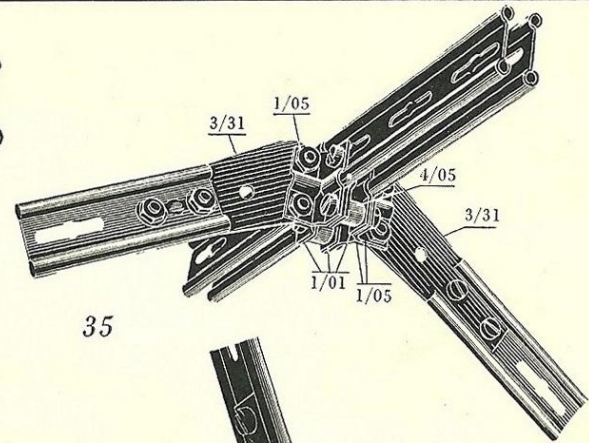




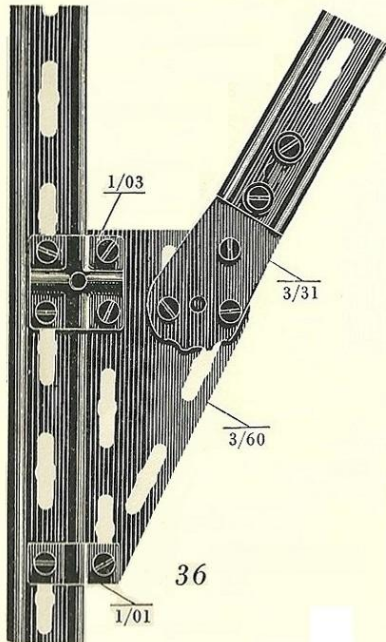
33



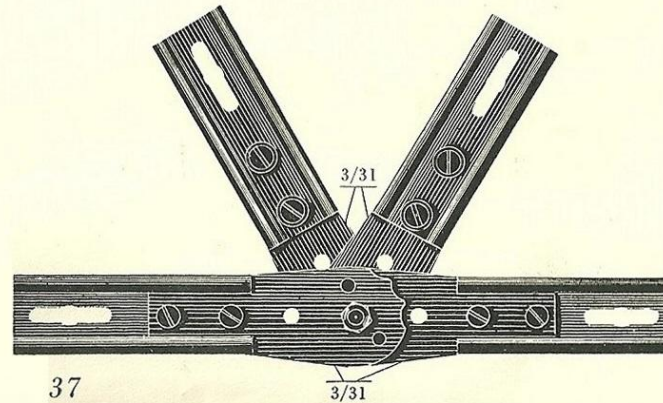
34



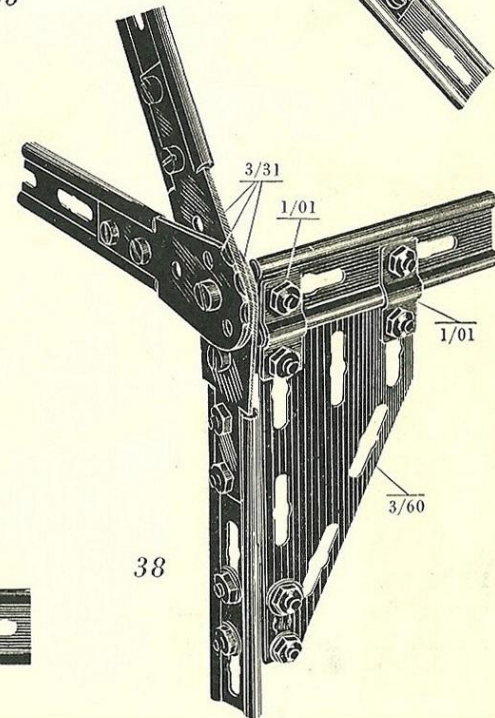
35



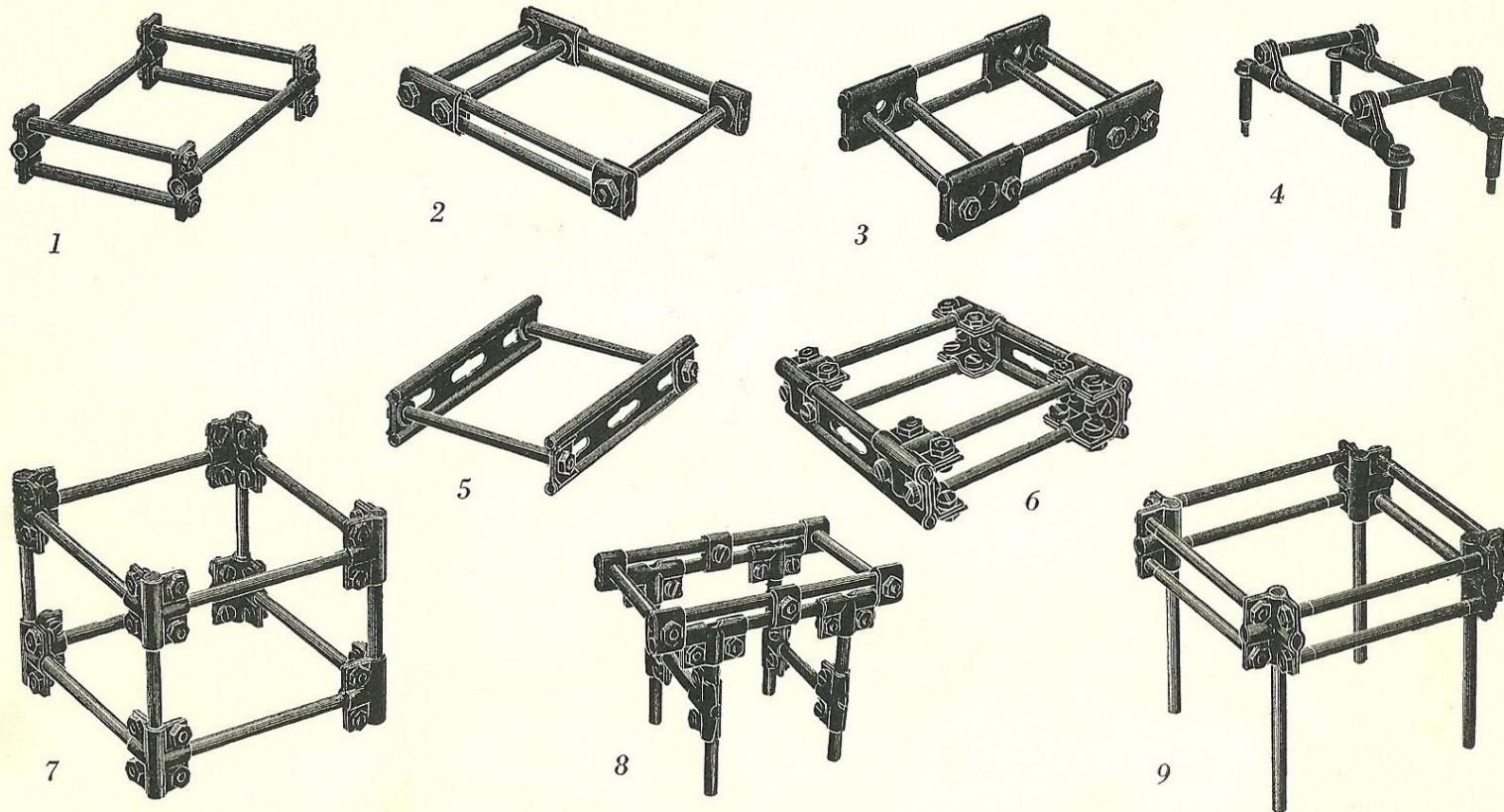
36



37



38



### FRAMEWORK

This section could be so comprehensive that it would fill the whole of this manual. The number of examples is, therefore, limited to very few structural models.

The examples shown, however, are representative of some common main types, which can be extended in all directions and combined with each other *ad infinitum*.

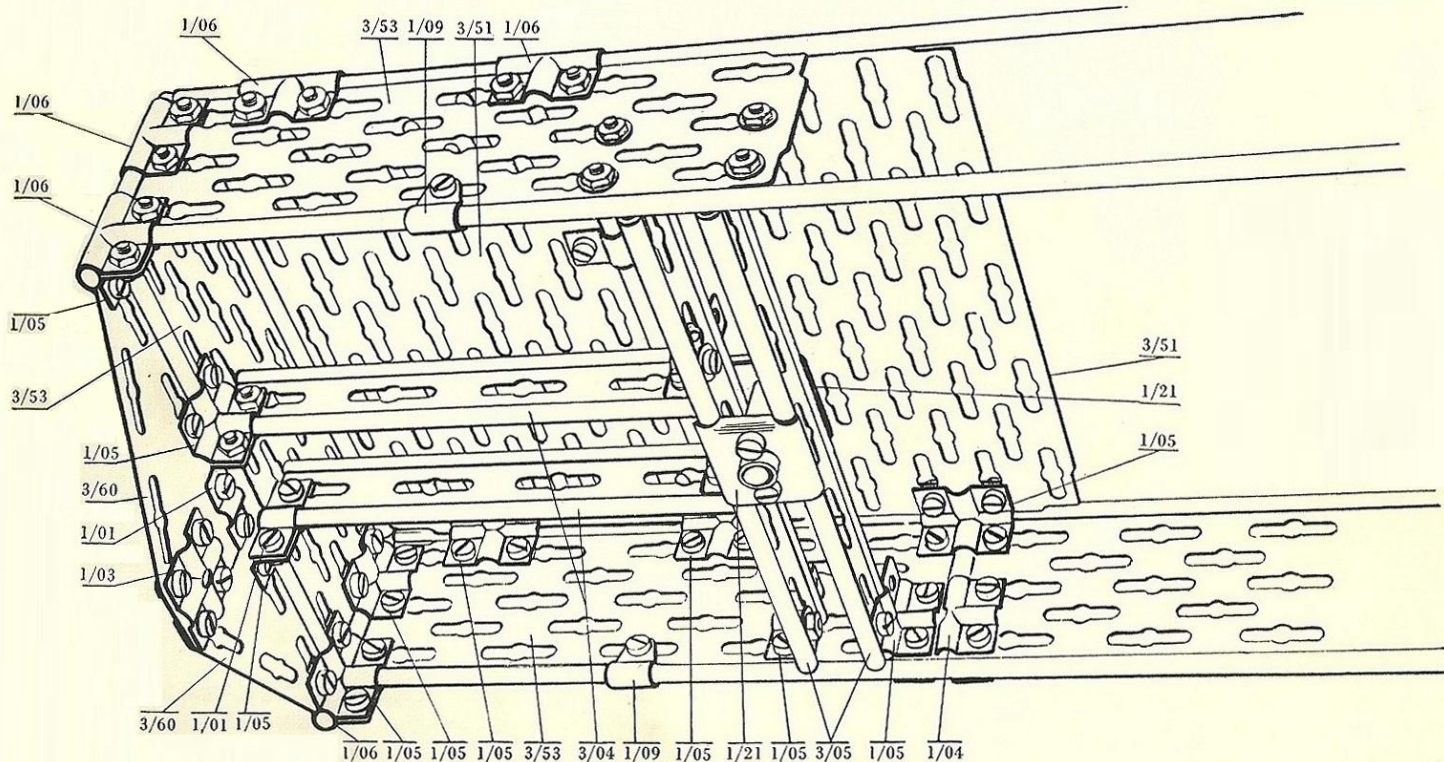


## PLATE CONSTRUCTIONS

The sheet metal plates 3/50 to 3/54 and 3/60 are frequently used, wholly, or partly, incorporated in framework of rods or beams, and are screwed fast between the couplings. The drawing below shows the chassis of a heavy

railway truck during assembly. Note the bogie bearing. A close scrutiny of the drawing makes the method of construction clear.

The notches in the corners of the plates have been made to make room for inner angle-plates and other coupling plates in connection with certain constructions. See pictures 5 and 7 in the illustrated supplement.





### 3, 4 AND 6 MILLIMETER

#### Axles, Hubs and Tubes

The axles forming part of the FAC system are of two sizes: 4 mm, i.e. the same as the rods, and for this reason no special axles, apart from these, have been included among the standard parts; 6 mm in three lengths of brightdrawn, nickel plated iron. Obviously these three lengths will not always meet varying requirements, wherefore they should be cut to the required length. For practical reasons it is not possible to maintain so wide a selection of axles of different lengths so that the right length for every requirement is available among the standard parts. A metal saw (hack saw) and a small vise are required for cutting the axles. A file for smoothing edges is also desirable. To cut rods reasonably heavy snippers are sufficient. The best axle material, however, is silver steel, which has been used in the models shown in the illustrated supplement.

The wheels in the FAC system have generally been bored for 6 mm axles. The only exceptions are the smallest spur-gear 6/16, worm-wheel 6/51, grooved wheel 5/05 and steering wheel 9/04. However, to allow all wheels to be mounted on 4 mm axles, a part, the split tube 4/09, has been introduced, which is inserted in the wheel hub and thereupon slipped over the axle. The grub-screws press the tube together so that it fits smoothly over the axle, and in normal cases this is sufficient. Should the torque, however, be so great that there is a danger of the wheel slipping on the axle, the tube may either be soldered fast or some notches made on the surface of the axle with nippers. The latter method is easy in practice, and the result entirely satisfactory.

The usual tubes are available in lengths of 5, 12 and 20 mm. Their use varies greatly, but typical is the adjustment of distance between wheels and bearings, and the insertion in hubs of wheels which are to run freely on the axle. The 20 mm tube 4/07 makes possible the coupling of two wheels moving on the same axle, which may be stationary, eg. a threaded rod, or may rotate at different speed or direction in relation to the wheel. These tubes on stationary axles are suitable when space does not permit the provision of rotating axles.

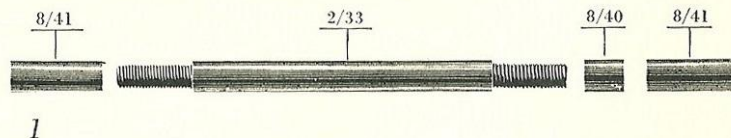
A special 4 mm grooved axle 2/61 is to be found among the axles. Until

further notice this axle is only available in a length of 80 mm. This axle is used for gear boxes and generally in cases where a wheel is to be movable along the length of the axle but has to follow its rotating motion. To make this possible a further part is necessary, viz. a slotted tube of steel 2/65 with a notch running in the groove of the axle. This slotted tube, as the name indicates, is fitted with a slot at one end, matching the chisel-like device of the chisel-tube 2/66, and may thus be fitted onto the latter directly. At the opposite end of the slotted tube there is a small lip, which prevents a freely moving collar 4/01, behind the fixed wheel, from slipping off. The collar serves as an attachment for the gear shifter (see gear boxes, page 38 and 39).

#### Codes

As a result of the varying diameters of screws, rods, axles and tubes, the FAC system, in addition to the method of building with only clamp couplings, uses another method, based on co-ordinating the threaded rods, nuts, tubes and eye-bolts with the other parts.

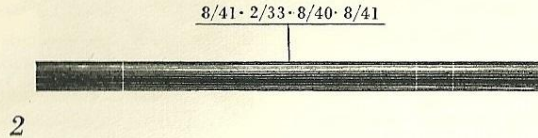
However, in regard to this type of construction, it is more difficult to identify the various parts in illustrations, as they frequently are inserted in, or cover, each other. A special kind of description has, therefore, been considered necessary, based on the numerical symbols of the parts. This has been evolved from the simple method of indicating a part with a line



from the part to its numerical symbol, fig. 1. The description is distinguished by the fact that the parts included in the mechanical whole are set forth as numerical symbols in line, in the order in which they are assembled.



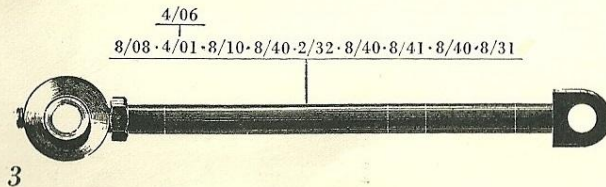
The line is horizontal or vertical from which a line is drawn to the completed part. If the line is horizontal, there is a point between each numerical symbol, see fig. 2.



When a part, available in various lengths, is symbolized and in the particular instance the length is unimportant, the last figure of the symbol is replaced with x, thus 2/0x. Parts not included among the standard parts of the system are symbolized with y.

This method is convenient, as it is only necessary to assemble the parts in the order in which they are enumerated. Sometimes, however, it may occur that certain parts are assembled before being fitted together with the remaining parts. Such assemblies, within a line, are in brackets. If an assembly is repeated one or more times, there is a number in front of the bracket, indicating the number of repetitions. Similarly the number and brackets are used in respect of single symbols, if the part is used several times, one after the other.

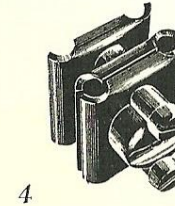
If one, or more, parts are entirely or partially hidden in some part, the line is drawn from the visible part to its numerical symbol and thereupon, in a line, the hidden parts, with a short line to the symbol of the visible part, fig. 3 on this page and fig. 9 on page 32.



This method of describing a construction may diagrammatically be represented as a code which, indeed, makes illustrations superfluous. Fig. 4 shows the bearing device for the bogie axles in fig. 9, page 43, and picture 3 of the illustrated supplement.

The construction may also be described by means of the following code:

$$\left. \begin{matrix} 8/04 \cdot 8/41 \\ 8/04 \cdot 8/41 \end{matrix} \right\} 9/31 \cdot 1/21 \cdot 4/03 \cdot 1/21 \left\{ \begin{matrix} 8/10 \\ 8/10 \end{matrix} \right\} 1/21 \left\{ \begin{matrix} 8/10 \\ 8/10 \end{matrix} \right\}$$

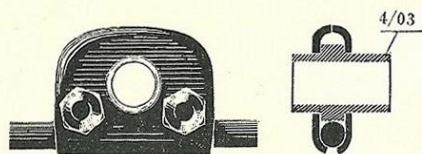


There is only one point in regard to which there can be any doubt, viz. the last bearing plate in the assembly sequence. If this is turned in the wrong direction, the part will not function, a fact which soon becomes apparent.

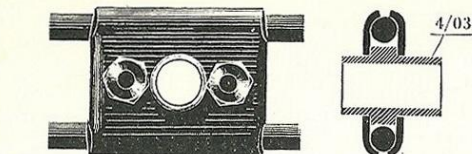
Gear transmissions are symbolized with a dash between the symbols in respect of wheels mounted on the same axel and x in respect of wheels which mesh, e.g. 6/64 × 6/16 - 6/64 × 6/24 - 6/48, etc.

If a wheel meshes with two others, brackets are used followed by two lines, one above the other, as in the following example:

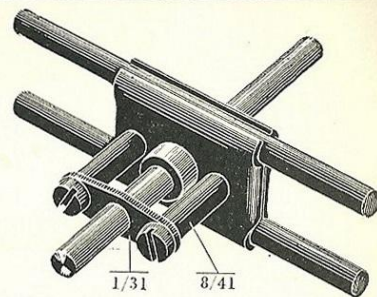
$$6/64 \times 6/24 - 6/64 \times \left\{ \begin{matrix} 6/24 - 6/80 \text{ etc.} \\ 6/32 - 6/80 \text{ etc.} \end{matrix} \right.$$



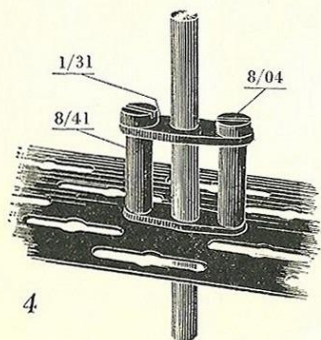
1



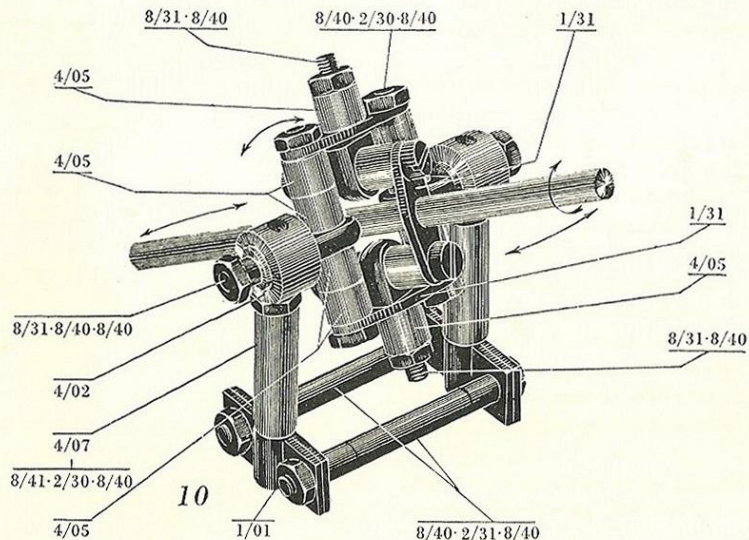
2



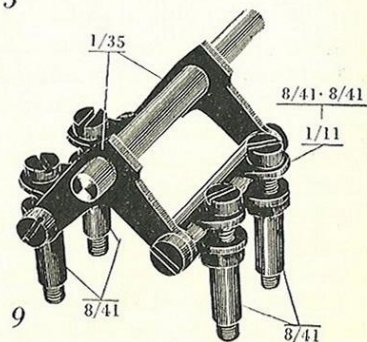
3



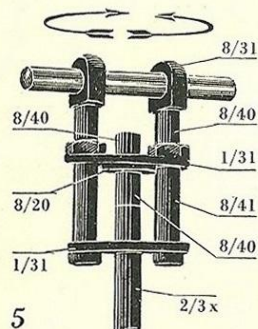
4



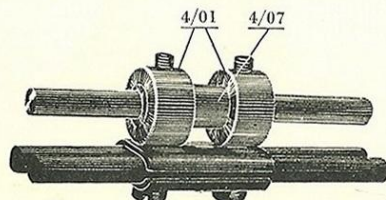
10



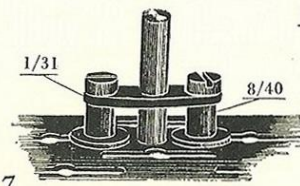
9



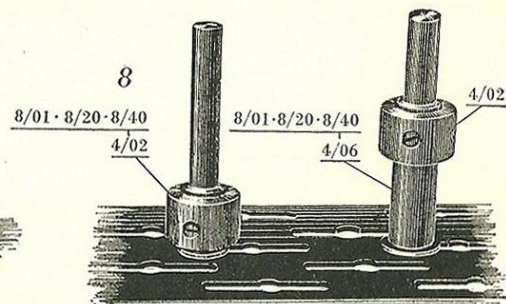
5



6



7



8



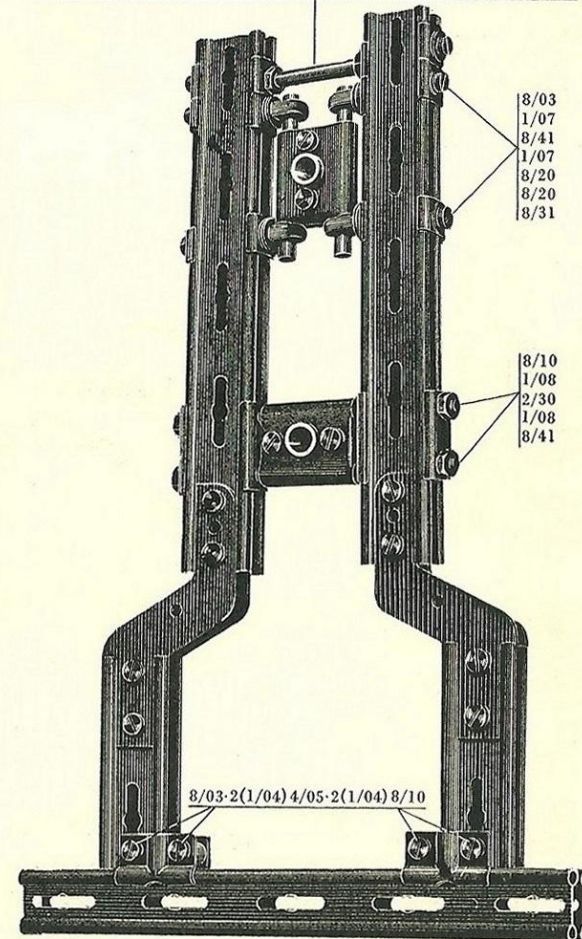
## BEARING DEVICES

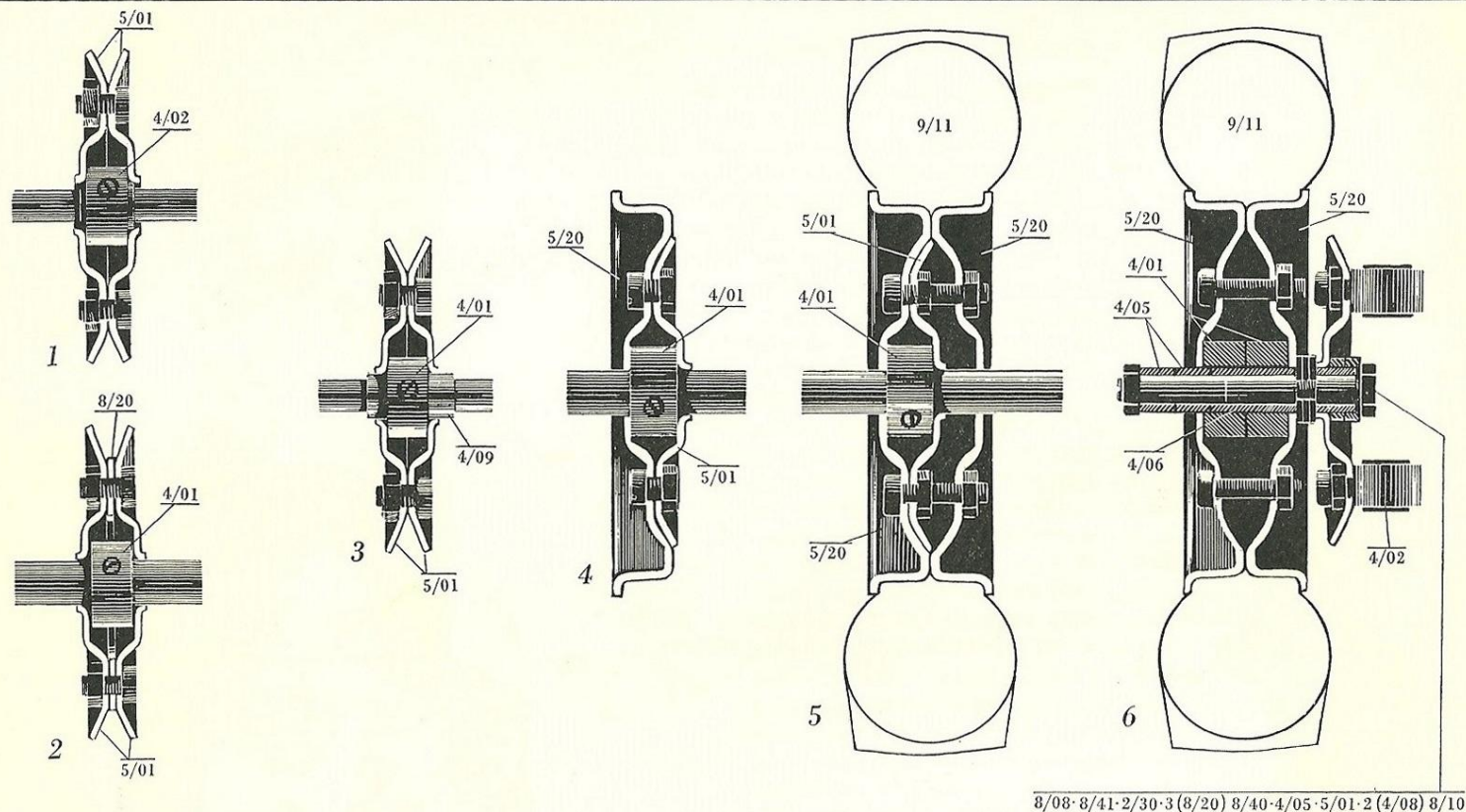
Axles may be mounted in bearings in various ways. The 4 mm axle permits the greatest number of different possibilities, consequently it is the one most frequently used.

Figures 1 and 2 show the construction of bearings with bearing brackets 1/20 and 1/21. Bush for 6 mm axle 4/03 has been used in both examples, this may be substituted by 4/04 for 4 mm axles. In order to prevent jamming of the axles between two bearings of this type – usually one constructs directly with FAC without too accurate fitting – the bushes have a limited play between the bearing brackets. If only one bearing used is for an axle, an axle guide is necessary. Such a device is shown in fig. 3. Fig. 4 shows a mounting of the axle guided through a plate, fig. 5 a revolving bearing made of eye-bolts 8/31. The eye-bolt is often an excellent bearing and the illustrated supplement gives several examples. A bearing made of 6 mm collars 4/01 and 20 mm tube 4/07 appears in fig. 6. Fig. 7 shows the mounting of the end of an axle in a three-hole link 1/31, fitted on a plate. Fig. 8 shows the use of axle pins, being 5.2 mm threaded sleeves screwed to a plate. In the one case a collar for 4 mm axles 4/02 is screwed directly onto the sleeves and the axle rotates in the 3 mm deep cup thus formed. In the other case the axle and axle pin are enclosed in a tube 4/06 which is prevented from slipping onto the axle by a collar 4/02. Fig. 9 shows a pedestal bearing made of toggle links. A gyroscopically suspended bearing is to be found in fig. 10. The axle is rotatable in all directions from a point along its axis.

Strong bearing devices are necessary for heavily loaded axles. Fig. 11 shows part of a strong framework for bearings made of coupled beams. The lower bearing may be attached at any point along the beams, whilst the upper is suspended, for raising or lowering, from eye-bolts 8/31. The bearing pedestal stands on rails of coupled beams and is movable along these. The fastening device with T-plates 1/04 is particularly effective. Compare with picture 1 in the illustrated supplement.

8/03-8/20-1/07-8/41 1/07-8/10-2/31-8/10-1/07-8/41-1/07-8/20-8/03





### ARRANGEMENT OF WHEELS

Figures 1 to 3 show the arrangement of flanged wheels used as pulleys. They may also be used as rims for the rubber tires 9/10. Freewheeling is attained by placing washers between the wheel plates, fig. 2. Fig. 4 shows the assembly of a rail wheel and figures 5 and 6 show how the rail wheel

plates are used as rims for the larger rubber tire 9/11. The assemblies shown in these figures have been used for the automobile shown in pictures 17 and 18 in the illustrated supplement. In this model, however, the flanged wheel 5/01 on the front axle, has been replaced by 5/02.

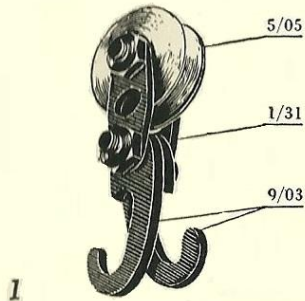


## BLOCKS, HOOKS, RATCHET WHEELS

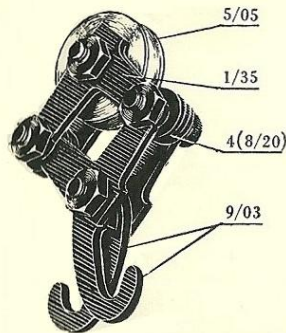
The fact that these various machine parts are dealt with under the same heading is due to their correlation in certain constructions, e. g. the clock, see the illustrated supplement pictures 14, 15 and 16.

Some simple block arrangements are shown in figures 1 and 2. These may of course, be amplified to comprise two or more grooved wheels. In this connection attention should be drawn to a special use of the hook 9/03, fig. 3. This can be fastened to coupled rods, as shown in the figure, so that a third rod inserted in the eye of the hook (4 mm) forms a core of three rods with a common distance from the centre equal to a. The arrangement has been used for the bogie spring attachments, picture 3 in the illustrated supplement.

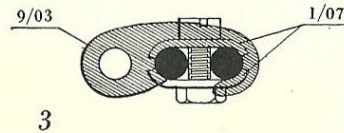
The ratchet wheels, figures 4 and 5, show two uses of the ratchet 6/05 and spring 6/06, firstly with the small spur-gear 6/24 (also fits 6/16) and secondly with 6/64, in which case the ratchet moves on a screw in the outer ring of holes on 6/96 or 5/40. If necessary, double ratchets may be used, fig. 5.



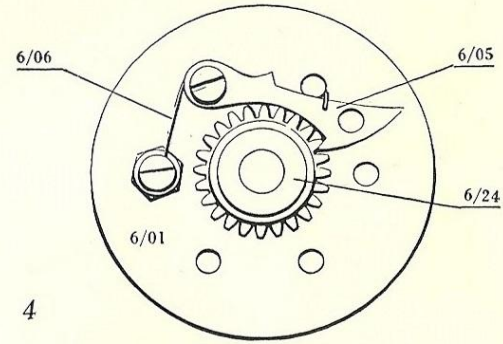
1



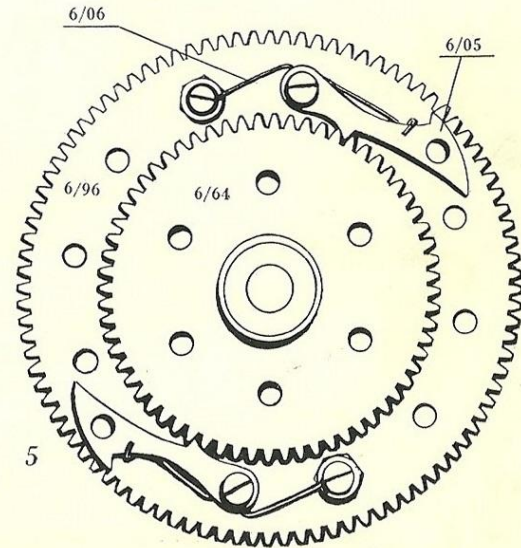
2



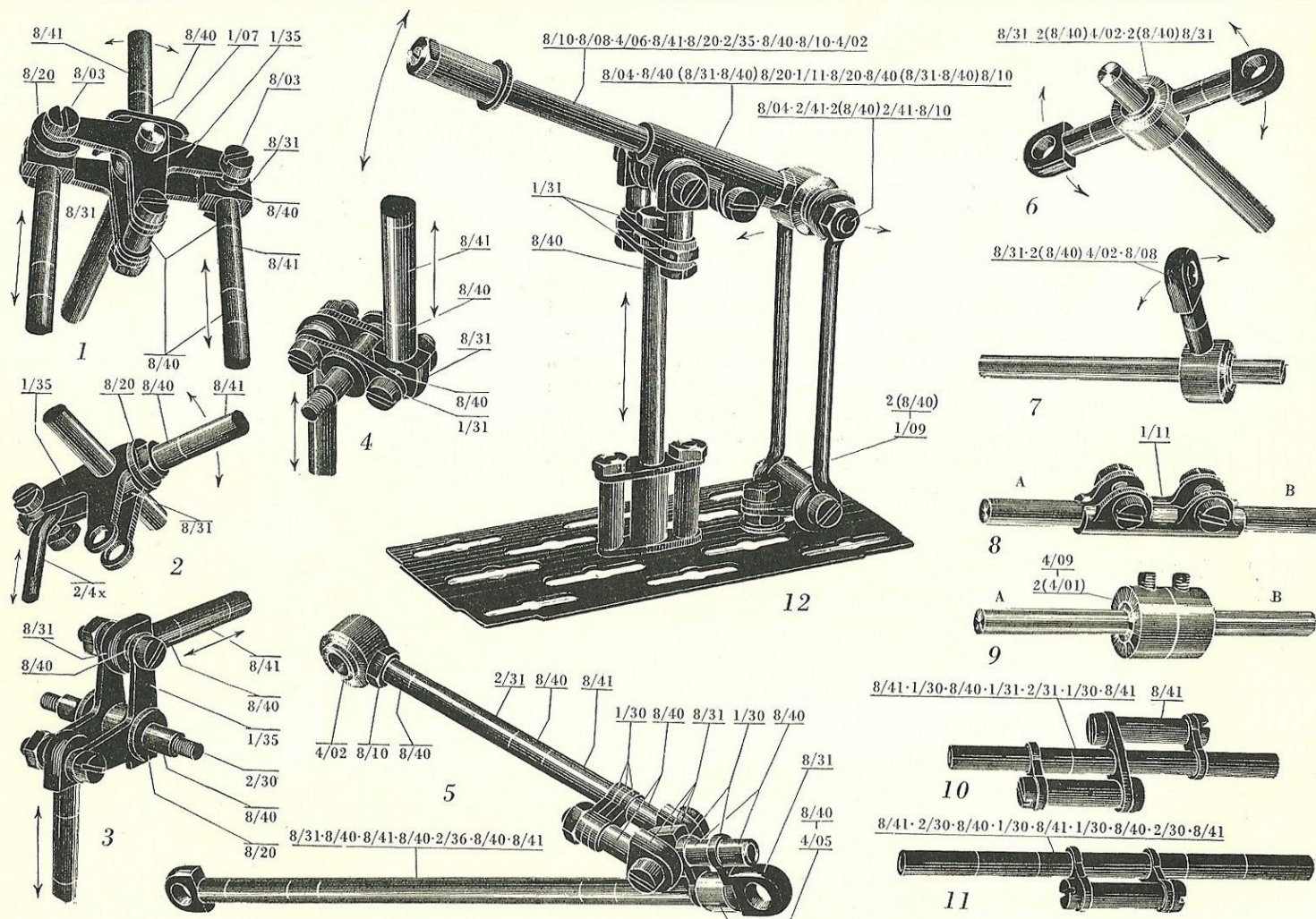
3



4



5

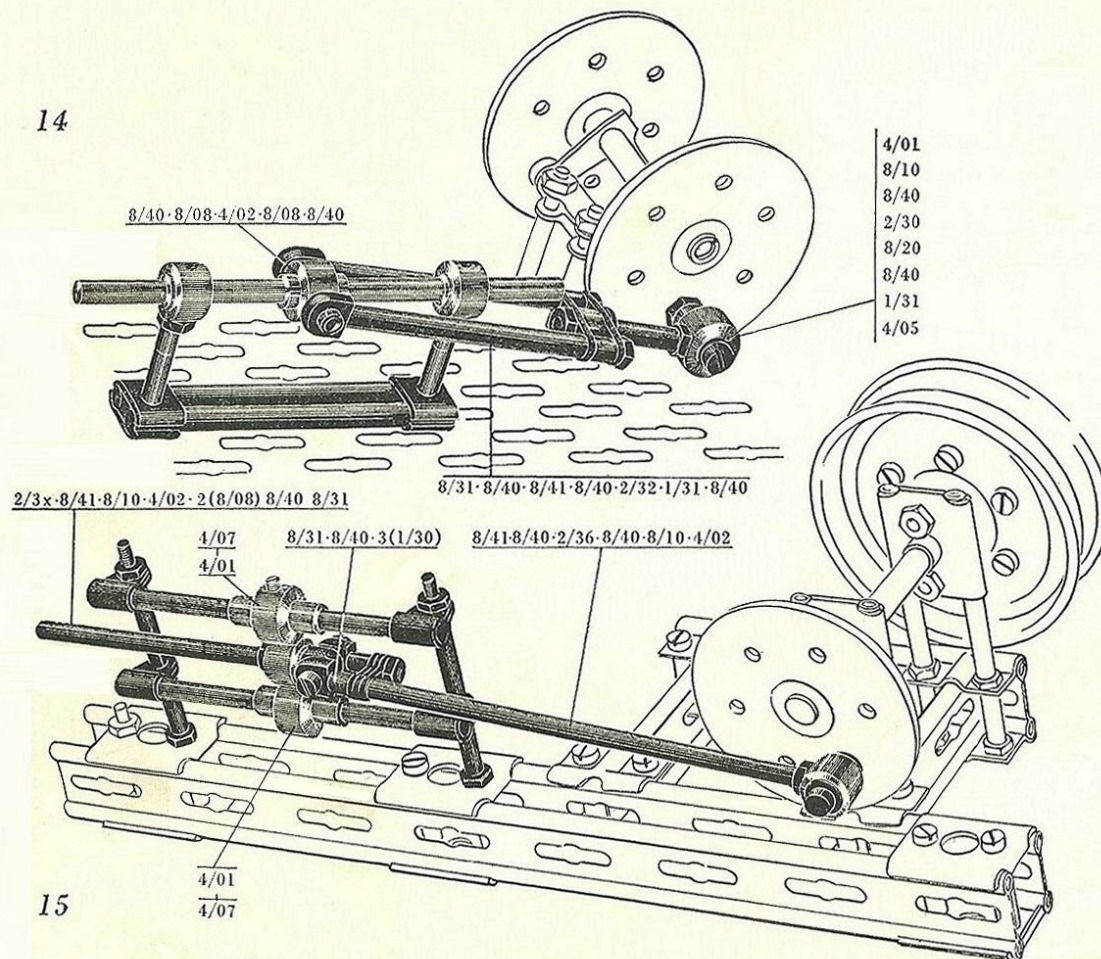








14



an unfavourable action on the piston and are therefore absorbed by special guiding devices, to prevent the piston being subjected to leverage. These guiding devices usually consist of guideways along which the cross piece, i. e. the specially constructed connecting rod bearing, slides.

Fig 13 shows a simple cross piece assembly, constructed on the spring cup 9/31. This has slots in the sides, which permit guiding between two parallel rods (centre distance 2 a). The example shown may be for a pump or the like.

Figures 14 and 15 show a further two assemblies of a connecting rod and guideways for the piston. The fork-shaped connecting rod in fig. 14 makes it possible to guide the piston both in front and behind the cross piece with collars 4/02.

In fig. 15 the cross piece consists of two collars 4/01 screwed fast directly onto the grub screws 8/08 on the collar 4/02 which, together with an eye-bolt 8/31, forms the end of the piston with the bearing for the connecting rod. With the two tubes 4/07 as sliding shoes, this construction is especially safe and free from play.

Special care when adjusting the guideways should, however, be taken to assure that the cross piece runs freely.



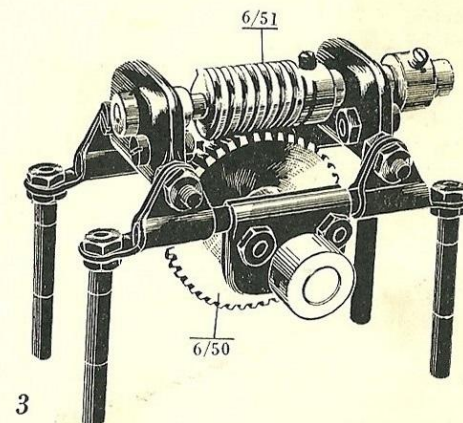
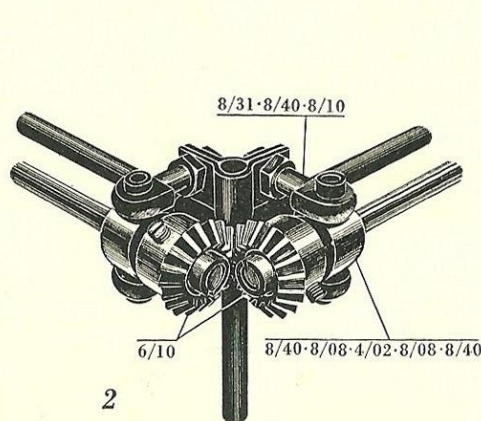
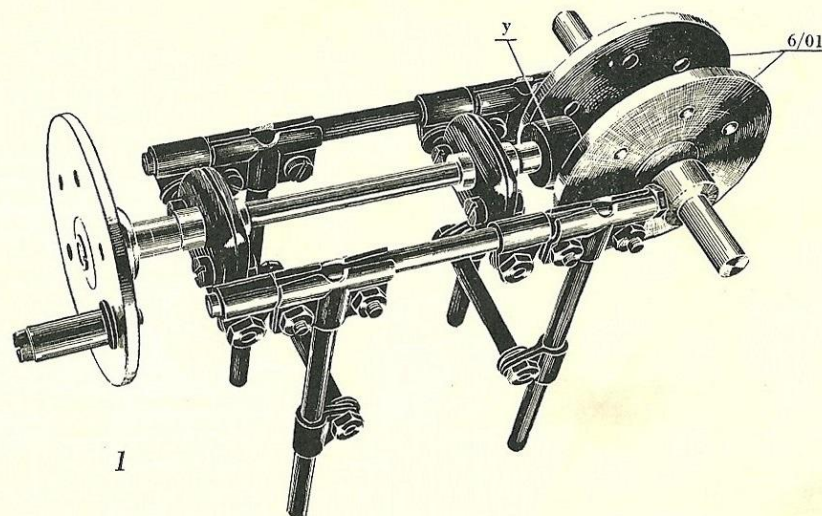
### ANGLE TRANSMISSION GEAR

The most usual angle transmission gears are illustrated on this page with three examples. Fig 1 shows a simple friction gear device with a small bobbin of rubber (rubber tubing threaded directly onto the axle or a collar) with contact against either the one or the other of the two bossed wheels 6/01, fitted on the same axle. This device is the most simple if it is desired to change the motion from a driving axle with constant direction of motion to forwards or backwards in the next stage of transmission. This construction serves for most types of winches for cranes, etc. The transmission of power is very smooth and sensitive. The play of the axle sideways can be negligible and lie within the permitted limits of play sideways of two spur-gears and for this reason further transmission requires no special devices.

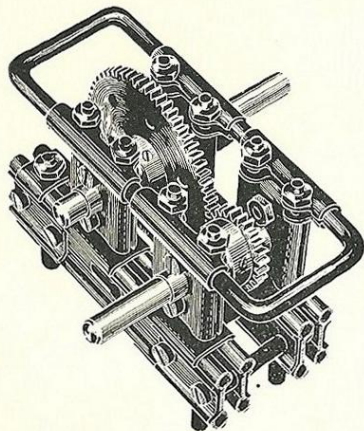
The pressure of the friction discs against the rubber bobbin may either be effected directly by means of a bar, e. g. in the case of cranes when the hook or arm is raised or lowered, or with the help of a spring device when operation in one direction or another is required continuously for considerable periods, e. g. powered trucks of various kinds, which are difficult to handle when in motion.

Fig. 2 shows the construction of an angle transmission gear with bevel-gears 6/10. The axles are mounted in bearings of collars 4/02 suspended from eye-bolts.

In fig. 3 a worm gear is assembled simply in a framework of end clips 1/10, rods 2/04 and threaded rods 2/31. In the case of bearings made of single bearing brackets (i. e. bearing brackets for one rod) the distance between the centre line of the axle and the centre line of the rod is equal to  $a$ . Thus the distance between the axle centres of a worm gear is  $3a = 21$  mm.







### GEAR RATIO

The adjacent table is intended to facilitate the construction of gear assemblies, using the spur-gears of the FAC system. The table may be read in several ways.

The pitch diameter of a spur-gear is equal to the product of the number of the teeth of the wheel, which is indicated by the last figures of the spur-gear symbol, and the modulus which in the case of cylindrical wheels is 0.70. Inasmuch as this diameter is also equal to the distance between the axles of two spur-gears of the size in question, its value may be read from the third column in the table.

The distance between the axles of two intermeshing wheels has been expressed in the table in mm as well as in FAC moduli,  $a$ . The latter information is of practical value when it is desired to mount axles in bearings in the holes in plates or when one is otherwise dependent on

the FAC modulus, for example, when mounting in links or on fixed axles, which maintain certain modulus distances. For example — which gear wheel should be chosen if two axles are to be geared 1 : 2, rotate in the same direction and be  $4a$  distant from each other? The gear ratio is achieved with wheels 6/16 and 6/32. The distance between the axles of these is  $2.4a$ , providing they intermesh. The transmission wheel, the size of which has no relation to the gear ratio, must then absorb the difference between  $4a$  less  $2.4a$ , viz.  $1.6a$ . This is the pitch diameter (see above) of wheel 6/16, which should, therefore, be chosen for practical reasons. A larger transmission wheel may also be chosen, but its points of bearing will not be in line with those of the other axles.

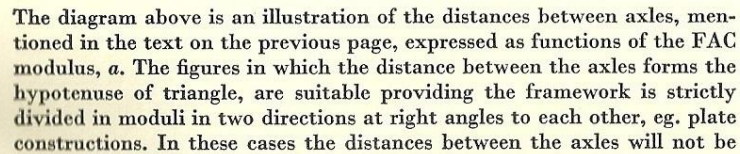
The gear ratios, possible with two spur-gears, are read direct from the table. If a connecting axle, on which further two spur-gears are mounted, is introduced, the number of possibilities is multiplied many times, and they are not possible to enumerate in the limited space available. However, from the values in the table it is possible to calculate whether a certain gear ratio is feasible and with which spur-gears it should be constructed. Consider, for example, the gear ratio 1 : 12. This is the product of the ratios 1 : 2 and 1 : 6 or 1 : 3 and 1 : 4. The ratio 1 : 12 is therefore feasible with four wheels, which in pairs assure the ratios mentioned, eg. 6/16  $\times$  6/32—6/16  $\times$  6/96 or 6/16  $\times$  6/48—6/16  $\times$  6/64. ( $\times$  symbolizes intermeshing wheels,—wheels mounted on the same axle, refer to the chapter on codes, page 27.) A further example: 1 : 60 is the product of 1 : 2, 1 : 5 and 1 : 6 or 1 : 3, 1 : 4 and 1 : 5 and is thus feasible with six wheels and two connecting axles. The following wheels

are suitable: 6/16  $\times$  6/32—6/16  $\times$  6/80—6/16  $\times$  6/96 or 6/16  $\times$  6/48—6/16  $\times$  6/64—6/16  $\times$  6/80.

In addition to the ratios shown in the table, that of the worm gear (6/50  $\times$  6/51) must be taken into account, viz. 1 : 22. Refer to the diagram on the opposite page.

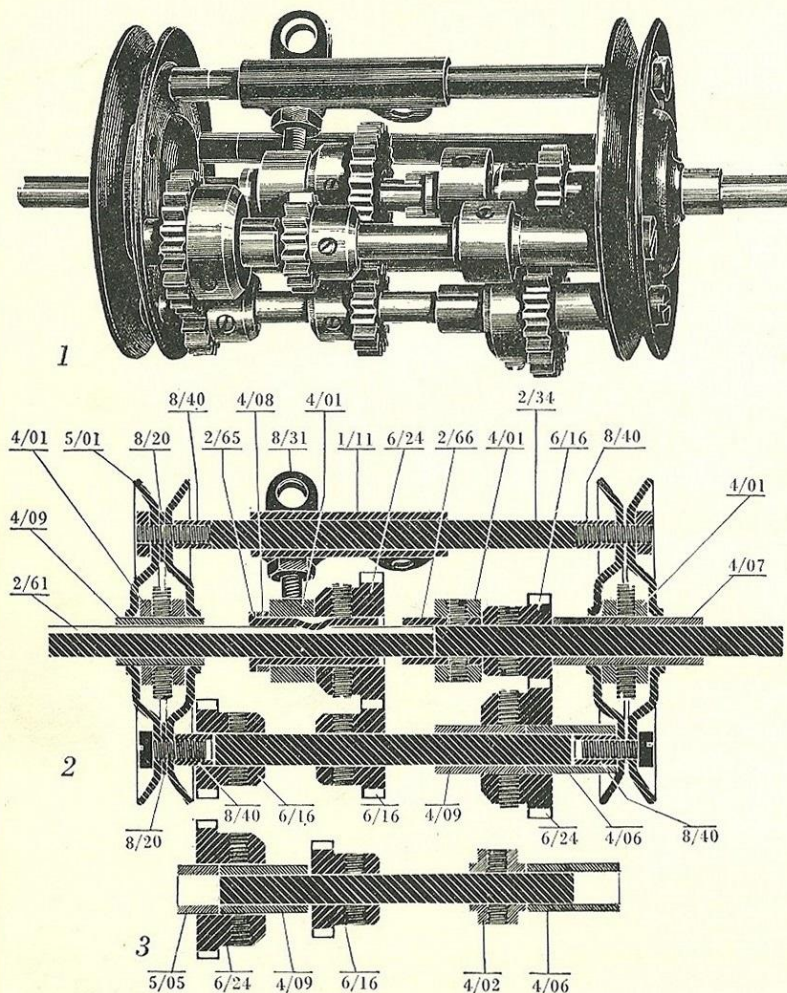
Spur-gear	Ratio	Distance between axles	
		in mm	in $a$
6/16 $\times$ 6/16	1:1	11.2	1.6
6/16 $\times$ 6/24	2:3	14.0	2
6/16 $\times$ 6/32	1:2	16.8	2.4
6/16 $\times$ 6/48	1:3	22.4	3.2
6/16 $\times$ 6/64	1:4	28.0	4
6/16 $\times$ 6/80	1:5	33.6	4.8
6/16 $\times$ 6/96	1:6	39.2	5.6
6/24 $\times$ 6/24	1:1	16.8	2.4
6/24 $\times$ 6/32	3:4	19.6	2.8
6/24 $\times$ 6/48	1:2	25.2	3.6
6/24 $\times$ 6/64	3:8	30.8	4.4
6/24 $\times$ 6/80	3:10	36.4	5.2
6/24 $\times$ 6/96	1:4	42.0	6
6/32 $\times$ 6/32	1:1	22.4	3.2
6/32 $\times$ 6/48	2:3	28.0	4
6/32 $\times$ 6/64	1:2	33.6	4.8
6/32 $\times$ 6/80	2:5	39.2	5.6
6/32 $\times$ 6/96	1:3	44.8	6.4
6/48 $\times$ 6/48	1:1	33.6	4.8
6/48 $\times$ 6/64	2:3	39.2	5.6
6/48 $\times$ 6/80	3:5	44.8	6.4
6/48 $\times$ 6/96	1:2	50.4	7.2
6/64 $\times$ 6/64	1:1	44.8	6.4
6/64 $\times$ 6/80	4:5	50.4	7.2
6/64 $\times$ 6/96	2:3	56.0	8
6/80 $\times$ 6/80	1:1	56.0	8
6/80 $\times$ 6/96	5:6	61.6	8.8
6/96 $\times$ 6/96	1:1	67.2	9.6





The figures farthest to the left should be noted, for example how the uppermost connects with the strap 1/01 and the three-hole link, the next one with the cross-plate 1/03 and the toggle link 1/35, whilst the lowermost, which shows the worm gear, should be compared with fig. 3 on page 35.





## GEAR BOXES

### Gear box with two forward and one reverse gear

This assembly, which is the same as for the automobile, see picture 17 in the illustrated supplement, is based on the two spur gears 6/16 and 6/24, with a mutual distance between the axles of 2a. Thus all FAC six-hole parts may be used for the ends of the box. Compare with the corresponding figure on the previous page. Flanged wheels, held together with threaded rods (of which one has been removed) have been used in this assembly. The ratios are 1 : 1, 4 : 9 and, in reverse, 8 : 27.

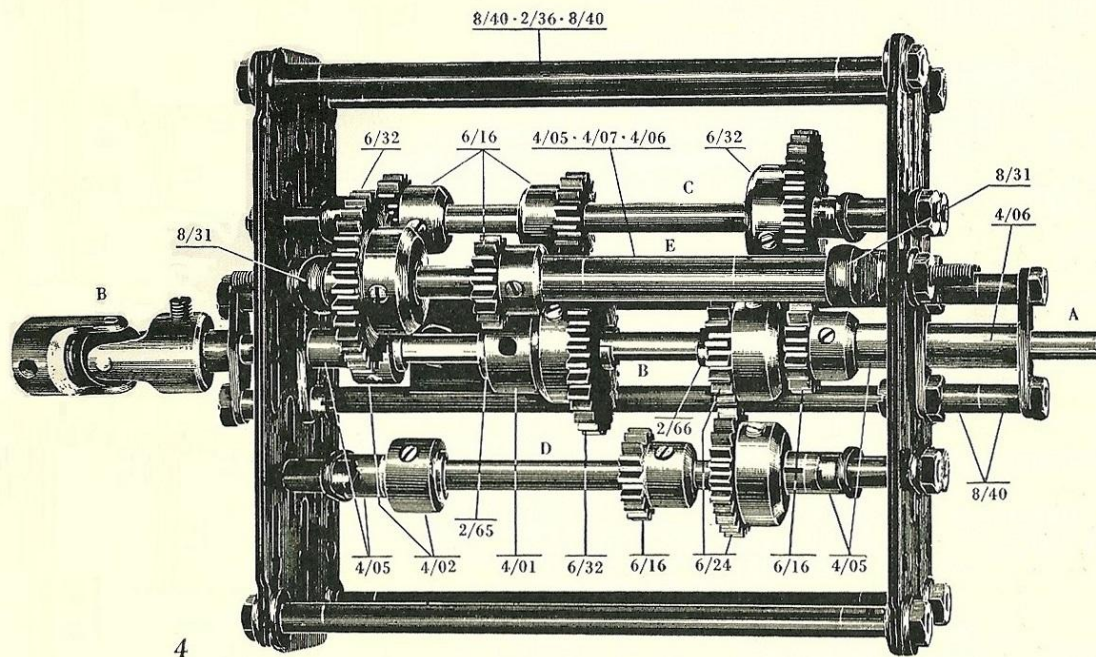
Only the primary and propeller shafts are continuous shafts. The other two, the secondary shaft and reverse idler shaft, are supported on pins made of threaded sleeves 8/40. The primary and propeller shafts meet inside the chisel tube 2/66, which has holes for the grub-screws in the collar 4/01, which has been threaded on, so that the screws may press directly against the shaft. The collar 4/01, with split tube 4/09, is screwed onto the propeller shaft 2/61. These run freely between the flanged wheels, the clamping effect of which has been neutralized by the insertion of washers 8/20 or three-hole links 1/31.

A coupling clip 1/11 acts as gear shifter. It moves on the threaded rod, with an eye-bolt screwed on, which is loosely threaded into the freely running collar 4/01 on the slotted tube 2/65. A cross section of the box is shown in fig. 2. The reverse idler shaft has been removed and is shown separately in fig. 3.

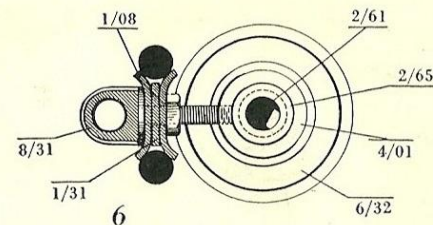
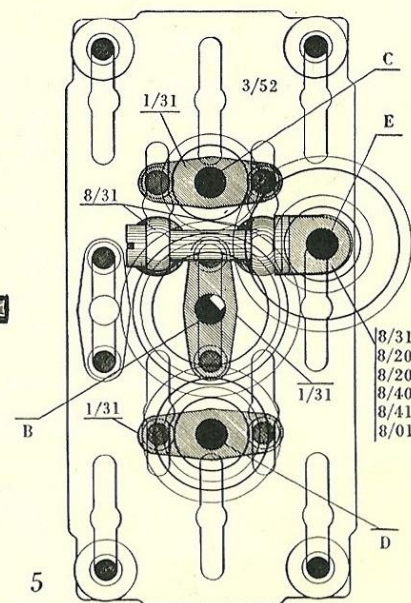
### Gear box with three forward and one reverse gear

The gear box, fig. 4, is based on the spur-gears 6/16, 6/24 and 6/32. The distance between the shafts thus depends on 6/16 and 6/32 and is the same as between two 6/24. This measurement is not directly obtainable, therefore plates 3/52 have been chosen for the box ends. For the sake of stability they have been duplicated and, as in the previous assembly, they are held together by threaded rods.

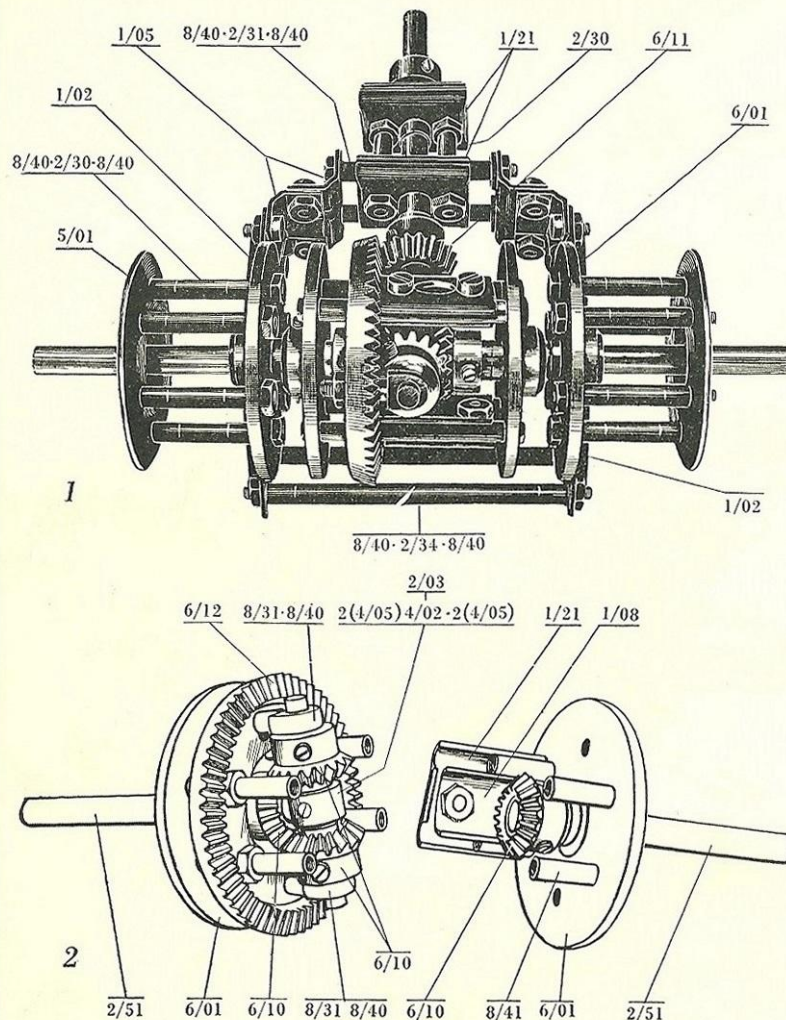




The primary shaft A and propeller shaft B are through shafts. By using the slots in the plate and three-hole links as bearings, the centre of the secondary shafts, C and D, is established. The centre of the reverse idler shaft, E, is not in line with any of the slots in the plate, therefore this shaft is mounted on supports made of eye-bolts, see fig. 5. The reverse idler shaft, E, together with the primary and propeller shafts, A and B, and the secondary shaft, C, form an equilateral triangle. The ratios are 1:1, 1:2, 1:4 and reverse 1:8. The last ratio may be changed to 1:4 by substituting the wheels  $6/16 \times 6/32$  between the secondary shaft, C, and the reverse idler shaft, E, by two  $6/24$ . The gear shifter is constructed as shown in fig. 6.







## DIFFERENTIALS

### Differential with crown wheel

The assembly in fig. 1 is based on the big bevel-gear 6/11×6/12 and is remarkable for its great accuracy and durability. The differential housing, or the framework from which the differential is suspended, may be constructed in several ways, depending on the special requirements of particular types of vehicle construction. Thus in the case of the automobile, where it is a question of this type, a more simple frame is used, see the illustrated supplement. In this instance a 4 mm axle 2/0x has been used as universal driving shaft, instead of the 6 mm axle reproduced here.

Fig. 2 shows the differential taken apart. Both halves are held together by means of shields made of a double bearing bracket 1/21 and a double clamp 1/08, assembled as shown in the figure. One shield has been removed.

The bevel-gear 6/12 is attached to a bossed wheel 6/01 with screws 8/04, threaded sleeves 8/40 forming the gap between the wheels. Nuts 8/10 and threaded sleeves 8/41 are also attached to the screws, as shown in the diagram. The corresponding parts on the opposite half are 8/03 and 8/41. The threaded sleeves 8/41 meet between, and are squeezed tight by the shields. This device facilitates rapid assembly and disassembly, as well as accurate adjustment.

The differential shaft is mounted in eye-bolts 8/31, which are screwed fast farthest out in the oblong holes in the bevel-gear 6/12. The bevel-gears on the differential axle runs freely. It should be noted that the smallest grub-screws 8/09 should be used for the collar 4/02.

### Differential constructed with one spur-gear

One of the simpler differential assemblies is shown in fig. 3. It is constructed between the spur-gear 6/64 and the bossed wheel 6/01, which are held together with angle-plates and cross-plates. The differential shaft is attached to the latter.

If the assembly is to be used in an automobile, an intermediate shaft, with a spur-gear (preferably 6/32) and a bevel-gear made of two 6/10, should transmit the drive from the propeller shaft to the differential, thus ensuring suitable step-down.



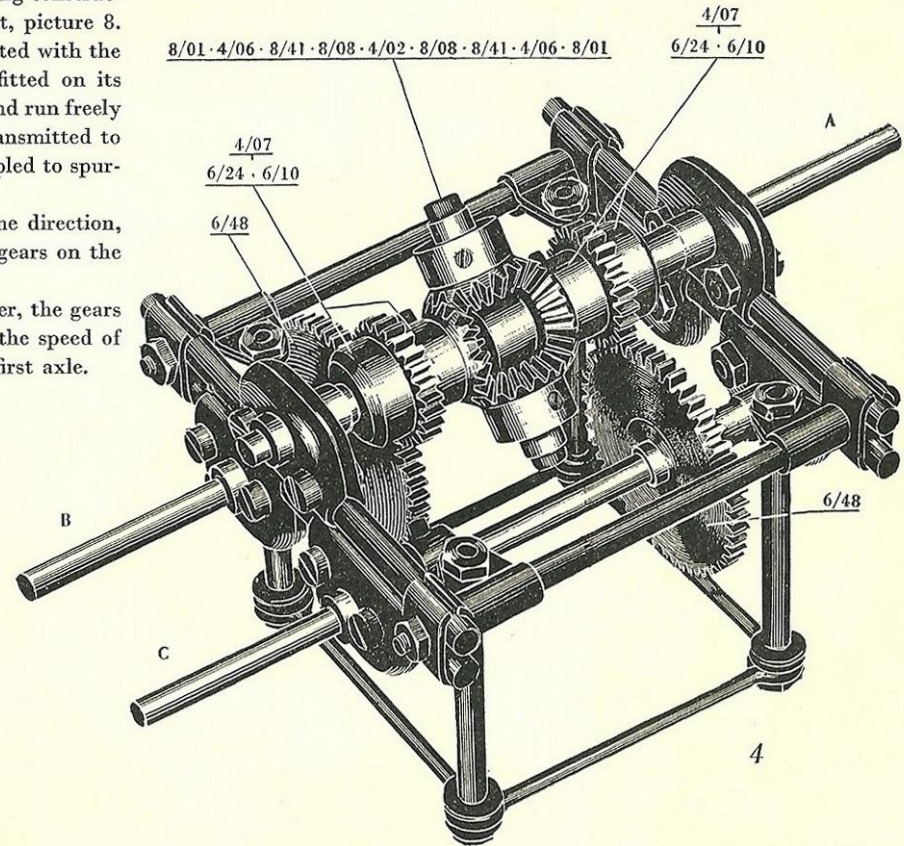
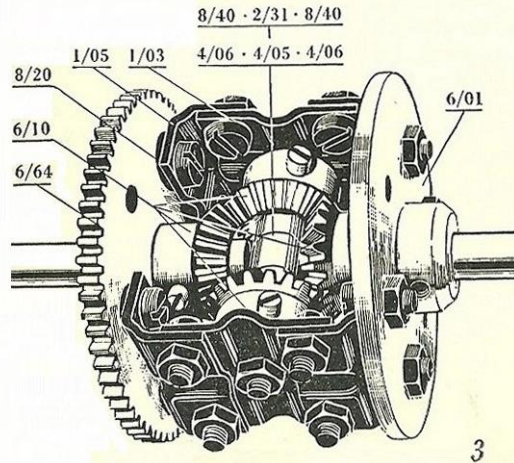
### Differential mounted on a bench

This assembly is very well suited for demonstrating the principle of the differential and shows how flexibly it can be adapted for varying constructional purposes. Note the crane in the illustrated supplement, picture 8.

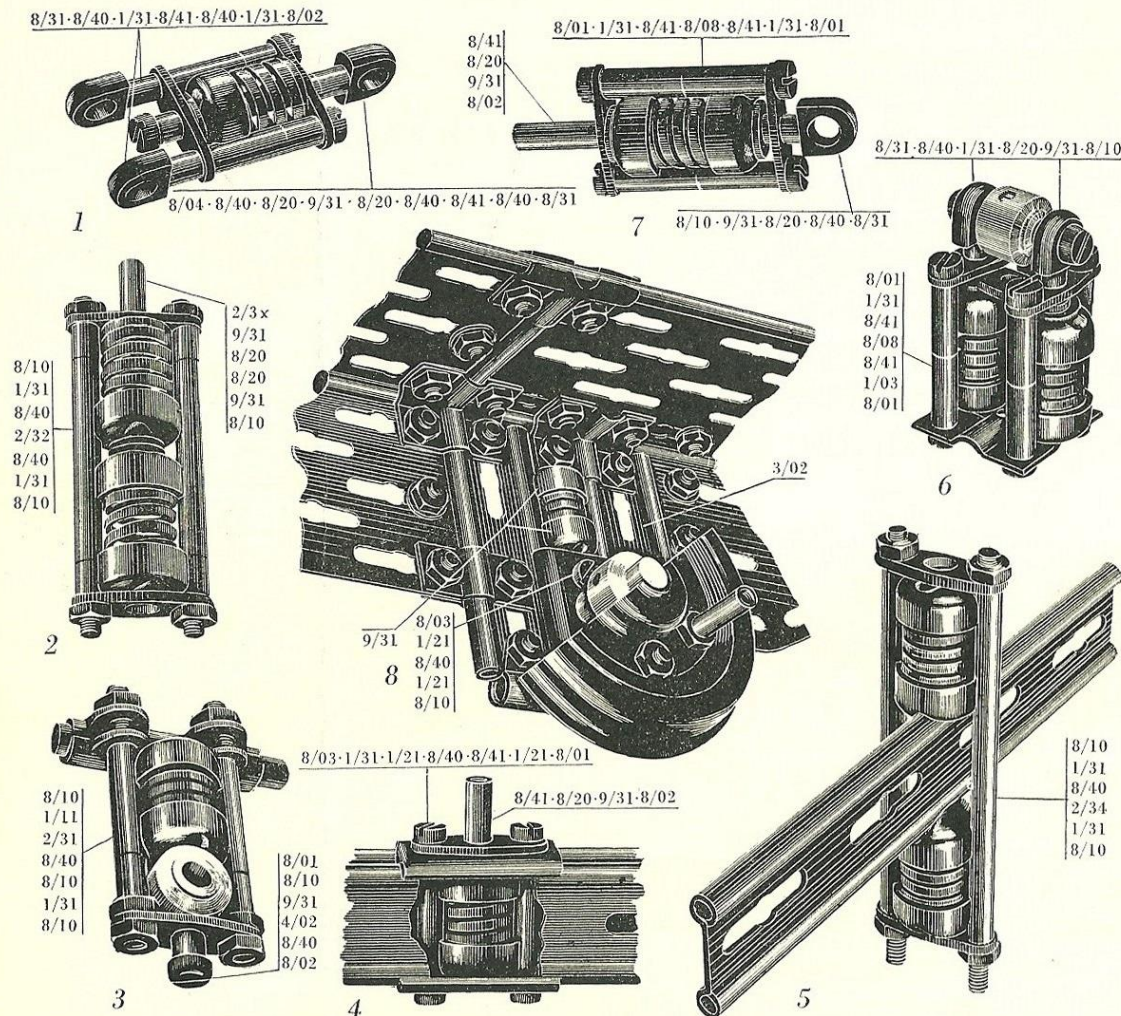
The primary shaft, A, drives the differential shaft, constructed with the collar 4/02, carefully fixed, and the threaded sleeves 8/41 fitted on its grub screws. The bevel-gears 6/10 are mounted on tubes 4/06 and run freely on the threaded sleeves. The drive from the differential is transmitted to the driven shafts, B and C, by means of bevel-gears 6/10, coupled to spur-gears 6/24 on freely running 20 mm tubes 4/07.

When the driven shafts, B and C, which rotate in the same direction, carry an equal load and thus rotate at the same speed, the gears on the differential axle act as carriers and do not revolve thereon.

When one of the driven shafts is loaded more than the other, the gears on the differential axle are forced to rotate, which increases the speed of the other axle in proportion to the decrease in speed of the first axle.







## SPRUNG DEVICES

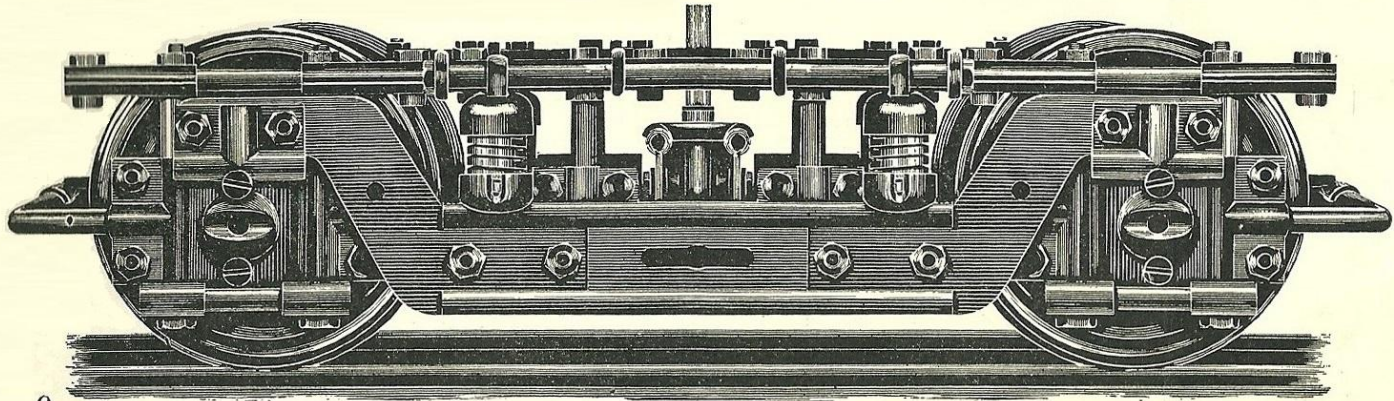
Special care has been devoted to this aspect of the FAC system. Even in regard to small-scale models it is of great importance that a carriage can be fitted with springs, which really serve their purpose.

Examples on these pages show the application of the helical spring 9/30 and the spring cup 9/31. The latter has grooves in the sides to guide it between parallel rods and a device at the base for attaching to beams or rods, figures 5 and 9.

The springs serve as compression springs in figures 3, 4, 5, 6, 8, 9 and 10, as tension springs in fig. 1, and for both purposes in fig. 2. In the case of the trolley, reproduced on page 5, the axles have been mounted in bearings as shown in fig. 3. Fig. 4 shows a spring fitted between two coupled beams (one partly open to show the construction). The device will be noted again in fig. 10, where it acts as a spring for the body of the vehicle. Fig. 6 shows a spring bobbin, suitable for similar purposes. Fig. 8 shows the spring assembly for the loco, picture 5 in the illustrated supplement. In this instance the wheel has been cut off along its diameter, so as not to hide the construction.

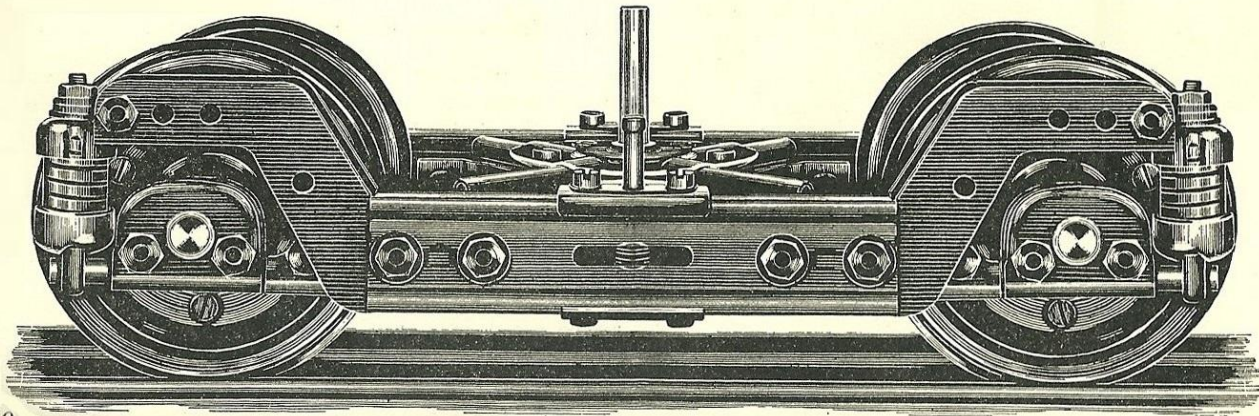
The bogie assemblies on the opposite page show examples of the sprung suspension of wheels on railway models, an aspect of FAC models where realism is especially striking. These types of models can also be varied ad infinitum. See pictures 2, 3, 4, 5 and 12 in the illustrated supplement.





9

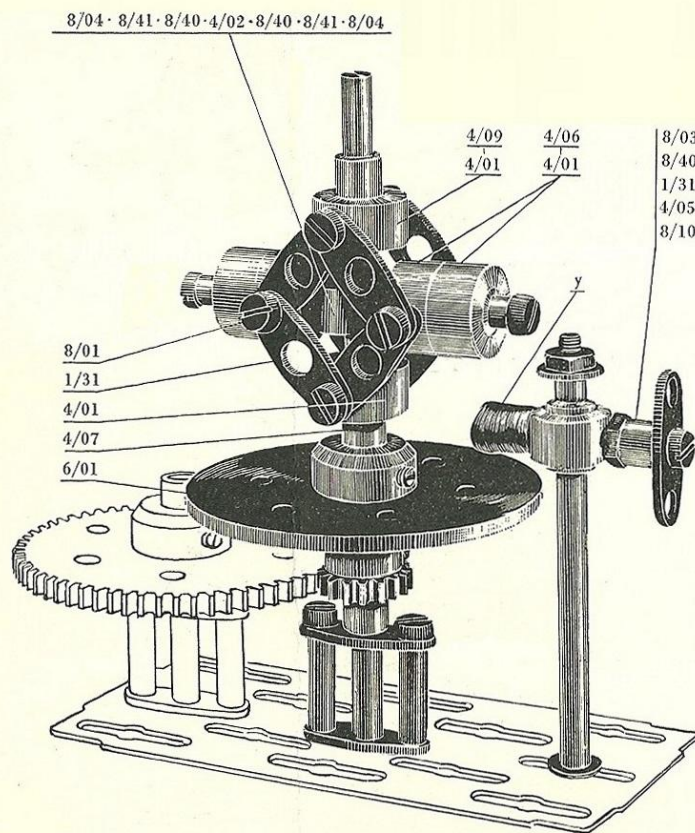
BOGIE WITH SPRING-LOADED BEAM (*AMERICAN TYPE*)



10

BOGIE WITH WHEEL-BEARINGS ON SPRUNG SWING-ARMS





### CENTRIFUGAL REGULATOR

The regulator belongs to machinery parts, but is in effect a machine in itself, inasmuch as it carries out an operation. The regulator in the illustration is constructed to be self-braking at a designated speed, so that this cannot be exceeded.

Weights, made of collars 4/01 fitted on tubes 4/06, are suspended from three-hole links on the regulator axle. These are horizontally guided by threaded sleeves, fitted to a movable collar 4/01 on the axle. When the axle rotates, the weights are forced out into the periphery by centrifugal force and lift the bossed wheel, until a rubber tube, y, fitted on a perpendicularly adjustable bar, acts as a brake.

This effect may be substituted by others, eg. lifting an indicator along a scale registering the speed, or, by means of a chain action, transmitting an impulse to some device, which is to come into action at a certain speed.

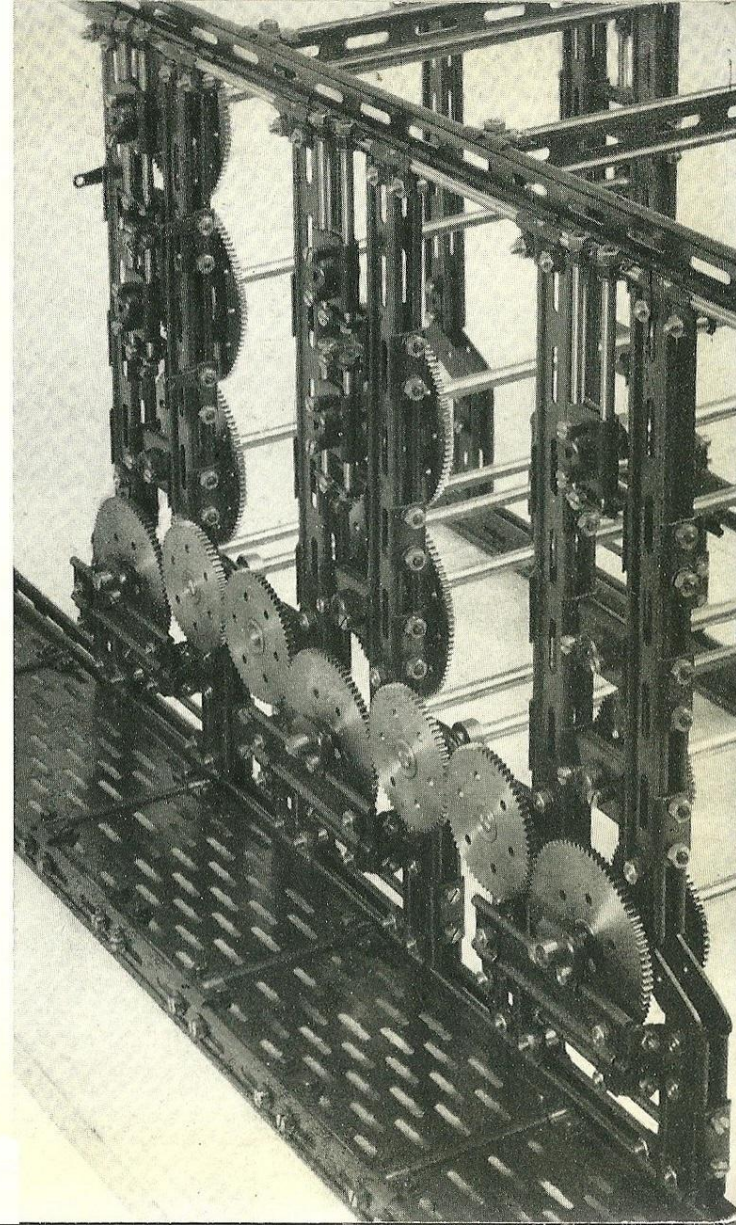
### ILLUSTRATED SUPPLEMENT

The photographs on the following pages reflect a representative selection of FAC constructions. The pictures speak for themselves and no further detailed description has been devoted to them. They illustrate the application of the method of construction, which has been described in the foregoing. However, to show as much as possible of the constructions, a number of detailed illustrations have been included.

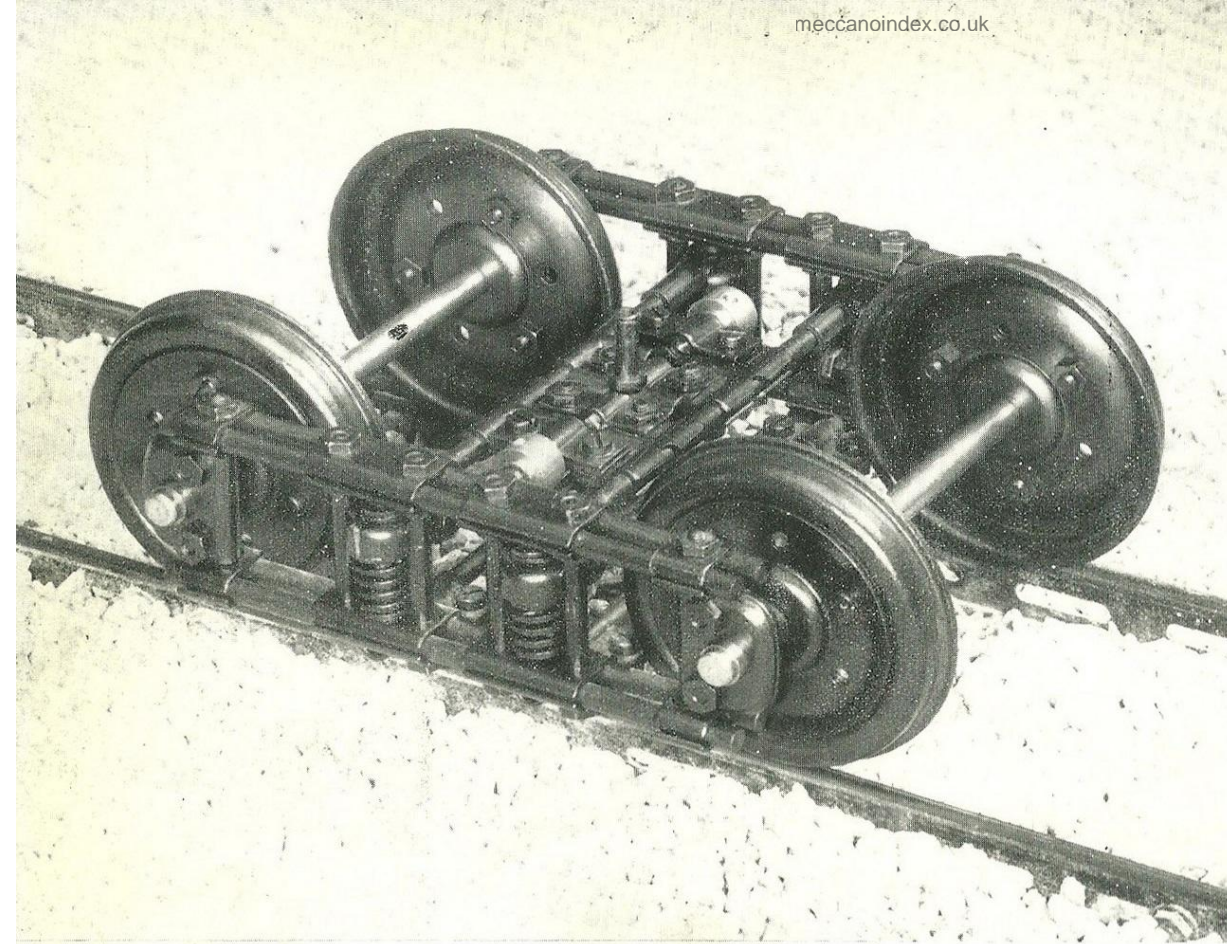
Some of the models are worked electrically. Inasmuch as FAC does not include a specialized motor suitable for the varying range of power requirements which may arise, a suitable power plant must be sought among the different types of smaller motors available on the market. In this connection the motors of used automobile windshield wipers are worth mentioning. These are easily adapted for mounting in FAC models. The transmission from such a motor is satisfactory by means of a friction gear, as described on page 35.



Picture 1. Framework for rotary press during assembly. The framework consists of a number of bearings of the type described in fig. 11 on page 29. These are attached to rails of coupled beams. The assembly rests on a foundation of strong plywood, which affords the necessary level surface. The upper bearings may be raised and lowered along guide bars of threaded rods and may be sprung. This assembly is an excellent example of mounting axles subject to great load in bearings on a machine of high precision and reliability. The press also comprises certain special parts, such as rollers and pressure cylinders, which have not been shown here.



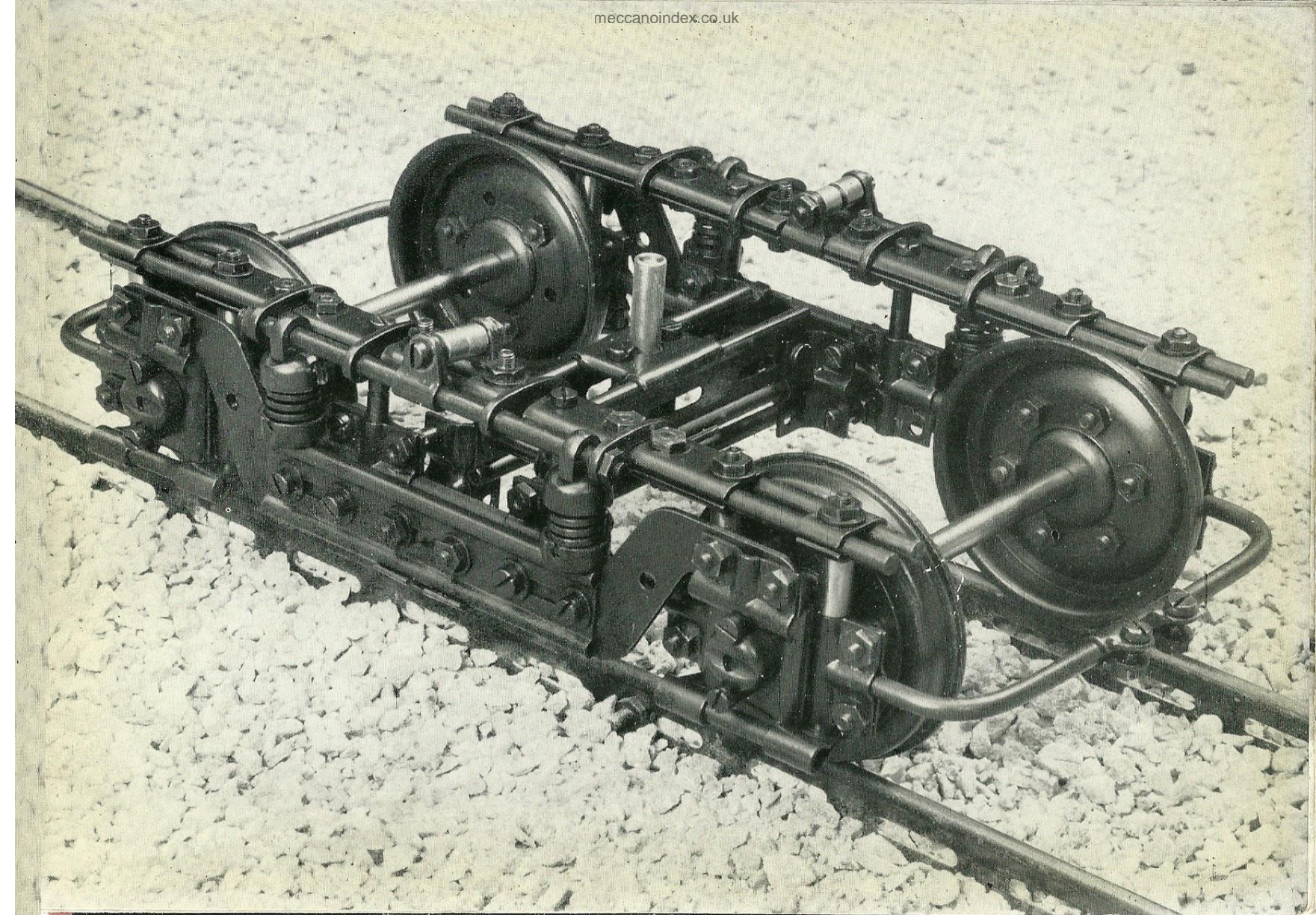




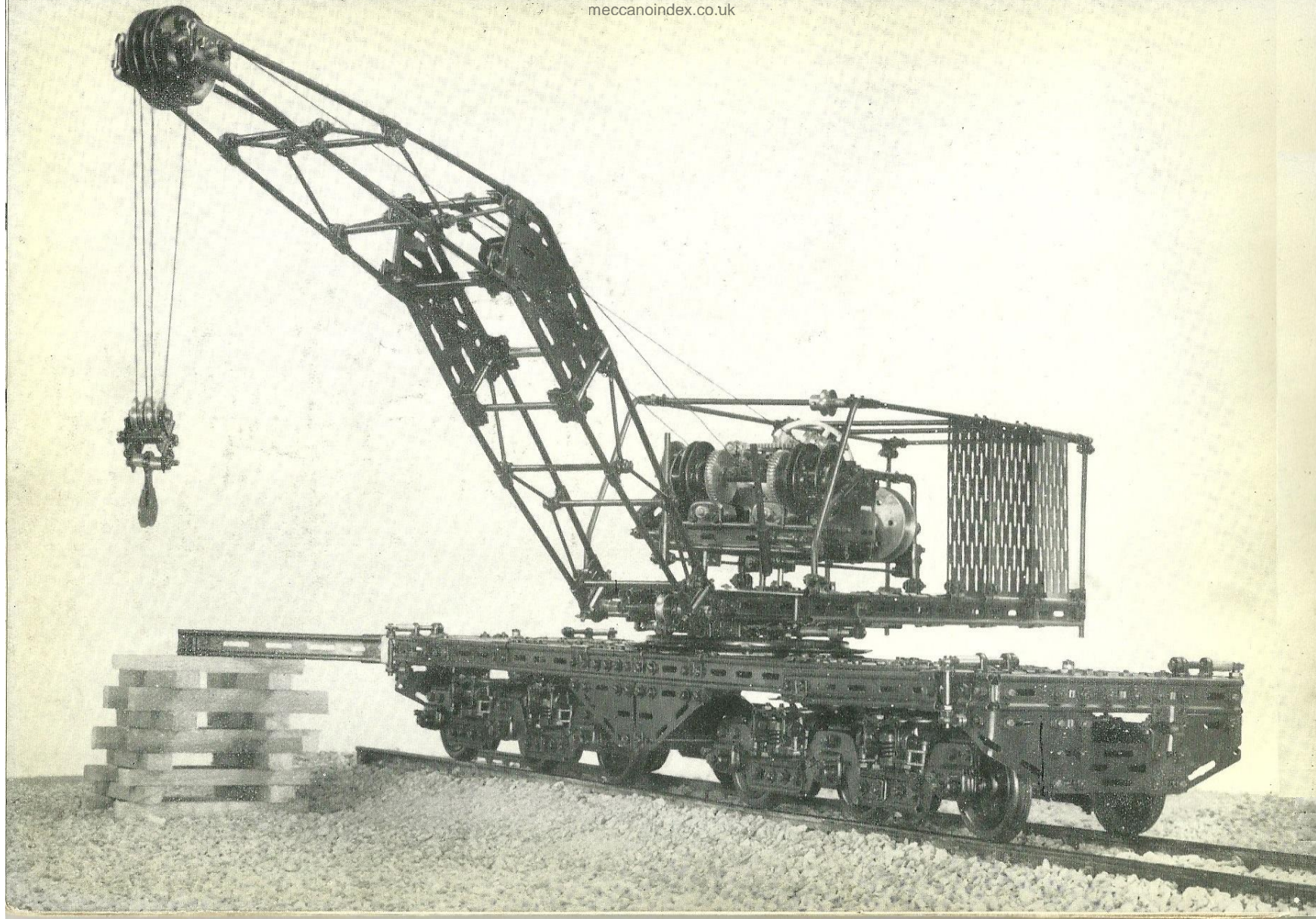
▲  
 Picture 2. Railway bogie, as used for the truck, picture 12. The framework is made of coupled rods, held together by clamps and threaded rods. The bearing boxes are fixed and are made of single bearing brackets with bushes for 6 mm axles. The centre beam, which supports the middle bearing and the supporting rolls of the body of the truck, is suspended with springs from the two halves of the frame.

►  
 Picture 3. Bogie with movable bearing boxes of the type described in fig. 4 on page 27, the spring pressure acting on the bearing boxes through a hanging beam (American bogie). By and large this assembly is the same as that shown in fig. 9 on page 43. See fig. 3 on page 31 for attachment of the springs to the frame. The centre beam with the middle bearing is joined fast with the two frame halves, but may also be sprung as described in connection with the previous assembly.

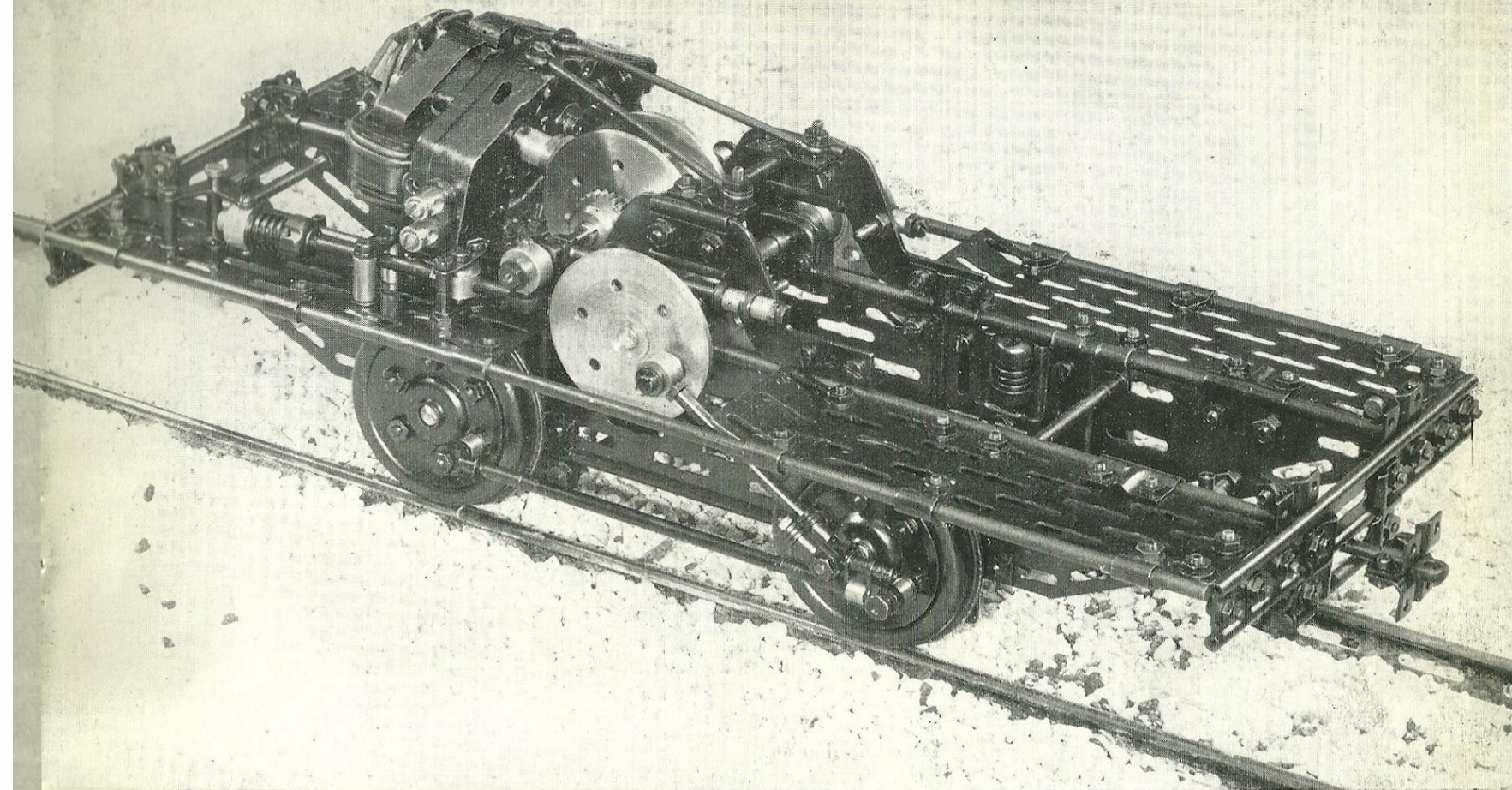








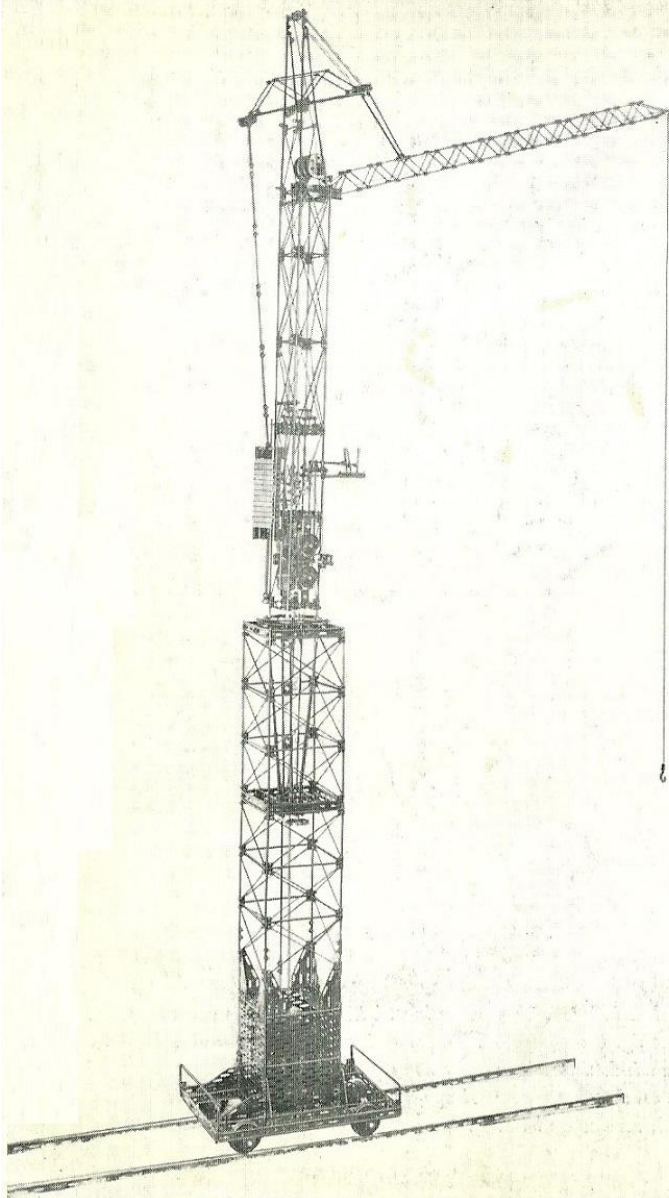




◀ *Picture 4. Large crane truck resting on three-axle bogies with fixed bearing boxes and sprung centre beams. The crane revolves on the big roundel 5/31. The chassis has hinged supports, resting on sleepers to prevent the truck from heeling when the crane is being loaded.*

▲ *Picture 5. Chassis for a small electric loco with power plant. This assembly is an example of sheet metal inner framework, see fig. 8 on page 42. The coupling rods are described in fig. 5 on page 32. The motor is from a windshield wiper and acts directly on a friction gear, see fig. 1 on page 35 and refer to the text on that same page. A spring device acting on the friction gear is used for adjusting to forward, reverse and idling.*



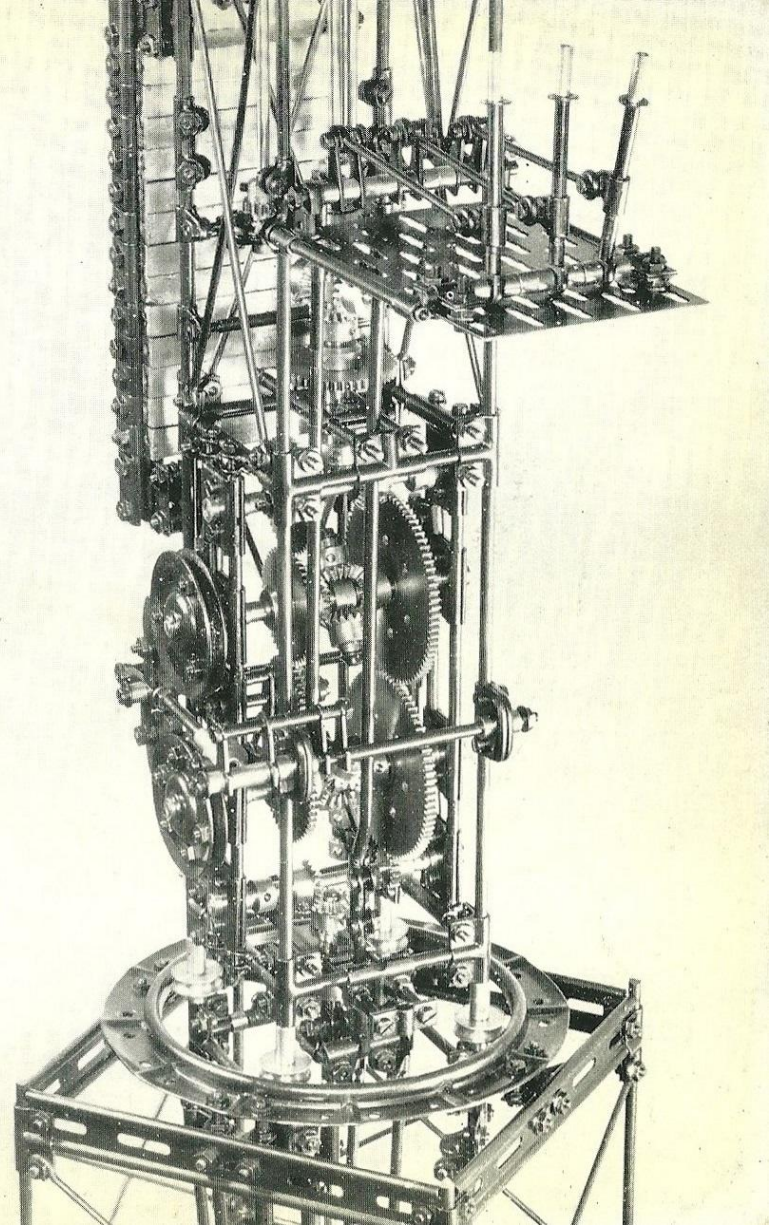
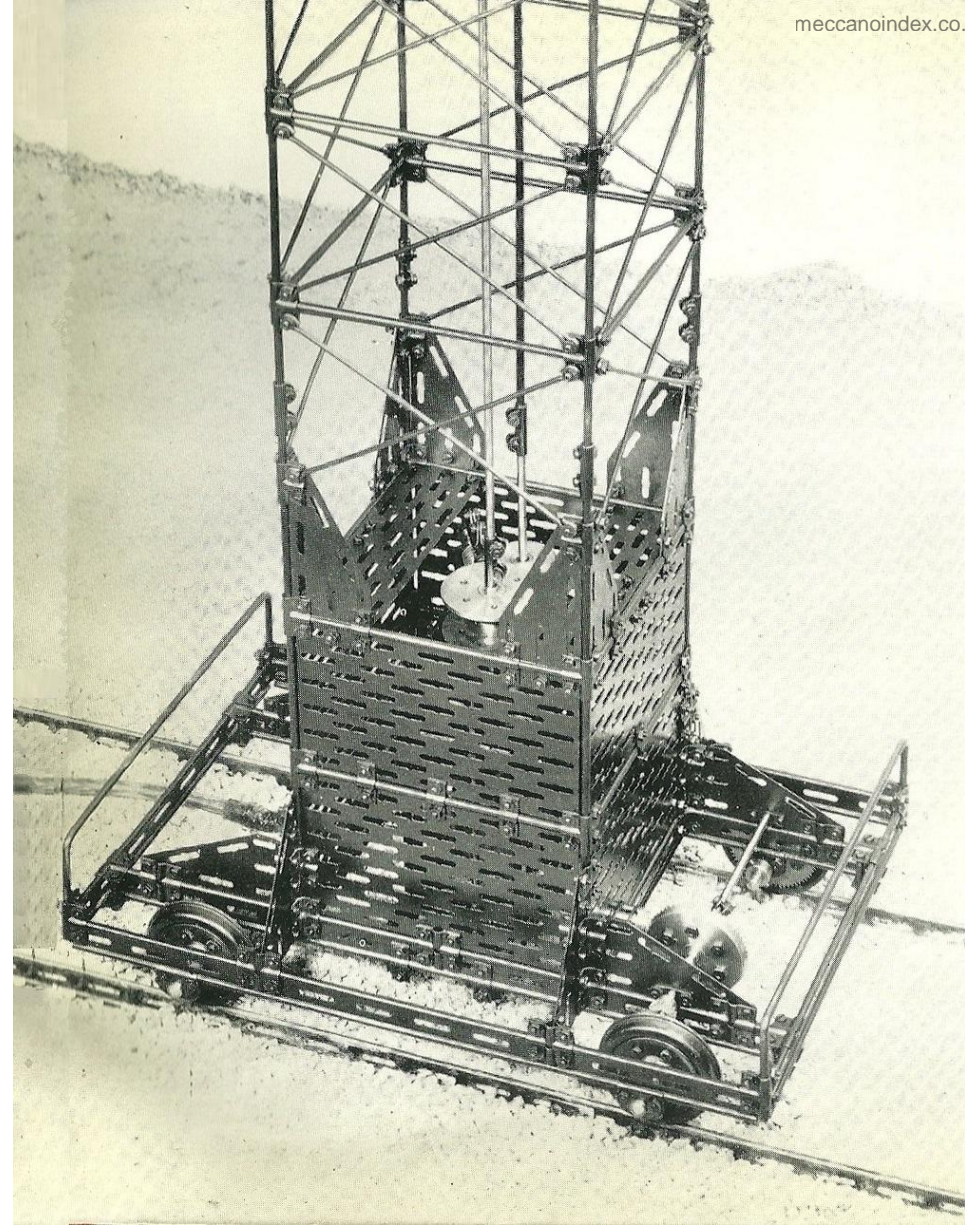


◀ Picture 6. Derrick crane, consisting of a fixed tower on a chassis moving on rails and, in the fixed tower, a revolving mast with a hinged crane boom and counterweight. The latter slides along guide rails of rods attached to the revolving mast.

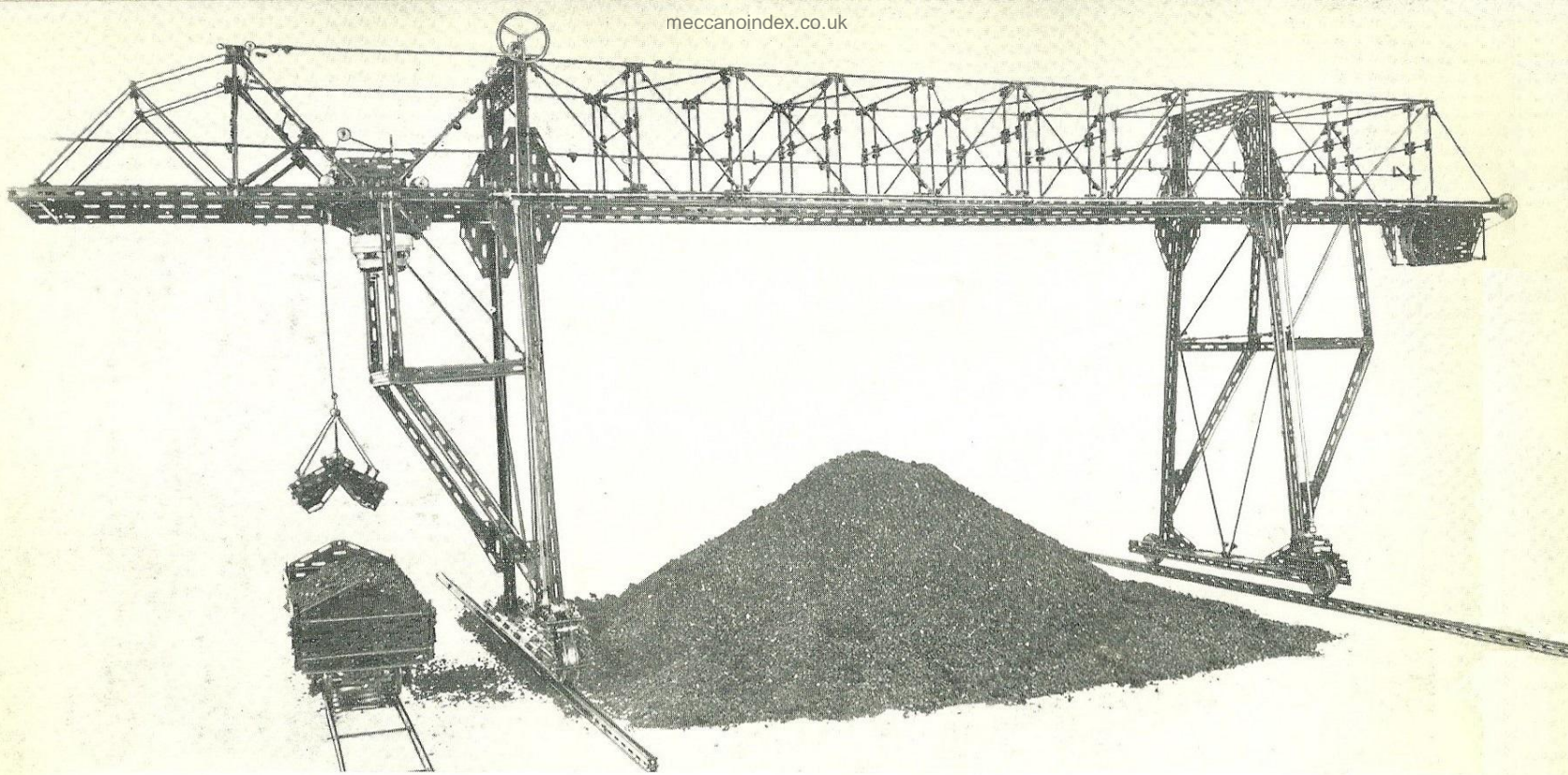
Picture 7. Detailed picture of the chassis and fixed tower of the derrick crane shown in picture 6. The chassis is a plate assembly and houses a central power plant, from which power is transmitted both to the rail wheels and to the revolving mast, effecting the revolving motion and the movement of the crane boom and hook. Note how the same rods which form the framework of the plate assembly, continue into the lattice work of the tower, thus clearly showing the organic and logical relationship between the two types of construction. ▶

Picture 8. Detailed picture of the previous assembly, showing the gear devices for the movements of the crane boom and hook. The device is constructed on the differential principle, but the simpler friction gears may also be used. All the functions are controlled by levers on the platform by means of link motions. This picture reflects an example of concentration of movable parts within a very limited space. ▶







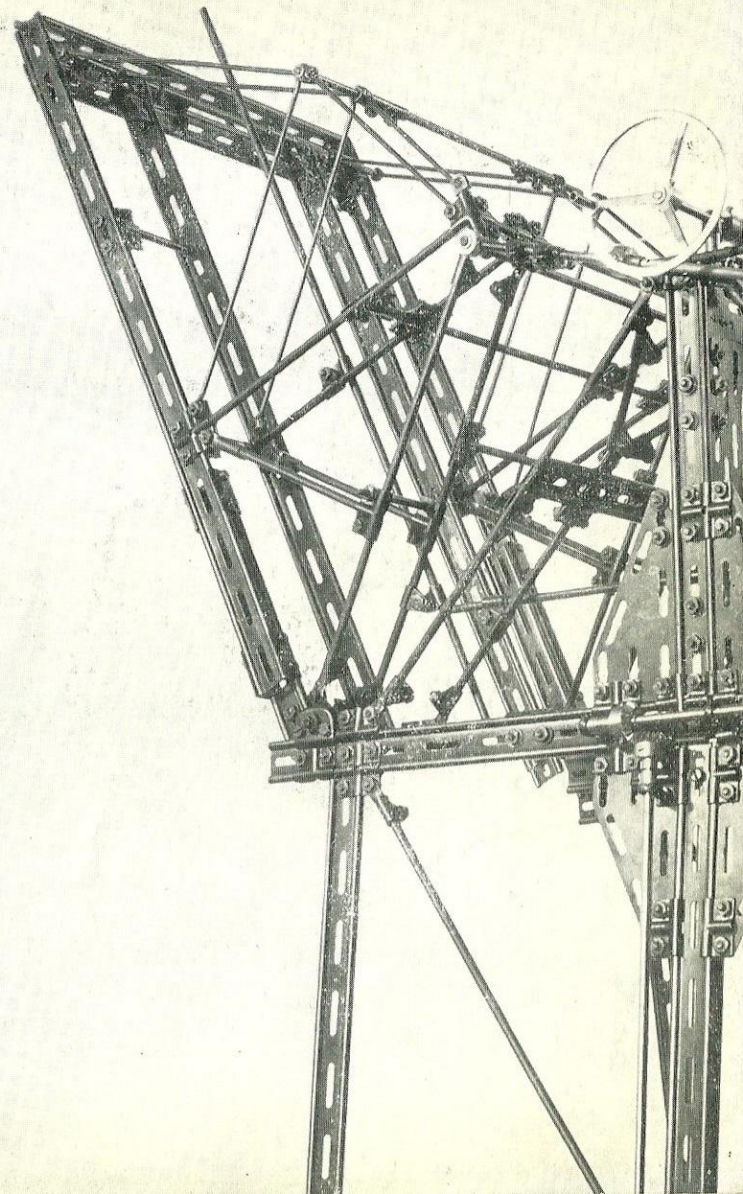
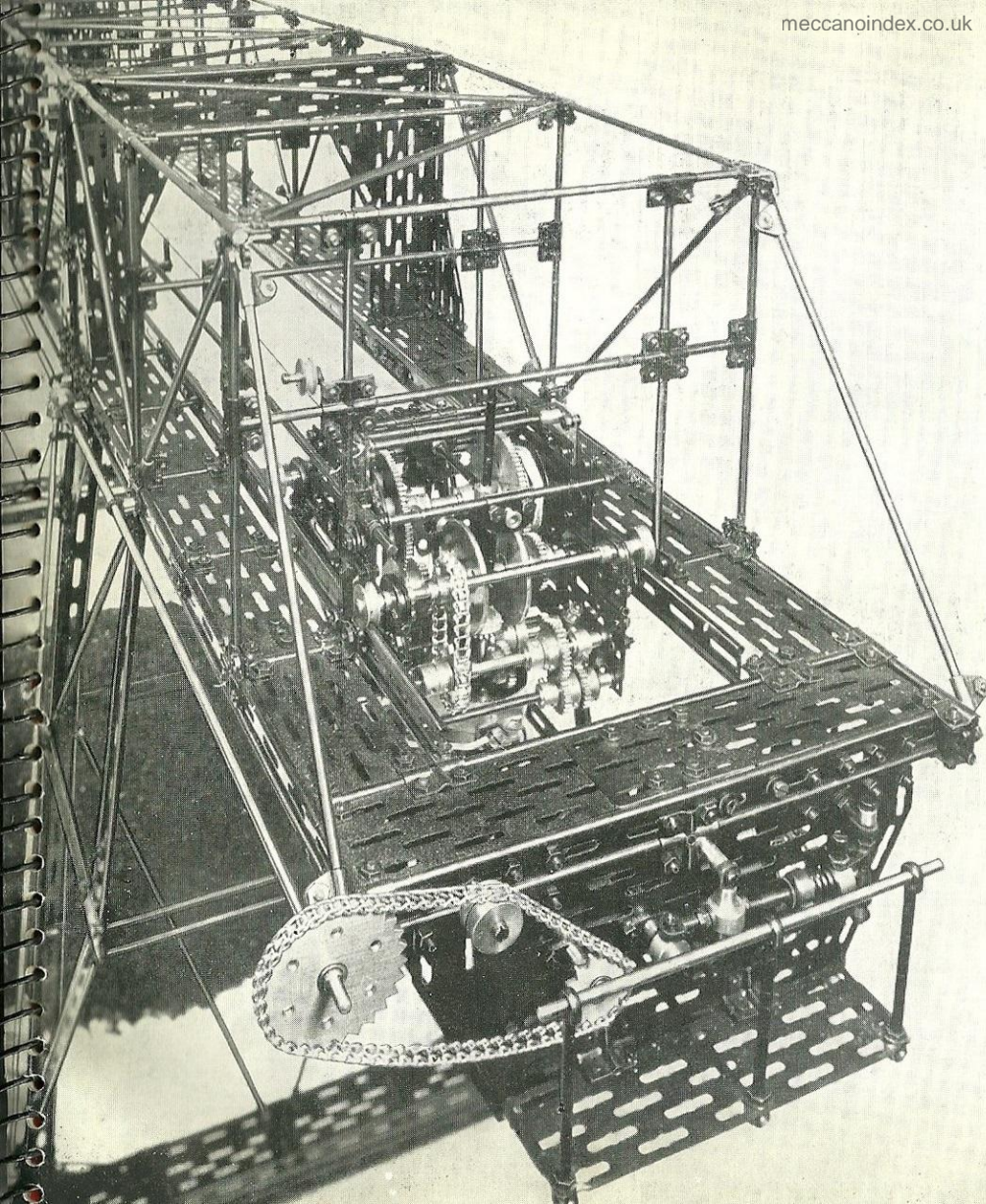


Picture 9. Model assembly on rails with bridge crane and truck for carrying coal, coke or similar freight, from a vessel moored at the quay-side to a hopper between the supports, and from the hopper to railway freight-cars. The shovel is operated from a trolley which moves the whole length of the crane. The part of the bridge crane, which extends over the hold of the vessel, is designed as a flying bridge which can be drawn up.

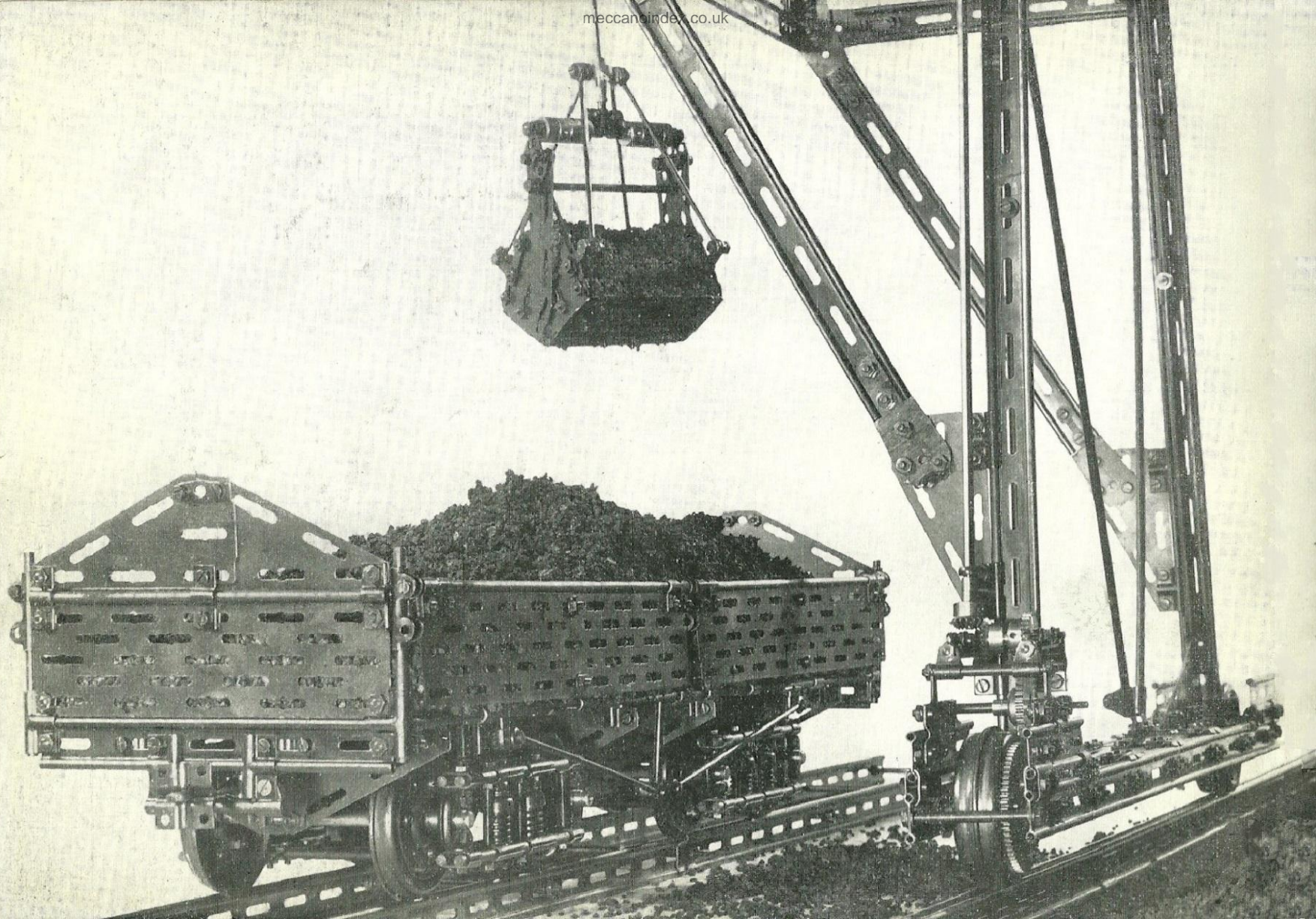
Picture 10. Detailed picture of the foregoing assembly, showing the rear part of the bridge. The sheet metal plates conceal a motor (windshield-wiper) acting directly on a friction gear, from which the power is transmitted to the wheels by means of 4 mm axles, mounted in bearings along the beams of the bridge and the support. The transmission from the friction plates to the axels may be expressed in the following code: 2(6/01)-6/16×6/80-6/70×6/71-, etc. The picture also shows a close-up of the carriage which supports the shovel. The trolley is driven by a motor (windshield wiper) which also powers the shovel winches by means of friction gears and disc clutches (note also the automobile clutch, picture 18).

Picture 11. Detailed picture of the bridge when raised. ►







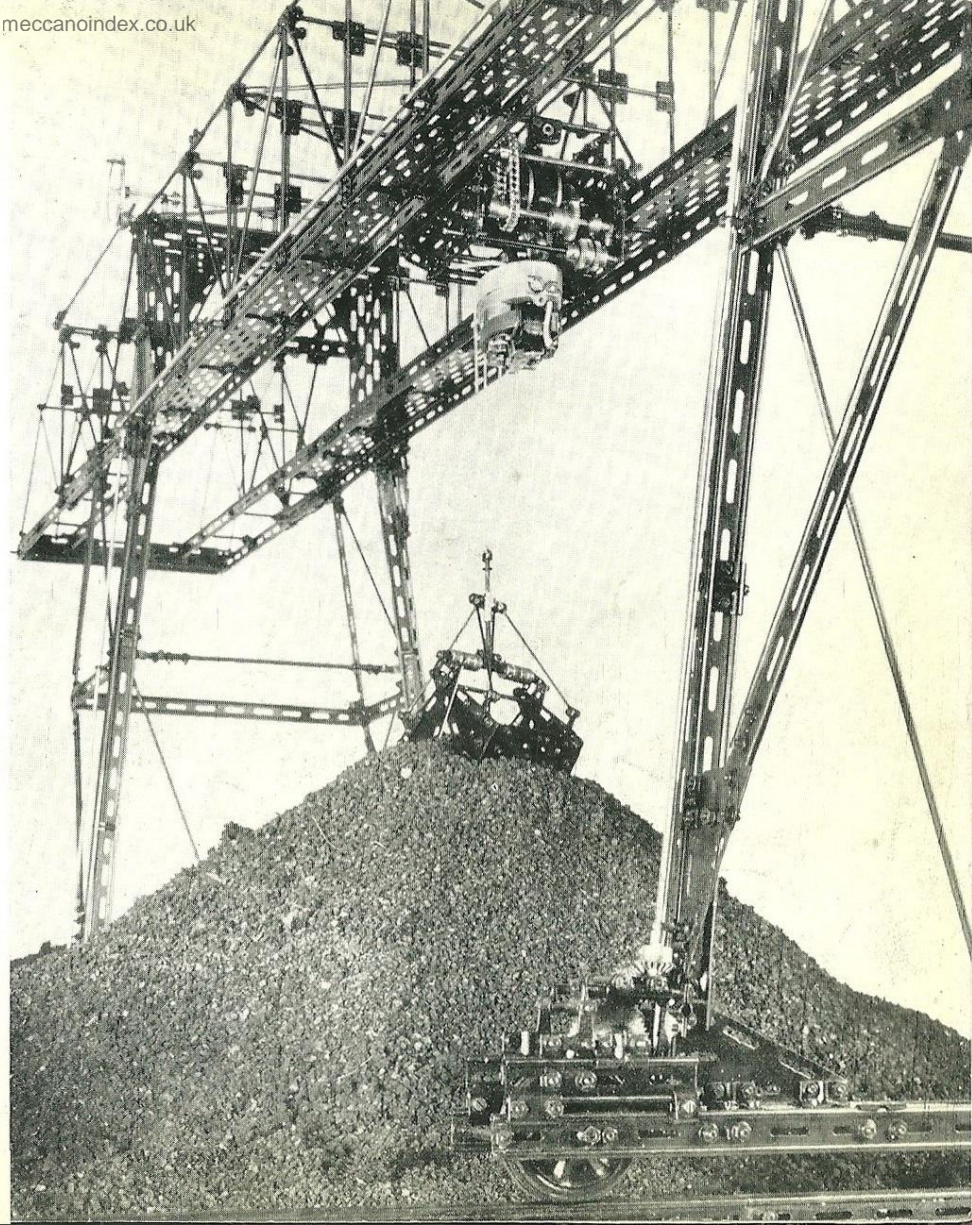




◀ Picture 12. Detail of the foregoing assembly, depicting the truck, the loaded shovel and the lower part of the crane supports. On the latter may be noted the wheels, made of two facing rail wheels, the flanges of which run between the coupled beams forming the rails. The truck bogies are the same as shown in picture 2.

Picture 13. Detail of the foregoing assembly showing the crane ▶ seen from below, with a close-up of the rear supports and the coal supply (in this instance of colored cork), with open shovel. The axles from the power plant to the wheels are clearly visible in this and the previous picture. The transmission from the axle to the wheels can be expressed in the following code: driving shaft-6/10×6/10-6/24×6/48×6/64-2(5/20).

With the exception of the driving bevel-gear, all the wheels run freely on fixed axles. The beam profile of the supports is shown in fig. 23 on page 21.





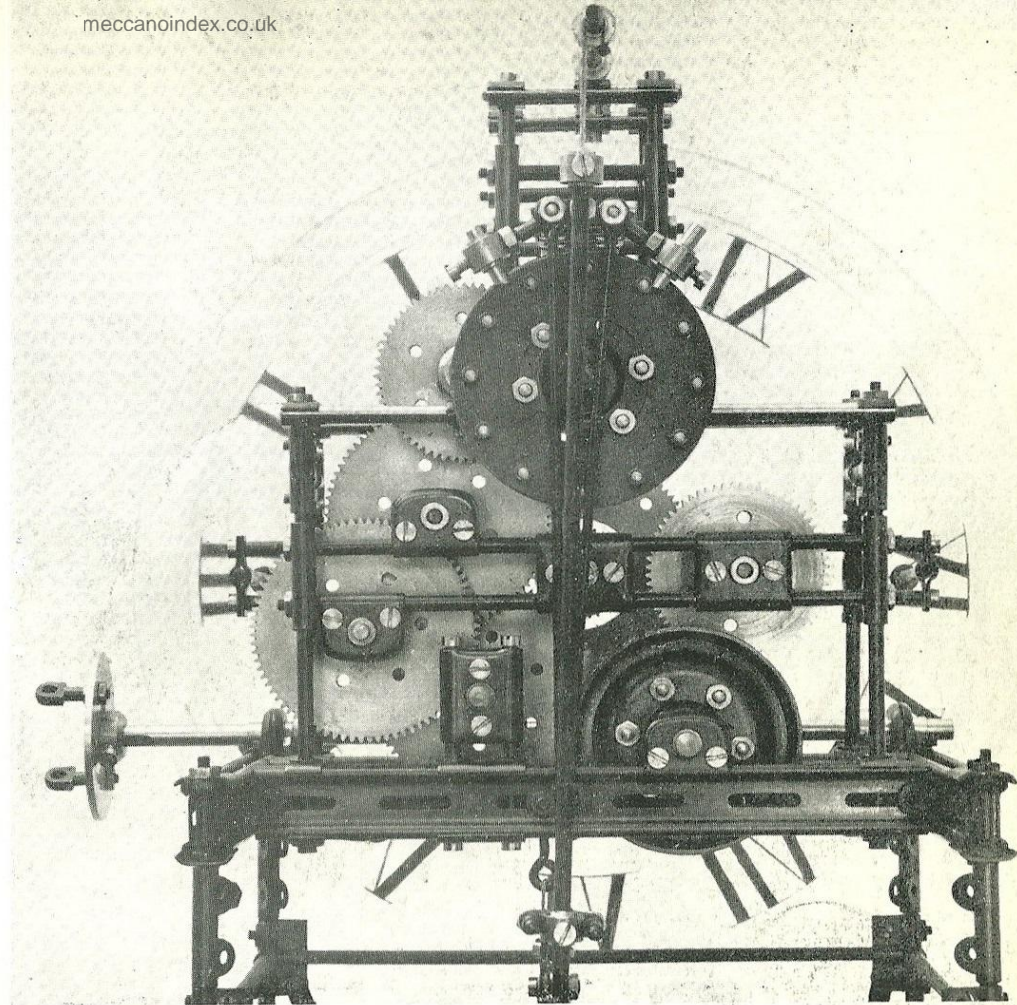
◀ Picture 14. Clock with pendulum and weight. All parts are FAC standard, with exception of the weight and the dial.

◀ Picture 15. Close-up of the works of the clock, seen from the side. The winding drum, made of two rail wheel plates, has a ratchet wheel as shown in fig. 4 on page 31, but  $6/01$  has been replaced by  $6/64$ . The clock is wound from the side by means of the bevel-gear  $6/11 \times 6/12$ . The two most heavily loaded axles are that for the winding drum and that for the immediately following spur-gear. These axles have a filed bevelling for the grub-screws to prevent wheel slip. The weight weighs 6 kg and has a drop of 125 cm. The movement runs for 32 hours for each wind-up.

Picture 16. The clock works seen directly from behind, ▶ with escapement wheel and catch. The escapement wheel consists of the perforated disc  $5/40$  with screws and threaded sleeves  $8/40$  in the outer perforated ring. The disc is screwed fast to a flanged wheel  $5/01$  which is attached to the axle (a threaded rod) in the manner described in fig. 6 on page 30. The catch is made of three-hole links  $1/31$  and eye-bolts  $8/31$  with collars  $4/02$ , in which teeth of short rods have been screwed.

The pendulum, consisting of a long rod with two large roundels  $5/31$  adjustably fixed thereon, governs the catch so that the escapement wheel moves forward one tooth at a time.

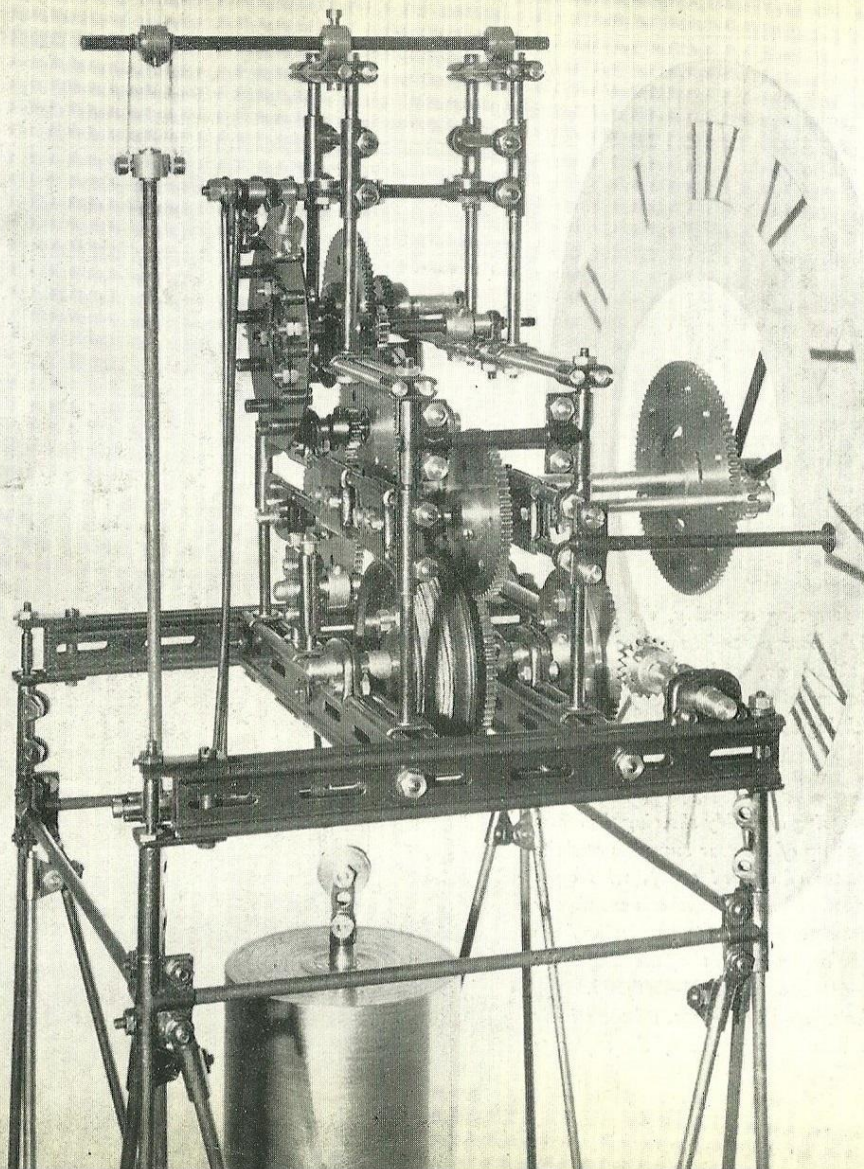
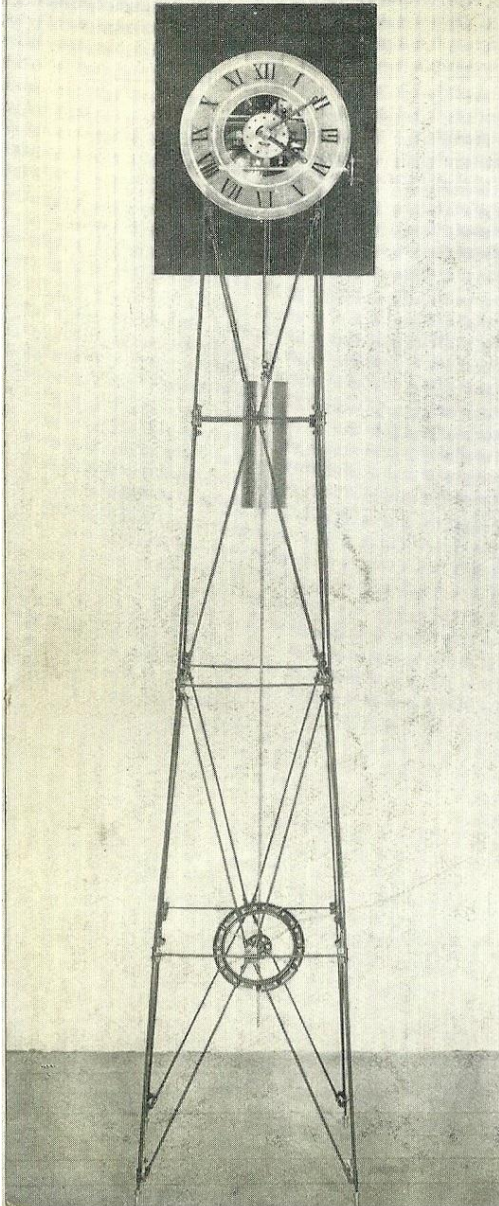
The gearing of the clock is set forth in the adjoining code. It is stated beginning with spur-gear  $6/64$ , on which the ratchet wheel  $6/24$  acts directly.



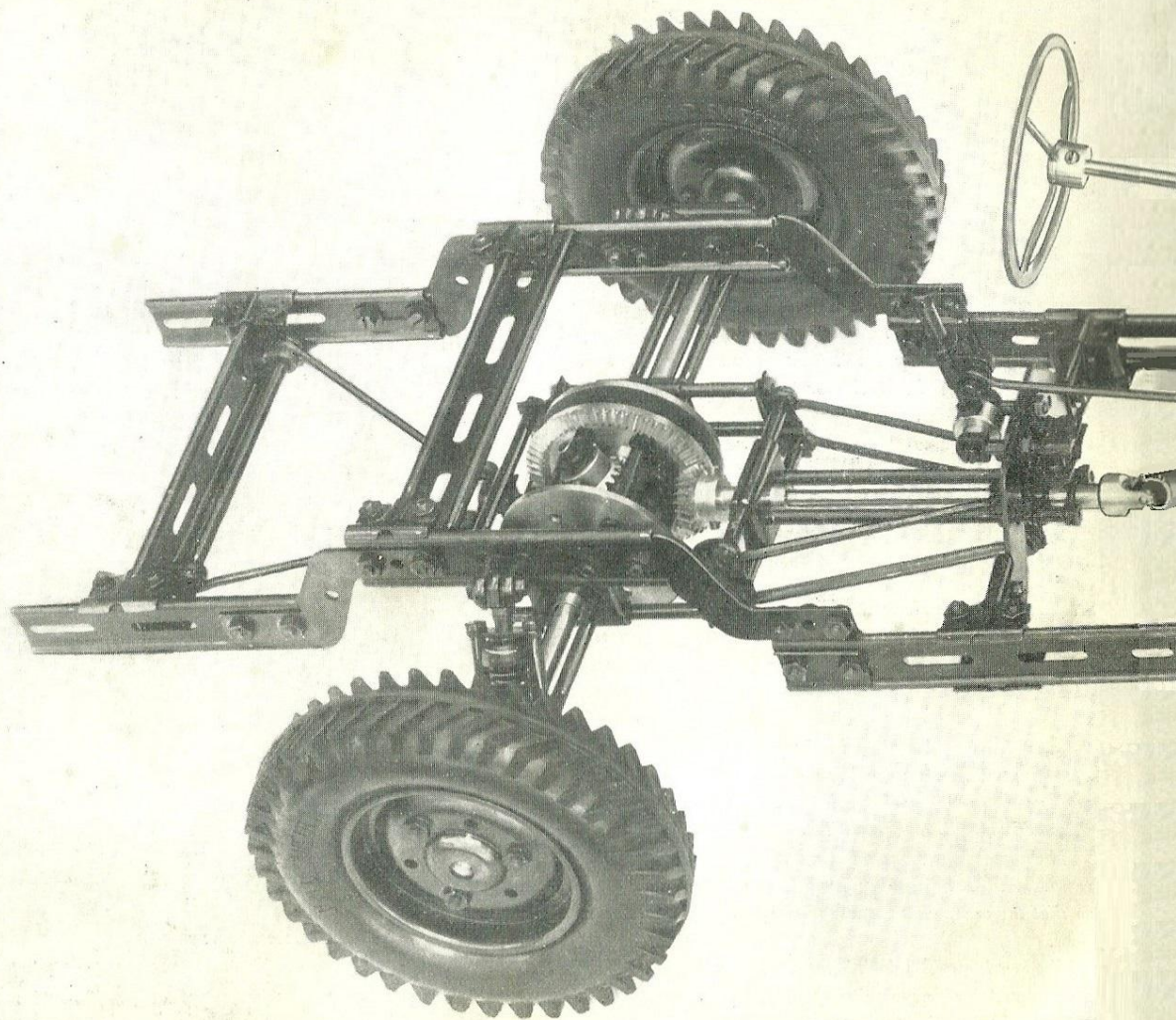
Transmission code:

$$6/64 \times \begin{cases} 6/64-6/16 \times 6/96-\text{hour hand} \\ 6/80 \times \begin{cases} 6/32-\text{minute hand} \\ 6/16-6/80 \times 6/16-6/80 \times 6/24-6/64 \times 6/16-\text{escapement wheel.} \end{cases} \end{cases}$$



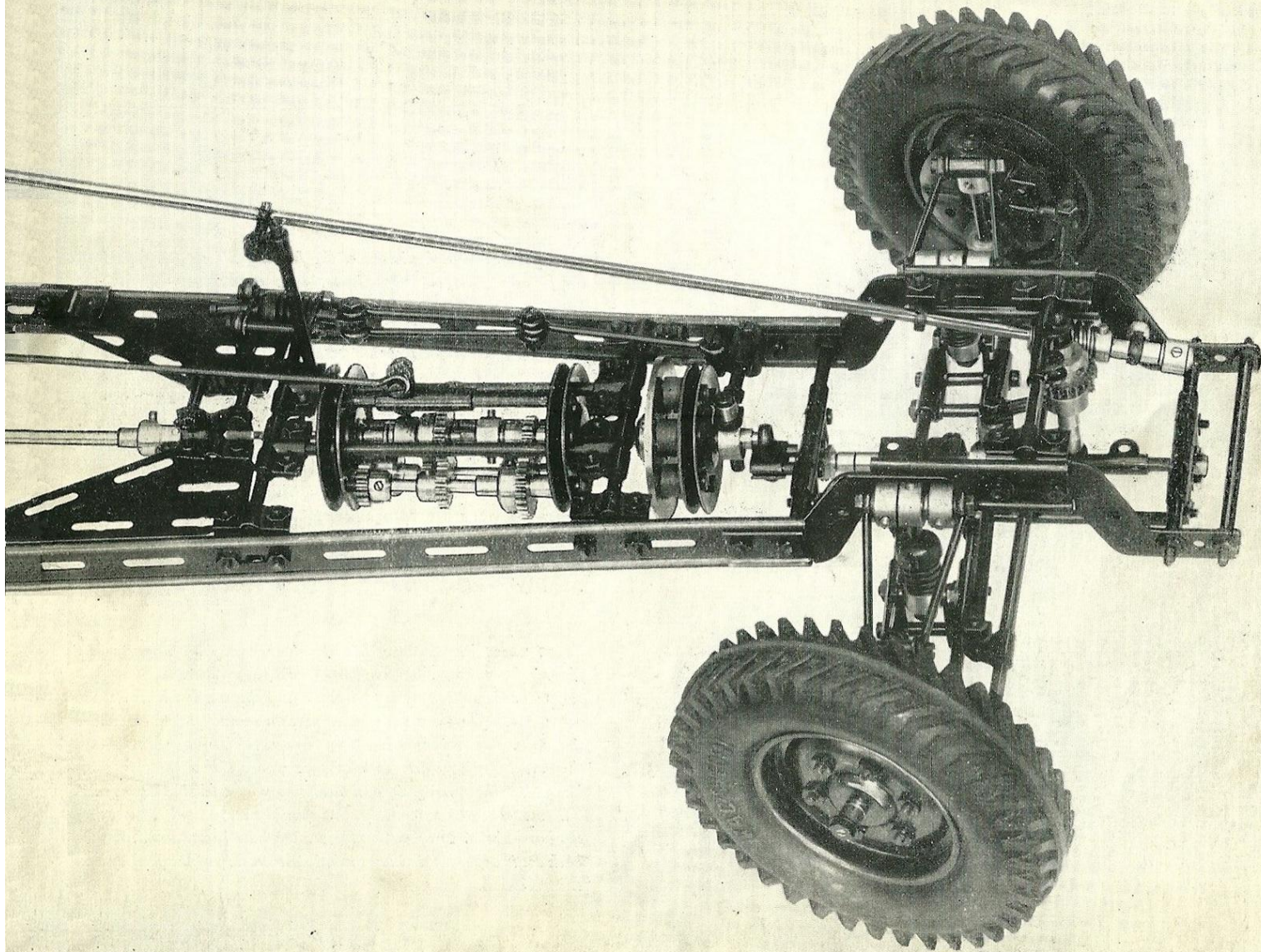




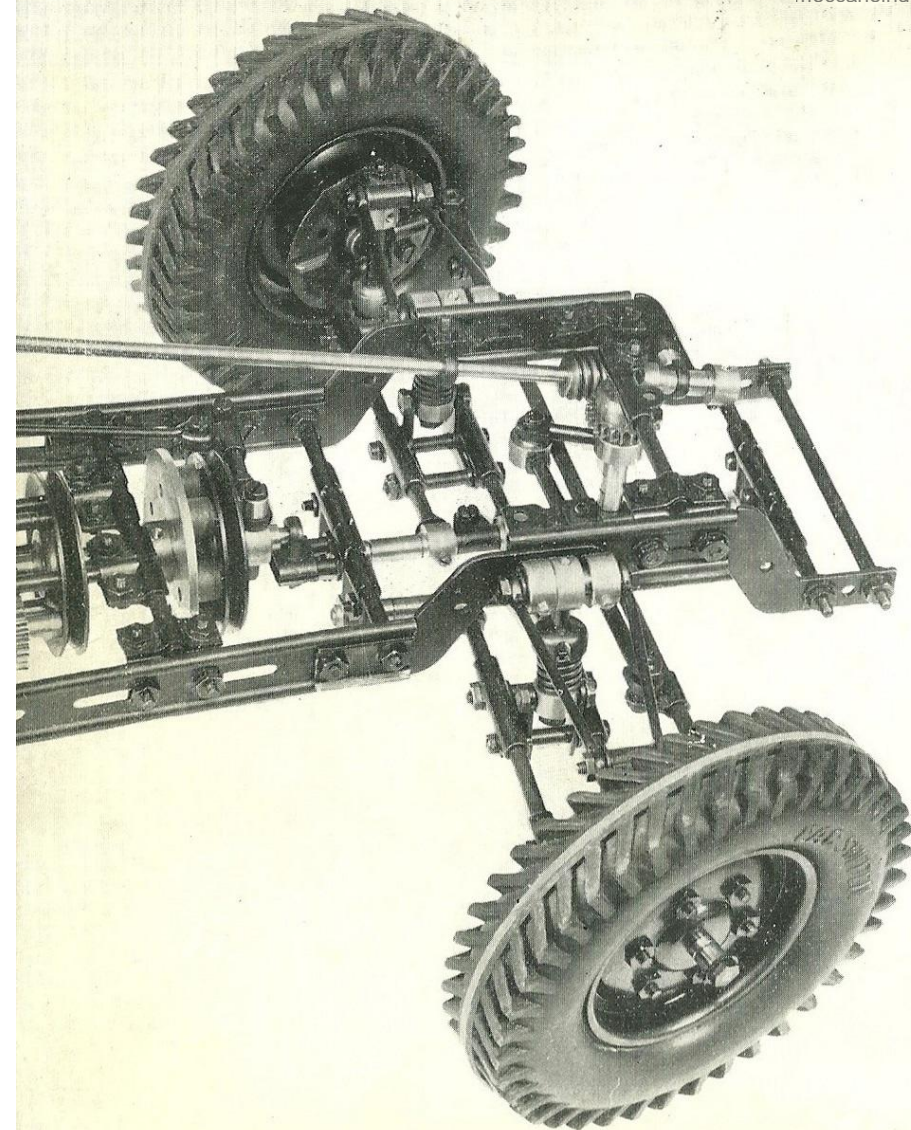


Picture 17. Automobile chassis with gear box, differential, clutch, steering assembly and sprung wheels, the front wheels being independently sprung. The power plant can be a small diesel or electric motor. In all its essentials the construction of the framework is shown in the picture. The gear box is described on page 38 and the differential on page 40. The assembly of the wheels is described in figures 5 and 6 on page 30.









◀ *Picture 18. Detailed picture of the front of the car, described on the foregoing pages. The picture is a good illustration of the springing device, steering device with steering gear and track rod, and the assembly of these parts in the frame.*

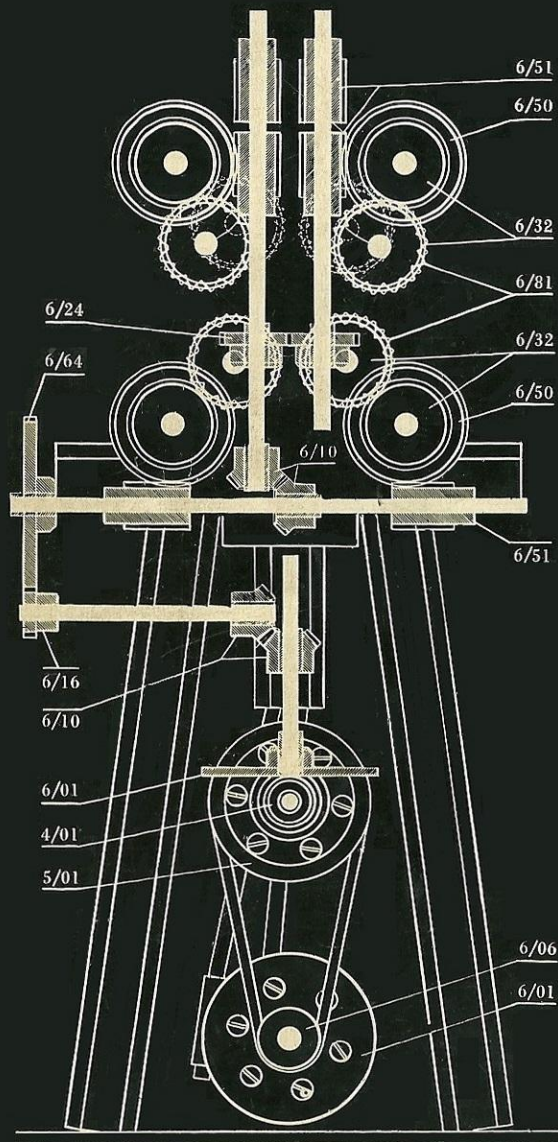
The clutch consists of an assembled wheel with rubber clutch plates (rubber tubing) attached to threaded sleeves 8/44, screwed onto the screws of the wheel. The wheel runs freely on the input axle of the gear box and presses against the fixed bossed wheel. The pressure is transmitted by means of a freely running collar 4/02, slipped over a tube and worked by a lever, which acts as a transmitter of the tension of the spring, visible in picture 17. When the pressure is transmitted to the assembled wheel, it draws with it the centre disc wheel, but if the pressure is discontinued the wheel runs freely on the axle. The motor drives the assembled wheel by means of a belt.

**Front cover illustration** Model frame saw with upper roller frames for raising, lowering and swinging outwards. The feed rollers are activated by worm gears and the worm wheels on the upper roller frames mesh with two worm screws placed one above the other. The reciprocating frame is guided by parallel rods and the blocking pieces are made of pear wood. Usual fretwork sawblades have been used. Several blades may be used simultaneously. The model works splendidly, but should not be used for wood of too hard kinds. The most suitable material is balsa wood. On the back cover is shown a diagrammatic illustration of the feed system transmission.









*FAC is available in two laboratory outfits, stored in wooden cases and containing a rich assortment of the whole body of items comprised in the system:*

*FAC X1*

*FAC X2 (extra large)*

*These kits are principally designed for amateurs, laboratories, experimenting departments in industry, technical schools, inventors etc.*

*FAC spare parts. Each item in the FAC system is available separately.*

*As a toy for a younger public the following kits are on sale:*

*FAC nr 0*

*FAC nr 1*

*FAC nr 2*

*How to purchase FAC:*

*Those who wish to begin FAC-constructing on a wide basis and to have immediate access to the entire system will naturally find their interests best served by the large cases X1 or X2. These outfits are composed in accordance with frequency calculations, i.e. the numbers of the parts are in proportions characteristic of the majority of FAC constructions, and one has at the very outset an excellent keeping-place, spacious enough to permit replenishment. The manual goes with these cases as instruction.*

*Should, however, the initial cost of these cases be considered too high, spare parts can be ordered with the aid of the manual for any construction, outlined and calculated in advance. The requisition is made by means of a list of parts, the desired items having been checked off.*

*The FAC toy kits address themselves to youngsters aged about ten years and upwards. The composition of units and instruction-books is made with regard to the maturity of this public. The instruction-books give detailed descriptions of a number of models constructible within the scope of the kits. Those who acquaint themselves with FAC through the toy will find no insurmountable difficulties in grasping the contents of the manual. A toy kit is to be regarded as a basic FAC outfit, expansible at the pace and to the extent convenient for one's circumstances. Thus the manual becomes the natural sequel to the toy kit.*

**MARK SYLWAN AB**  
**STOCKHOLM · SWEDEN**

*Diagrammatic view of drive in  
frame-saw shown on front of cover.*