

How Electricity is Produced

CAN you imagine what life would be like without electricity? There would be no cars, no television or radio, no telephones and no electric lighting. In fact, modern everyday life would practically grind to a halt if electricity was to suddenly become non-existent. An example of how much we rely on electricity is shown when a power cut takes place. People sit miserably at home without fires or television, trying to read newspapers in front of dimly glowing candles, while the refrigerator starts to defrost and mother glowers at a cooker which won't even heat a kettle to make a cup of tea.

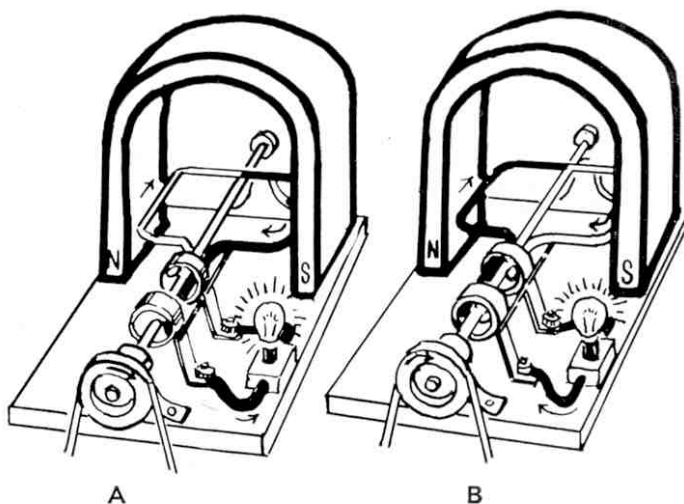
The question now, of course, is: when was this form of power first discovered and how is it produced? The answer to the first part of the question is fairly simple. Between 1800 and 1830, it was discovered that there was a definite relationship between magnetism and electricity. It had been shown that a flow of electric current through a wire which was free to move in the vicinity of a permanent magnet would cause the wire to move.

Taking these theories a step further, Michael Faraday held the view that the reverse should also be possible. In other words, if you rotated a wire between the poles of a magnet, then electricity should be produced. His next step was to put his theories into practise by building the first generator. This was completed in 1831 and was the forerunner of the giant generators which now supply the whole country with electricity.

Michael Faraday proved that when a conductor is revolved in the 'field' of a magnet an electric current is set up in the conductor. The more powerful the magnet, or the faster the rotation of the conductor, the greater the amount of electricity produced. Another interesting fact is that the direction of the flow of electrical current depends on the direction of movement of the conductor. If the conductor moves from right to left, the current travels one way and if the conductor moves the other way, the current, too, reverses direction.

Figures A and B, which illustrate a very simple dynamo or generator, clearly show the flow of current. In figure A, the current flows up the white half of the wire and down the black. This is collected by the two slip rings and fed to an electric light. When the coil of wire rotates inside the magnet to the position shown in figure B, the current

In fig. A the current flows up the white half of the wire and down the black. In fig. B the current reverses direction. This is known as alternating current.



changes direction, flowing up the black wire and down the white. The current at the bulb is also flowing in the opposite direction. This form of electricity is known as alternating current (A.C.) and is the most widely used form of electricity.

The ordinary bicycle dynamo produces alternating current and the actual flow of the current can be seen by turning the drive shaft very slowly. The bulb in the headlamp will pulsate the light rather than give a continuous glow.

Chemical Electricity

There is a second type or form of electrical current, which flows in one direction only, known as direct current. This form of current is normally supplied by batteries or by dynamos which have rectifying equipment fitted. The rectifier ensures that the output of current flowing from the dynamo only travels in one direction.

Dynamos produce electrical current mechanically, while batteries produce electricity by the chemical action of various acids upon metal. In actual fact, it was only a few years prior to Faraday's experiments with the generator that Alessandra Volta invented the first battery. It consisted of a pile of alternate silver and zinc discs with pieces of cloth moistened in brine between every other disc. If the top and bottom discs were touched at the same time, a shock was felt.

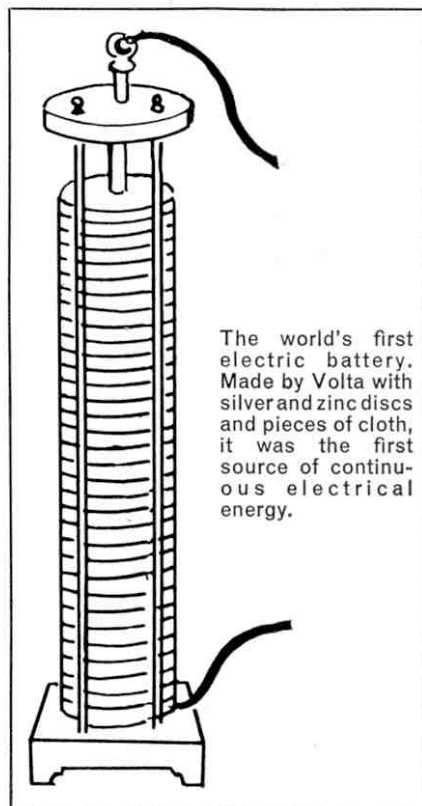
This, in the year 1800, was astonishing, for it was the first real source of electricity which was created without movement, friction or heat. What was more important, the charge did not leak away or disappear in a flash. It lasted, weakening only as the cloth discs dried.

Sulphuric acid soon replaced the cloth discs and different metals were tried. The end result, of course, is the dry battery of today, which is used in torches, portable radios, etc.

Unfortunately, batteries of this type eventually lose their charge due to their metal plates being attacked and eaten away by the chemicals used in their construction. Once exhausted they can-

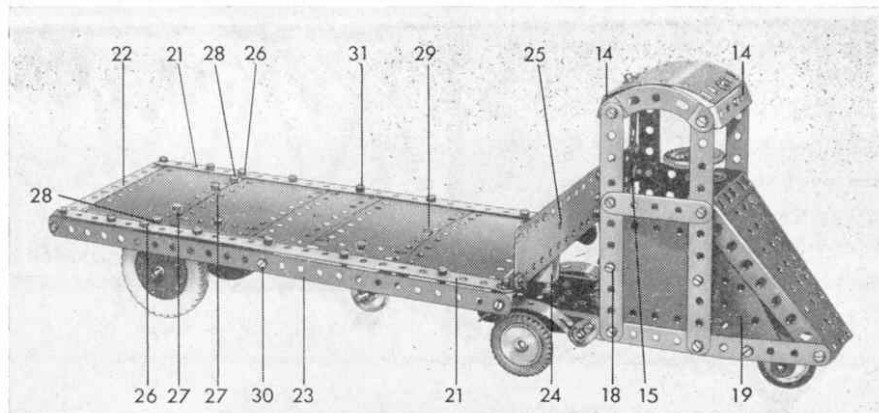
not be used again. This difficulty was overcome in the mid-1800's by a Frenchman named Planté, who found that two thin plates immersed in sulphuric acid, would store up the electricity that was fed into them, due to the chemical changes which took place.

This meant that batteries could be charged, exhausted and re-charged with electricity. In fact, the more the battery was used, the more effective it became. This advantage of being able to store and supply electricity, as well as being able to absorb energy to replace that which has been used, has proved of great value. The Planté battery was the forerunner of all the batteries now in use on motor vehicles throughout the world.



The world's first electric battery. Made by Volta with silver and zinc discs and pieces of cloth, it was the first source of continuous electrical energy.

A Mechanical Horse and Trailer



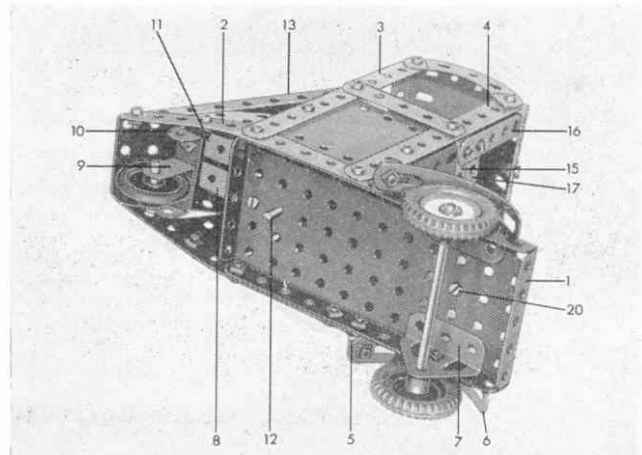
You can build this fine Mechanical Horse and Trailer from a No. 4 Meccano Outfit, plus a 1" Pulley and a 2½" by 2½" Transparent Plastic Plate.

I HAVE not included an Outfit model in these pages for several months now, as I find that most constructors like the challenge of modifying my instructions to suit the parts they have available. Understandably, however, some readers find this a little difficult; therefore, in this case, I will describe the alterations I would make to construct the attractive load-carrying vehicle illustrated here.

Basically, the model can be built from Outfit No. 4 with the addition of one 1 in. Pulley and one 2½ in. by 2½ in. Transparent Plastic Plate—as is evident from the parts list. Looking at the illustrations, however, we see that the extra Pulley is used as a steering wheel. Immediately the question is raised, 'Is there another part which could be used?' Answer: 'Yes—Outfit 4 contains a spare Bush Wheel that would serve perfectly well as a steering wheel'. Straightaway, the problem is half-solved, leaving only the Transparent Plate to be dealt with. But the Plate is only used as a window, and this is not really essential, so just forget about it and the model can be finished.

When building the model it is best to start with the tractor unit. Three 5½ in. Strips 2, 3 and 4 are bolted to each side of a 5½ in. by 2½ in. Flanged Plate 1. In the end hole of the 5½ in. Strips 2, an Angle Bracket 5, which supports the Formed Slotted Strips 6, serving as the mudguards, is fixed and two Trunnions 7 are also bolted to the Flanged Plate to act as bearings for the rear axle, which is a 3½ in. Rod carrying two 1 in. Pulleys with Tyres. A 2½ in. Strip 8 is bolted to the centre of the Flanged Plate 1, then a 1 in. by ½ in. Double Bracket 9 is tightly fixed to a 1½ in. by ½ in. Double Angle Strip 10 using a ⅜ in. Bolt. The whole assembly is now lock-nutted through the end hole of the 2½ in. Strip 8. A 2½ in. Strip 11 is cranked slightly and loosely attached to the Double Angle Strip 10 by a ⅜ in. Bolt with a nut on either side of the Double Angle Strip locked together. The other end of the Strip 11 is lock-nutted

This view of the underside of the Mechanical Horse shows the constructional detail.



to a Bush Wheel mounted on a 4 in. Rod 12. A Fishplate, bolted to an Obtuse Angle Bracket, is fastened to a Flanged Sector Plate 13, the same Bolt securing a 2½ in. by 2½ in. Transparent Plastic Plate in position. The 4 in. Rod 12 is journaled in this Fishplate and the Flanged Plate 1, as shown. The steering wheel is represented by a 1 in. Pulley with Rubber Ring secured to the end of the Rod. Each side of the cab is filled in by a 2½ in. by 2½ in. Flexible Plate, a 2½ in. by 2½ in. Transparent Plastic Plate, a 2½ in. Strip and a 2½ in. Stepped Curved Strip. The sides are joined together by three 2½ in. by ½ in. Double Angle Strips 14 and 15.

How to build the roof

The roof is formed by a 2½ in. by 2½ in. Curved Plate, attached to the Double Angle Strips 14 by Obtuse Angle Brackets. Two 2½ in. Strips 16 are bolted to the Double Angle Strip 15 and a further 2½ in. Strip 17 is fastened to the 2½ in. Strips 16. A 2½ in. by ½ in. Double Angle Strip is bolted to a 2½ in. by 2½ in. Flexible Plate and attached to the 5½ in. Strips 4 by the Bolts 18. A 2½ in. by 1½ in. Flexible Triangular Plate 19, on each side, is bolted to the 5½ in. Strip 2, which can then be fastened to the Flanged Sector Plate.

A ⅜ in. Bolt 20 is fastened to the Flanged Plate, as shown, on which to hook the trailer. This finishes the tractor, thus leaving the trailer to be built. Two 12½ in. Strips 21 are joined together at each end by two 5½ in. Strips 22 with an Angle Bracket at each corner on which to fasten the 12½ in. Strips 23. Two ½ in. by ½ in. Reversed Angle Brackets 24 are bolted to the front 5½ in. Strip 22 and a 5½ in. by 1½ in. Flexible Plate 25 is attached by Angle Brackets. The trailer platform is filled in with two 5½ in. by 2½ in., one 5½ in. by 1½ in. and two compound 5½ in. by 2½ in. flexible plates. The last-named items are built up from two 4½ in. by 2½ in. and two 2½ in. by 1½ in. Flexible Plates. Two 3½ in. Strips are attached to the underside of the platform by the Bolts 26, while Bolts 27 fasten a 2½ in. by ½ in. Double Angle Strip to these 3½ in. Strips. Flat Trunnions, bolted to the lugs of the Double Angle Strips, support a 4 in. Rod carrying two 2½ in. Road Wheels. Formed Slotted Strips, attached by Bolts 28, represent the mudguards. To strengthen the main platform, a 2½ in. by 1½ in. Double Angle Strip and a Double Bracket are fixed in its centre by Bolts 30 and 31.

A Double Bracket secured by the Bolt 29 has a 2½ in. Strip bolted to each lug, and these support a 1 in. Pulley on a 1½ in. Rod.

Parts required.—4 of No. 1; 8 of No. 2; 2 of No. 3; 9 of No. 5; 1 of No. 10; 2 of No. 11; 1 of No. 11a; 8 of No. 12; 3 of No. 12c; 2 of No. 15b; 1 of No. 16; 1 of No. 18a; 1 of No. 18b; 5 of No. 22; 1 of No. 24; 4 of No. 35; 85 of No. 37a; 79 of No. 37b; 8 of No. 38; 1 of No. 48; 6 of No. 48a; 1 of No. 52; 1 of No. 54; 2 of No. 90a; 3 of No. 111c; 2 of No. 126; 2 of No. 126a; 2 of No. 142c; 2 of No. 155; 2 of No. 187; 2 of No. 188; 2 of No. 189; 3 of No. 190; 2 of No. 191; 2 of No. 192; 3 of No. 193a; 1 of No. 200; 4 of No. 215; 2 of No. 221.

Build a Contra-rotating Mechanism

At first glance, the Contra-rotating Mechanism detailed here may appear to serve no useful purpose and, in fact, it does not have many uses in the average private model. However, if you like to build moving structures that seem complicated to the spectator or, more particularly, if you sometimes supply local shops with animated display stands, then this amazingly simple arrangement will prove invaluable.

The sort of display stand I have in mind consists of a large revolving disc with, above this, another smaller disc revolving in the opposite direction. General goods to be displayed could be placed on the lower disc, while the centre-piece of the display would be given the more prominent and eye-catching spot on the upper disc.

You will see that, in our model, Helical Gears are used, but their place could be taken by several alternative parts, such as Contra Wheels and Pinions, or even Worms and Gear Wheels. Anyway, I am sure you could adapt it to suit the parts you possess.

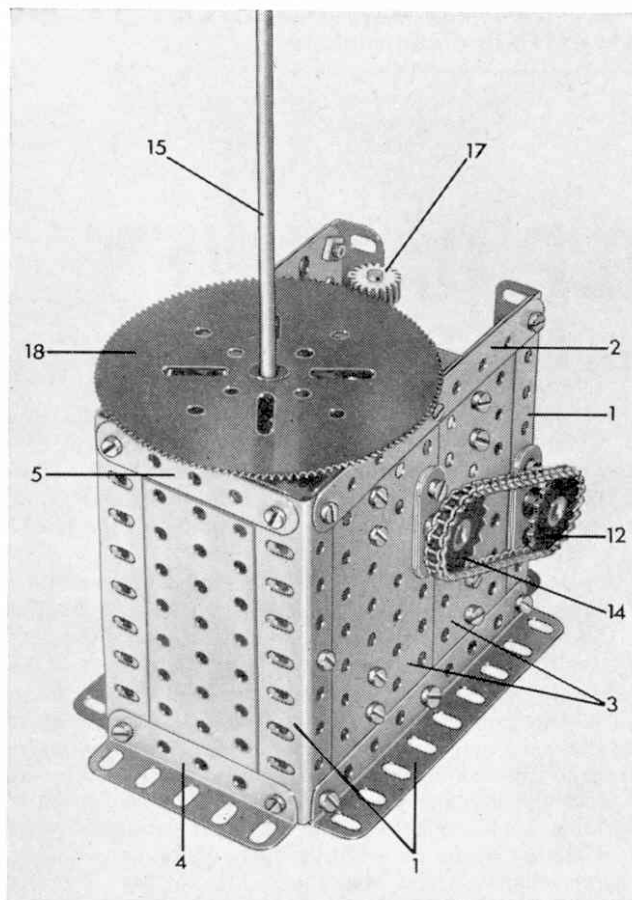
Constructional details are as follows: Two similar sides are built up from $4\frac{1}{2}$ in. Angle Girders 1, a $4\frac{1}{2}$ in. Strip 2 and two $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Flat Plates 3. These sides are then connected, at one end, by a $2\frac{1}{2}$ in. Angle Girder 4, a $2\frac{1}{2}$ in. Strip 5 and another $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Flat Plate. At their other end, they are joined by a $2\frac{1}{2}$ in. Angle Girder 6, braced by 2 in. Strips, as shown, while further strengthening is supplied, inside, by four $2\frac{1}{2}$ in. by 1 in. Double Angle Strips 7, 8 and 9. Note, incidentally, that these Double Angle Strips are fixed by bolts through *both* the holes in each of their lugs.

To both sides of the model, two sets of three $1\frac{1}{2}$ in. Strips are bolted, and two $3\frac{1}{2}$ in. Rods 10 and 11, each carrying a $\frac{1}{2}$ in. Helical Gear, are journalled in the centre holes of these Strips. Rod 10 is held in place by a 1 in. Sprocket Wheel 12 and a $1\frac{1}{2}$ in. Sprocket Wheel 13, whereas Rod 11 is held by a Collar and a 1 in. Sprocket Wheel 14. Next, further sets of three $1\frac{1}{2}$ in. Strips are bolted to all the Double Angle Strips 7, 8 and 9. An $11\frac{1}{2}$ in. Rod 15, carrying a $1\frac{1}{2}$ in. Helical Gear to mesh with the Gear on Rod 11, is mounted in $1\frac{1}{2}$ in. Strips fixed to one pair of Double Angle Strips, and a 5 in. Rod 16, also carrying a $1\frac{1}{2}$ in. Helical Gear, is mounted in the other pair. Both Rods are held in place by Collars.

A $\frac{1}{2}$ in. Pinion 17 is fixed tightly on Rod 16 and this meshes with the $3\frac{1}{2}$ in. Gear 18 which is *free* on Rod 15. Sprocket Chain connects Sprocket Wheels 12 and 14.

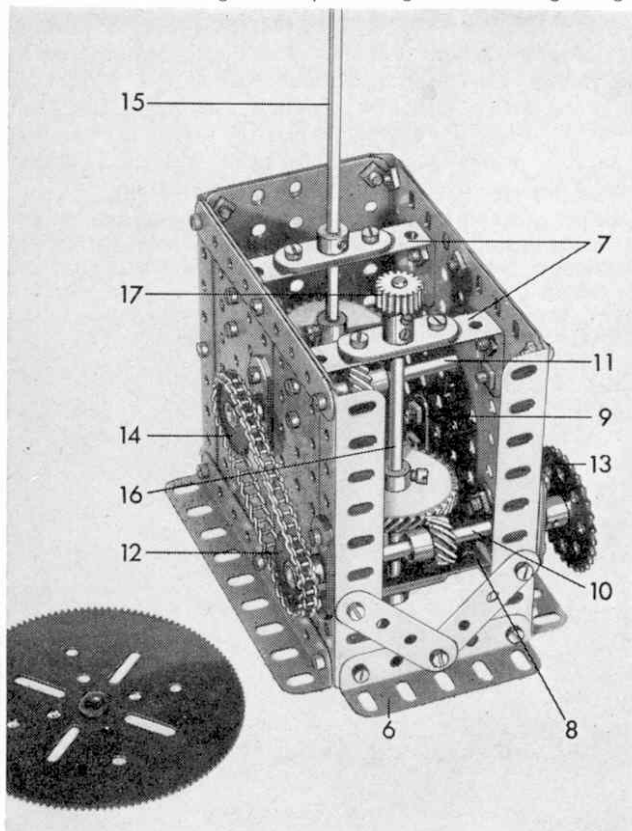
If the mechanism is to be used for the purpose I mentioned, the large turntable is mounted on Gear Wheel 18 while the upper platform or object is fixed on Rod 15. A Face Plate or Bush Wheel would be a useful means of attaching it to the Rod.

Parts required.—2 of No. 2a; 1 of No. 5; 2 of No. 6; 24 of No. 6a; 6 of No. 9a; 2 of No. 9d; 1 of No. 13; 1 of No. 15; 2 of No. 16; 1 of No. 26; 1 of No. 27b; 54 of 37a; 54 of No. 37b; of 4 No. 46; 5 of No. 53a; 5 of No. 59; 1 of No. 94; 1 of No. 95a; 2 of No. 96. 2 of 211a; 2 of No. 211b.



This mechanism is ideal for mechanised display stands.

Another view showing the simple arrangement of the gearing.



by **Spanner**

Build a Cutting Machine

THE cutting machine described here gives an interesting and very useful example of the Meccano system's possibilities, incorporating an idea which could be used in many other constructions. Serious builders must surely have discovered that an invaluable mechanism is one that gives a continuous drive to a Gear, or similar part, mounted on a flexible arm which is constantly moving, and such a feature is present in the model described below.

The base of the model is formed from a 5½ in. by 2½ in. Flanged Plate 1, to which is bolted a 5½ in. Angle Girder 2, two 3½ in. by 2½ in. Flanged Plates 3 and 4, and a 5½ in. by 2½ in. Flat Plate 5. One of the bolts holding this Flat Plate also passes through the end hole of the Trunnion 6, a bolt in the other end hole fixing it firmly to the Flat Plate. A further Trunnion 7 is bolted to the Flanged Plate 3 by one of the bolts holding Flanged Plate 3 on to Flanged Plate 1. A 2½ in. by 2½ in. Flat Plate 8 is joined to Plate 5 by Angle Brackets.

A 6½ in. Rod carrying a Collar, two 1 in. Sprocket Wheels, a 2 in. Pulley and two compound 6½ in. Strips each made up of two 5½ in. Strips, is journalled in the Trunnions 6 and 7. The compound strips are free to move vertically, but are stopped from sliding along the Rod by the Collar and one of the Sprocket Wheels. A Threaded Pin is bolted to the 2 in. Pulley to form a handle.

Two Double Brackets 9 and 10 connect the compound strips and a 1½ in. Rod 11, carrying a Collar, a ¾ in. Sprocket Wheel and a 2½ in. Gear Wheel which forms the cutting blade, is journalled in the second hole from the ends. A length of Sprocket Chain 12 is passed around the 1 in. Sprocket Wheel on the 6½ in. Rod and the ¾ in. Sprocket Wheel on Rod 11.

Next, Channel Bearing 13 is bolted to the Flanged Plate 1 and two Flat Trunnions are attached to it. A 2 in. Rod 14, carrying a ¾ in. Pinion 15 and a 1 in. Sprocket Wheel 16, is mounted as shown, and is kept in place by a Collar, then a 1½ in. Rod is journalled in the apex holes of the Trunnions. This carries a Single Throw Eccentric, a Collar and a 1½ in. Gear Wheel that meshes with the ¾ in. Pinion 15. The Eccentric is pivotally connected to the compound strip by a 1½ in. Strip. A length of Sprocket Chain 17 connects Sprocket Wheel 16 to the other Sprocket Wheel on the 6½ in. Rod.

The chute which catches the sawn material as it is cut consists of two U-section Curved Plates that are joined to the rest of the mechanism by an Obtuse Angle Bracket, bolted through the centre hole of the flange on Plate 4, and by a Reversed Angle Bracket 18, bolted to the Flat Plate 8. When the 2 in. Pulley is turned, the 6½ in. compound strips move up and down and, at the same time, the 2½ in. Gear Wheel forming the cutting blade rotates.

Parts required.—4 of No. 2; 1 of No. 6a; 1 of No. 9; 2 of No. 11; 2 of No. 12; 1 of No. 12c; 1 of No. 14; 1 of No. 17; 2 of No. 18a; 1 of No. 20a; 1 of No. 25; 1 of No. 27; 35 of No. 37a; 35 of No. 37b; 3 of No. 38; 1 of No. 52; 1 of No. 52a; 2 of No. 53; 4 of No. 59; 1 of No. 72; 1 of No. 94; 3 of No. 96; 1 of No. 96a; 1 of No. 115; 1 of No. 125; 2 of No. 126; 2 of No. 126a; 1 of No. 130a; 1 of No. 160; 2 of No. 199.

