

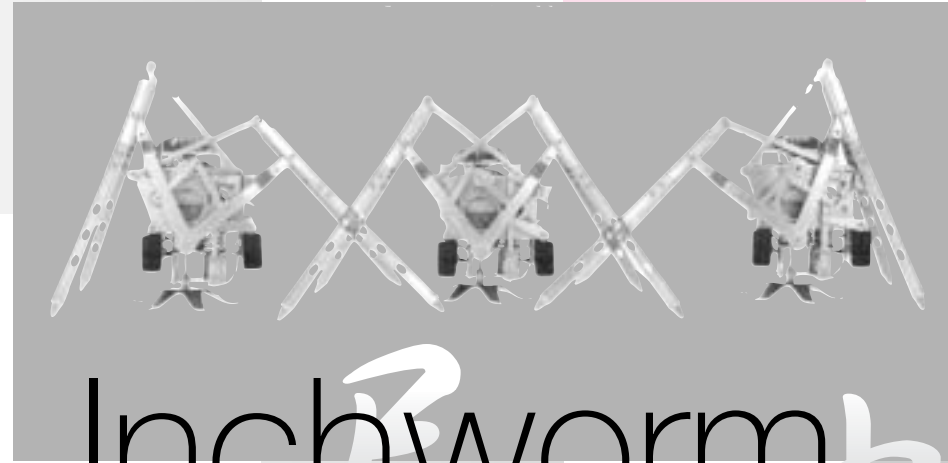
# 大人の科学 Otona no Kagaku The Sophisticated Science Kit for Adults

## MECHAMO

メカモイナワーム MECHAMO Inchworm THE MECHANICAL ANIMAL SERIES

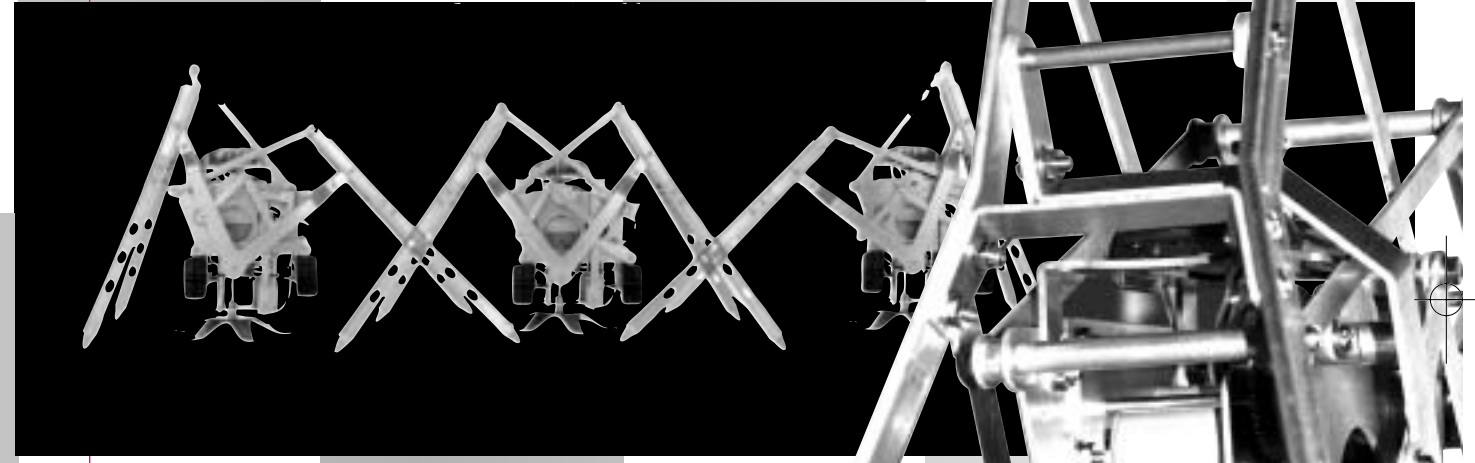
### Instructions for Assembling and Operating

The parts list is separately attached.



# Inchworm

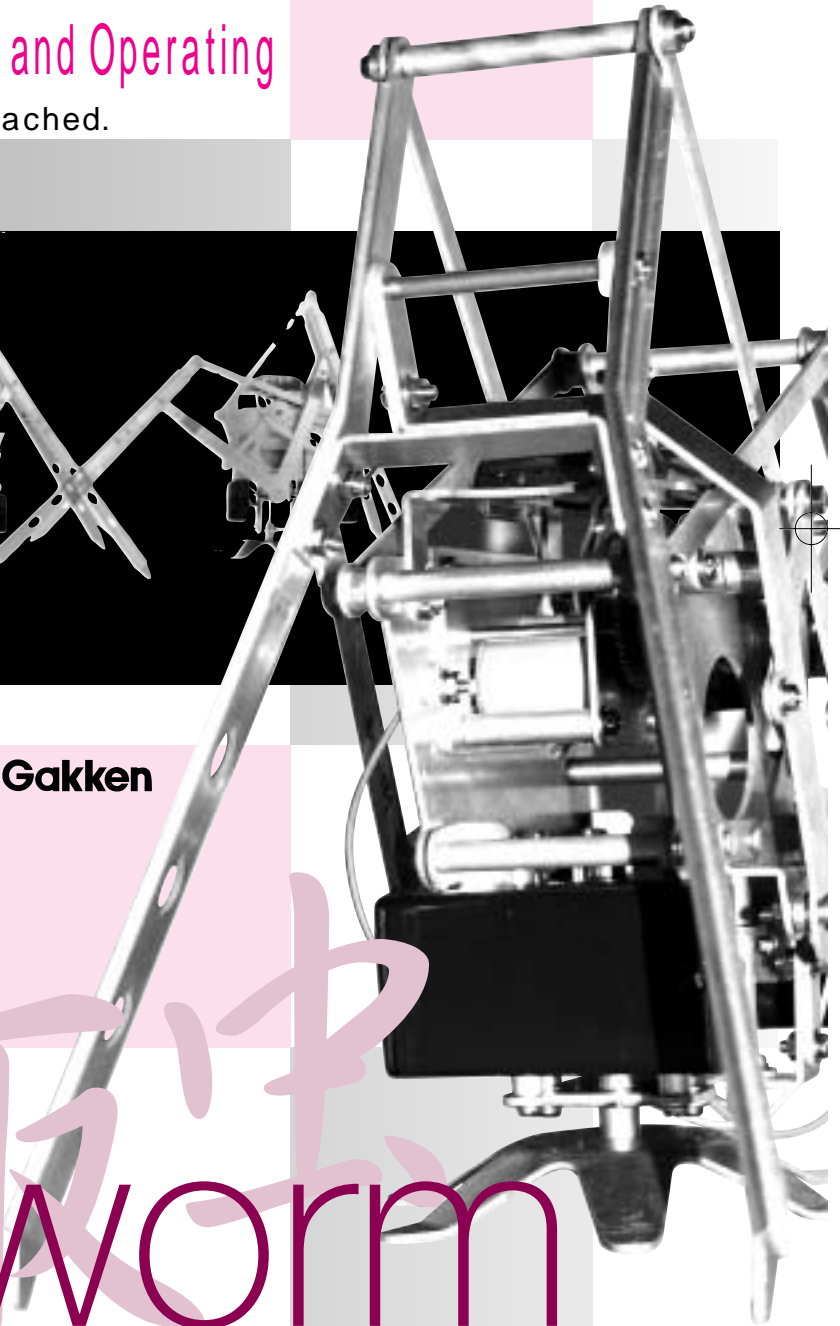
# 尺取虫



Gakken

# Inchworm

# 尺取虫



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**CAUTION!** ★Please read the following instructions before using this kit.

- Use caution when handling any metallic parts. Improper use may cause injury.
- To avoid the risk of suffocation, do not swallow small parts such as screws.
- To avoid the risk of injury, do not point your hands and eyes with the screwdriver and the like in this kit.
- To avoid the risk of injury, use caution not to get your fingers caught in the machine while it is operating.
- To avoid the risk of traffic accident, do not operate the machine on the road.
- To avoid the risk of electric shock, do not insert lead wires into an electric socket.

Six size AA batteries are required. Improper use of the batteries may cause the generation of heat, explosions or leaks. The following precautions should be taken:

- Do not use rechargeable batteries, such as nickel cadmium batteries. Also, oxyride dry cell batteries are unsuitable because they are too powerful.
- Ensure that the positive and negative terminals on the batteries are facing the right way.
- Do not use used batteries and new batteries together and do not mingle more than two kinds of batteries.
- Ensure that the switch is turned off and the batteries are removed after use.
- Do not short-circuit, recharge, break up or put the batteries in a fire.
- Remove the batteries when not using for a long time.

★Please read the assembly instructions and cautions in this booklet carefully before using this kit. Do not use any materials that have become damaged or deformed while in use.

★Keep the kit away from small children when not using.

**Warning : Do not touch the Mechamo while it is operating. It is very dangerous. Particularly, never let small children touch it.**

●The metallic materials used in this kit●  
main body parts : aluminum gear : steel + brass screws : nickel-plated iron

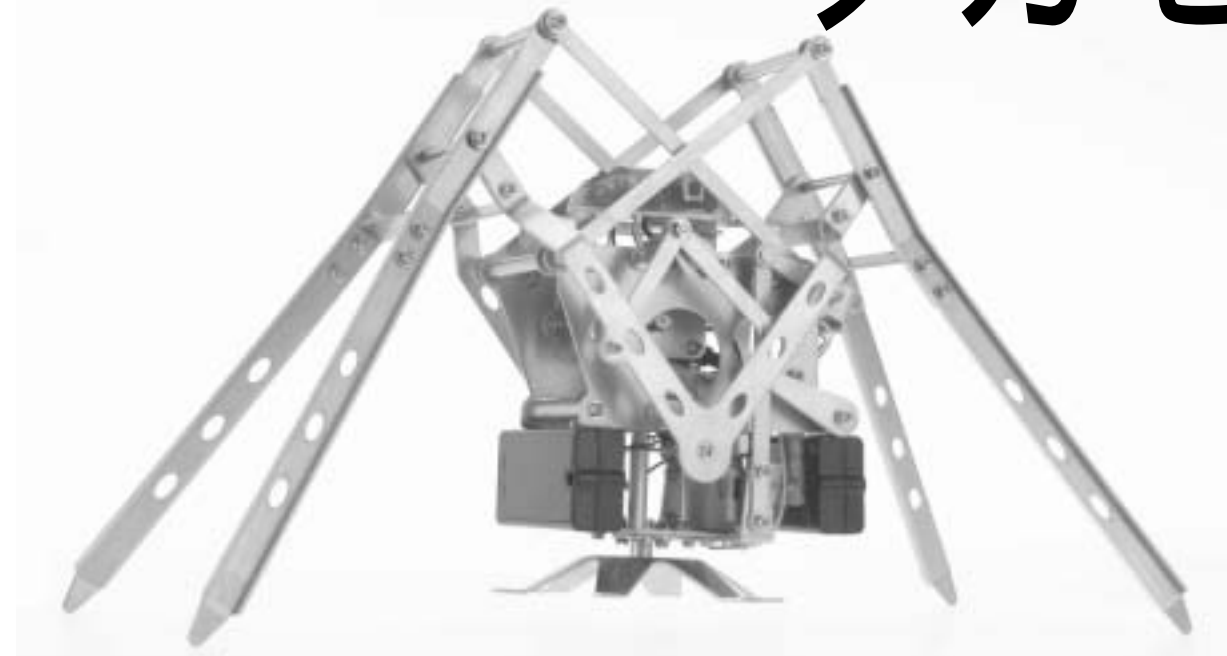
●The plastic materials used in this kit●  
battery box : ABS resin cover of the light sensor : ABS resin remote control : ABS resin  
connector : POM screwdriver handle : ABS resin

\* Vinyl chloride resin is used for the covers of the lead wires.

\* When disposing of the kit, please follow the recycling regulations in your area.

## 大人の科学 Otona no Kagaku

The Animal-shaped Robot Devised from Mechanical Engineering



The legs of an Inchworm consist of three parts: fore legs, hind legs, and center legs. When you observe the points of contact to the ground, you can see there are two patterns: the fore legs and the hind legs are touching the ground and the center legs are in the air while the machine is moving, and only the center legs are touching when the fore legs and the hind legs go back their positions or while it is making a change of direction. The Inchworm moves by repeating these two patterns by turns. It moves horizontally and not as vertically as possible by using link mechanisms so that it consumes minimum energy to move.

Try to examine from where to where the kinetic energy is transmitted through links when assembling. Then, operating the machine will be more impressive.

It takes about two hours to assemble. Please follow this instruction booklet when you assemble.

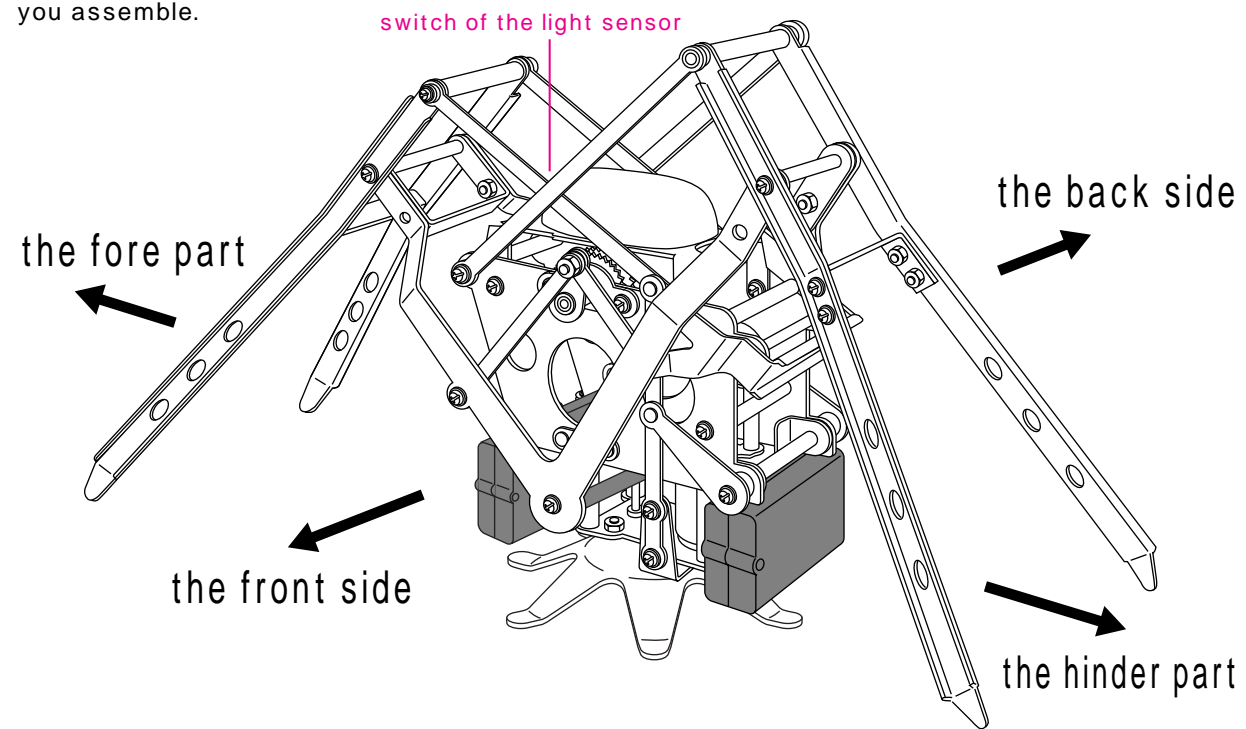
※It will be helpful in assembling the kit if you keep the parts list handy.

**Warning★Do not touch the Mechamo while it is operating. It is very dangerous. Particularly, never let small children touch it.**

# Before Assembling the Kit

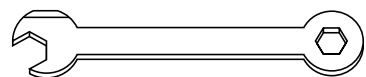
## 1. Understanding the right direction

Inchworm has the fore part and the hinder part, and the front side and the backside. The fore part is with the switch of the light sensor and when Inchworm goes forward, it goes to this direction. The front side is that without lead wires of the motor for drive. Distinguish the fore part and the hinder part, and the front side and the backside of the figures of this booklet when you assemble.

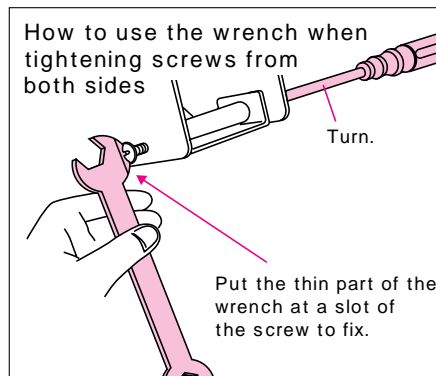


## 2. How to Use Supplied Tools

### wrench

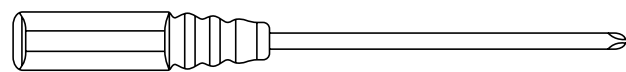


The wrench can be used not only for tightening a nut but also for tightening screws from both sides as shown in the right figure.

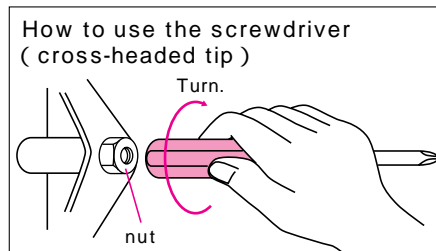


ビスはしっかり締めてください。

### screwdriver (cross-headed tip)



The screwdriver can be used not only for tightening a screw but also for tightening a nut as shown in the right figure.



Please note that shapes of materials may appear slightly different from pictures and illustrations in this booklet.

# 1 Attaching the Motor to the Body

**Parts to be used PARTS A** There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.

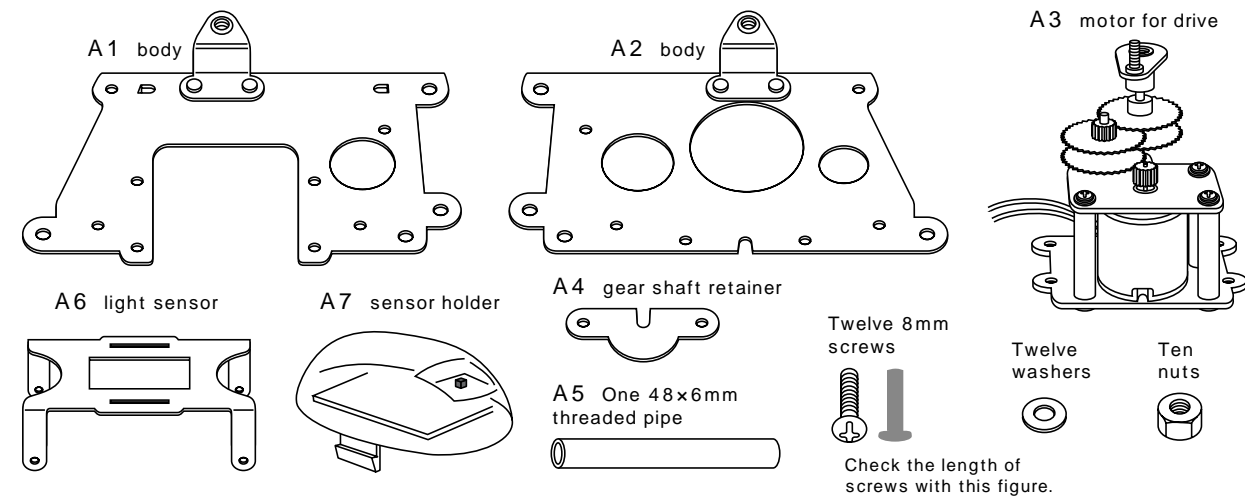
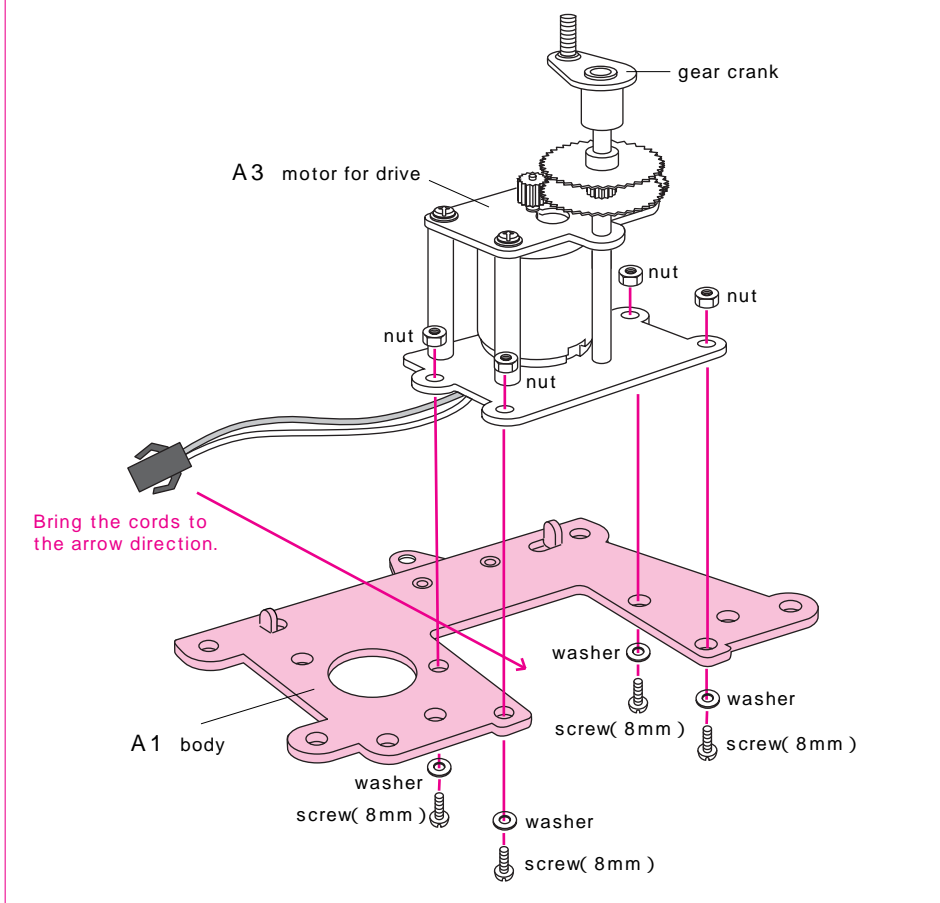


Figure-1 Set the A3 motor for drive on the A1 body. Fasten it at four points with screws and nuts as shown in the figure.

## 1 Attach the A3 motor for drive to the A1 body.

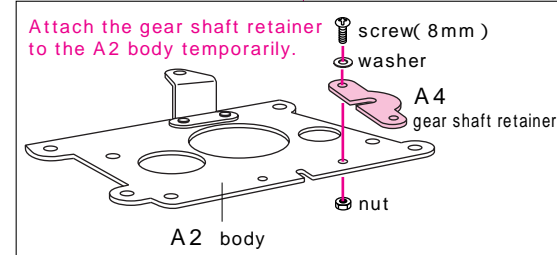


**Warning** Do not touch the Mechamo while it is operating. It is very dangerous. Particularly, never let small children touch it.



**Figure- 2**  
Set the gear shaft into the notch of the A2 body and connect the A1 body and A2 body with the A5 threaded pipe.

**2** Combine the A1 body and the A2 body.

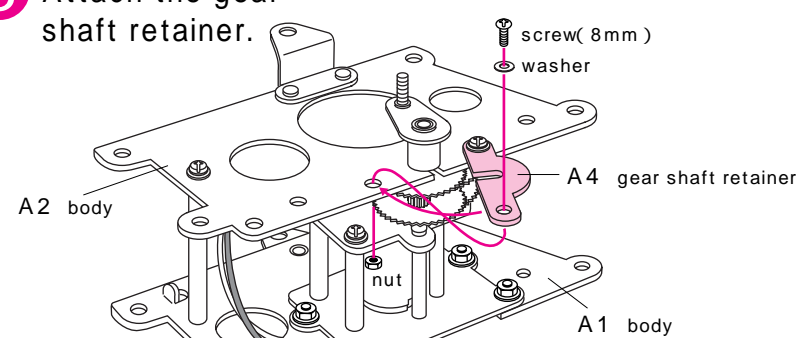
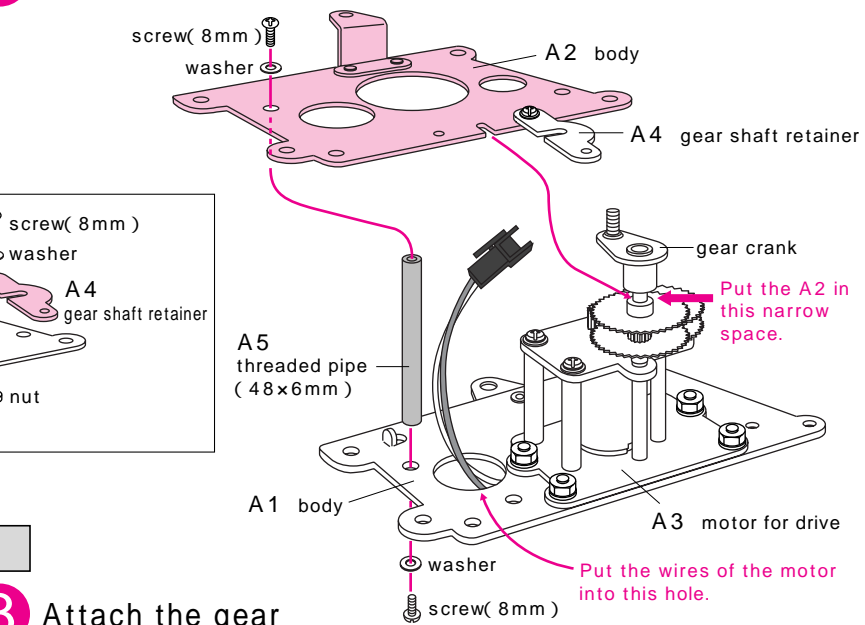


Full-scale Check the size with this.  
A5 threaded pipe( 48×6mm X 1 )

**Figure- 3**  
Turn the A4 gear shaft retainer to the direction of the arrow in the figure and fasten the end with a screw and a nut.

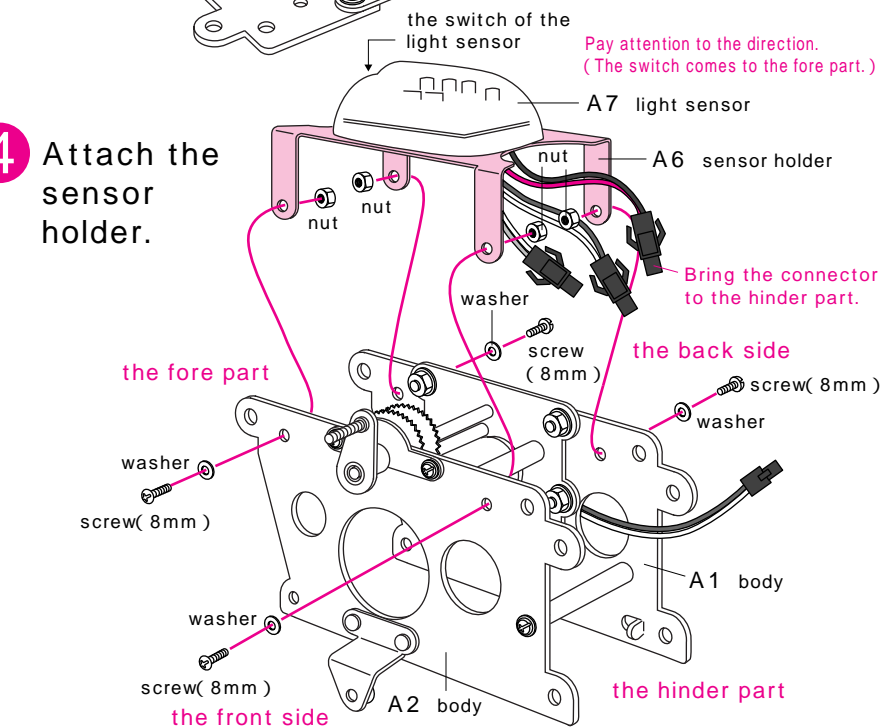
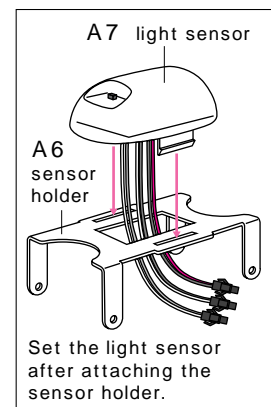
Fasten both ends of the A4 gear shaft retainer to the A2 body completely.

**3** Attach the gear shaft retainer.



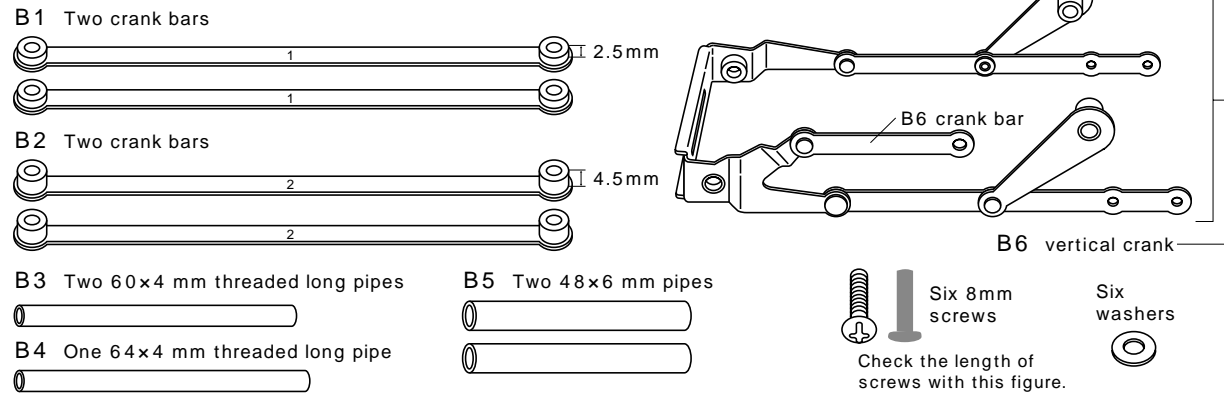
**4** Attach the sensor holder.

**Figure- 4**  
Attach the A6 sensor holder to the body assembled at Figure- 3 with screws and nuts.

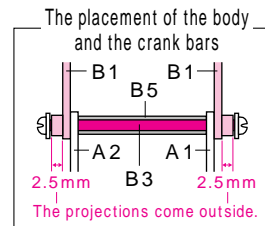


**2** Attaching Crank Bars for Moving Legs

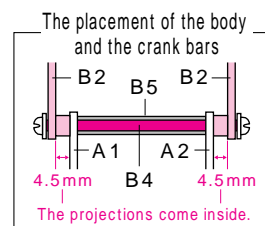
**Parts to be used PARTS B** There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.



**Figure- 5**  
Attach B1 crank bars to the A1 body and the A2 body. Make sure that the 2.5mm projections of the crank bars come outside.

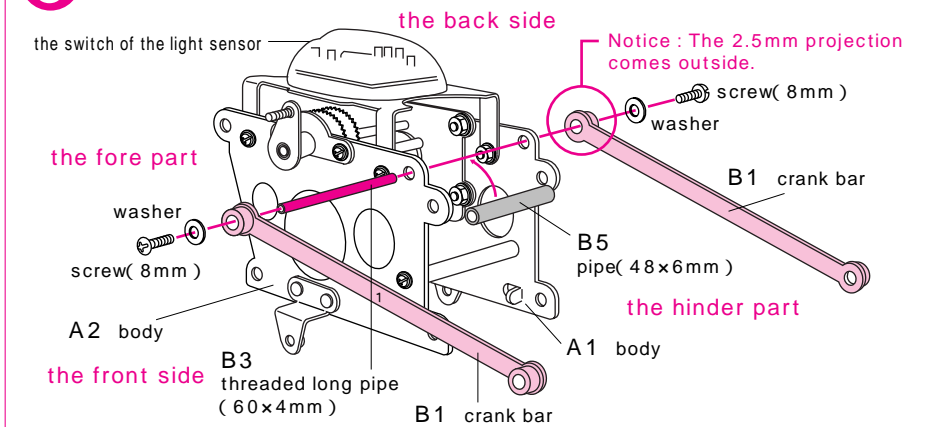


**Figure- 6**  
Attach the B2 crank bars to the body assembled at Figure- 5. Make sure that the 4.5mm projections of the crank bars come inside.

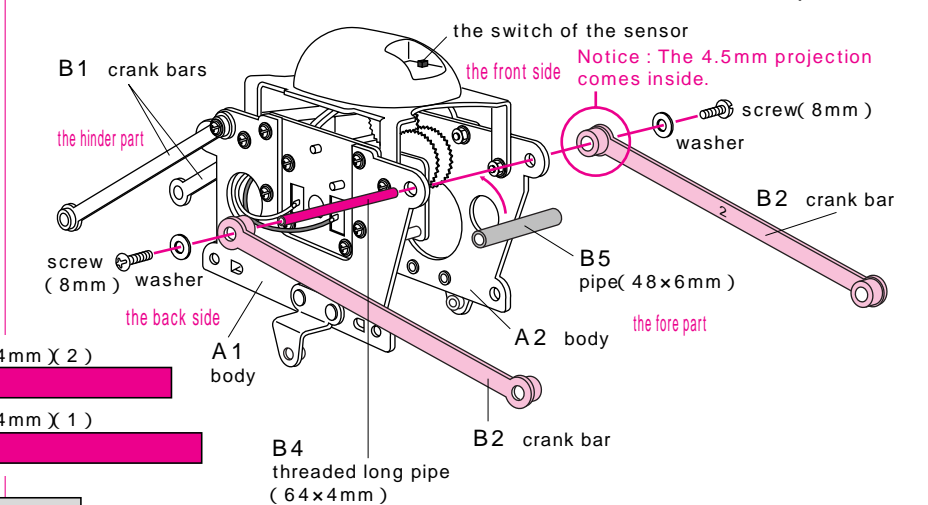


Full-scale Check the size with this.  
B3 threaded long pipe( 60×4mm X 2 )  
B4 threaded long pipe( 64×4mm X 1 )  
B5 pipe( 48×6mm X 2 )

**5** Attach two B1 crank bars to the hinder parts of the A1 and the A2 bodies.

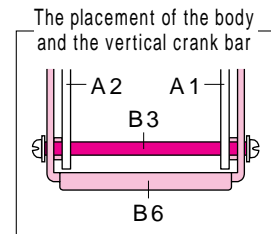


**6** Reverse the front side and the back side of the A1 and the A2 bodies and attach two B2 crank bars to the fore part.

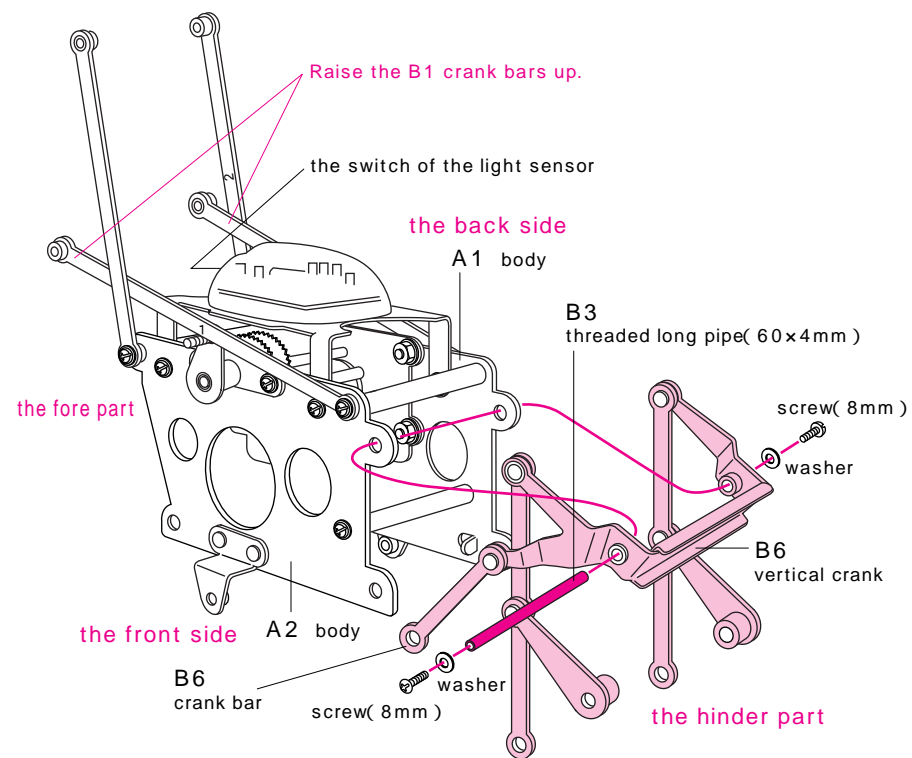


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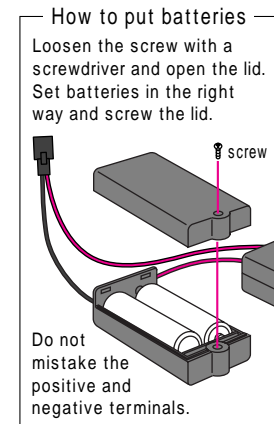
**Figure—7**  
Attach B6 vertical crank to the body assembled at Figure—6 by putting through the B3 threaded long pipe and fastening both ends with screws.



**7** Attach B6 vertical crank to the hinder part of the body.

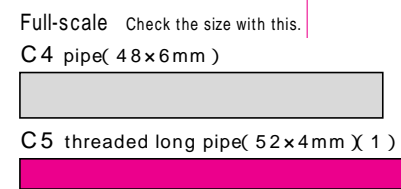
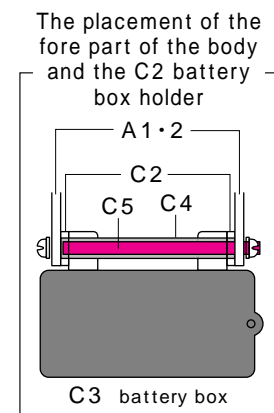


**Figure—8**  
Attach the C1 and the C2 battery box holders to the C3 battery boxes.



Remove the batteries when not using the machine for a long time. Also, oxyride dry cell batteries are unsuitable because they are too powerful.

**Figure—9**  
Attach the C2 battery box holder with a battery box to the fore part of the body.

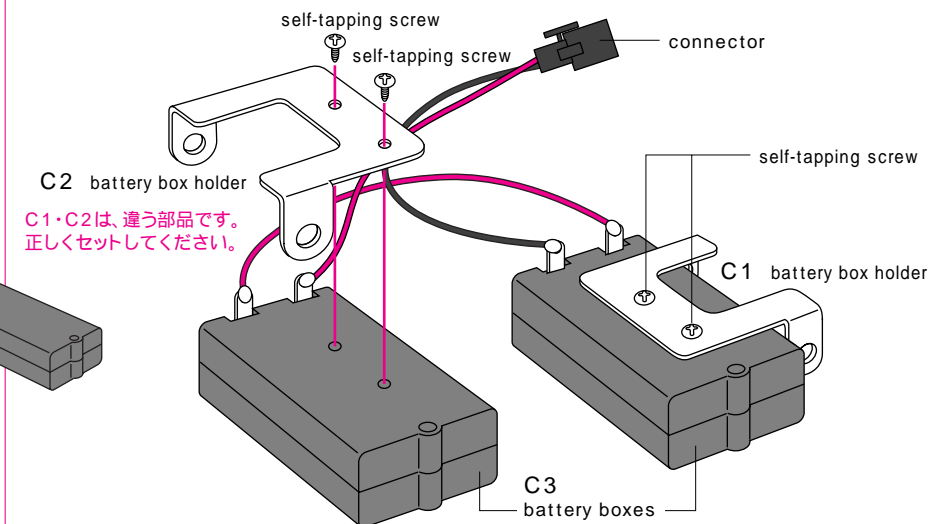


Full-scale Check the size with this.

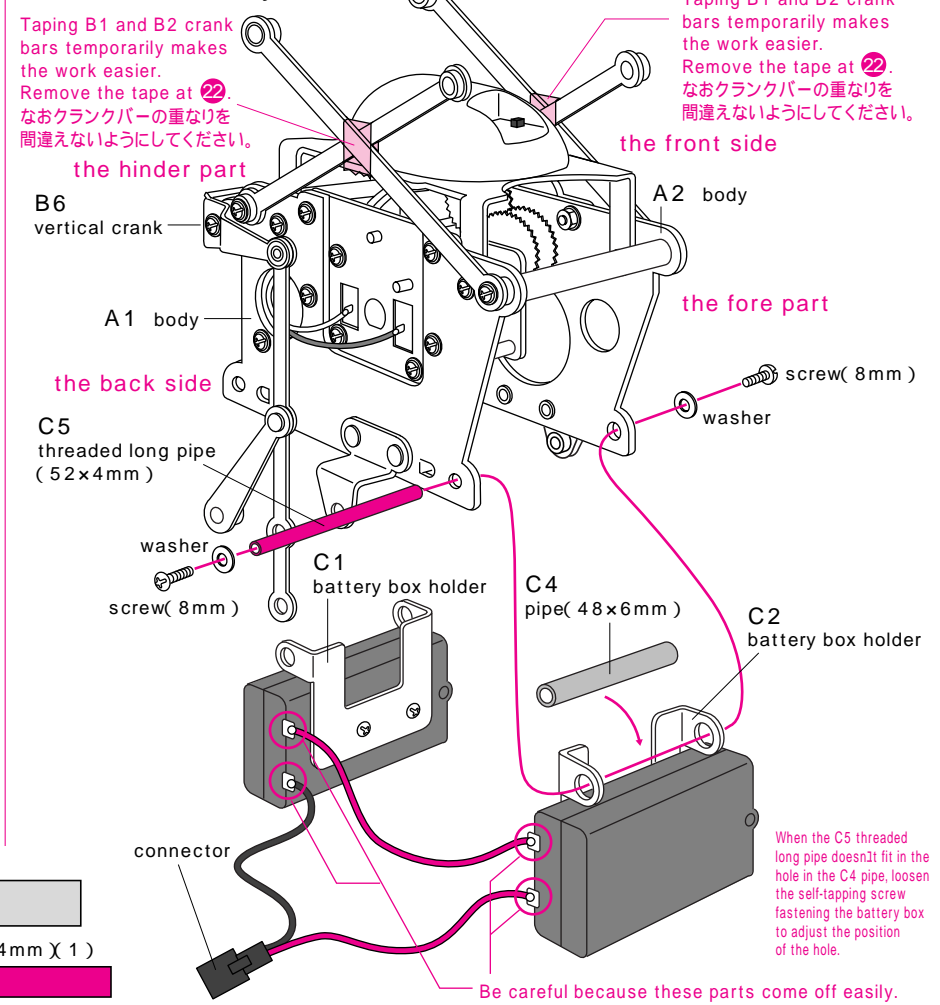
C4 pipe( 48x6mm )  
C5 threaded long pipe( 52x4mm X 1 )

**Gakken**

**8** Attach the C1 and the C2 battery box holders to the C3 battery boxes one by one.



**9** Attach the C2 battery box holder to the fore part of the body.



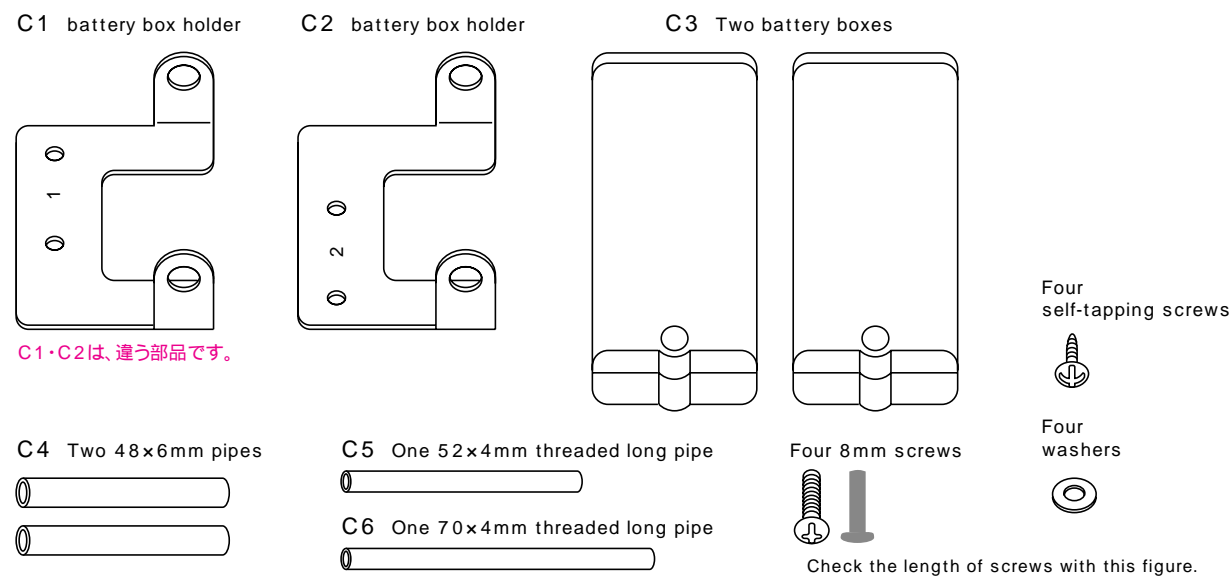
Taping B1 and B2 crank bars temporarily makes the work easier. Remove the tape at 22. なおクランクバーの重なりを間違えないようにしてください。

Taping B1 and B2 crank bars temporarily makes the work easier. Remove the tape at 22. なおクランクバーの重なりを間違えないようにしてください。

**3 Attaching Battery Boxes**

**Parts to be used PARTS C**

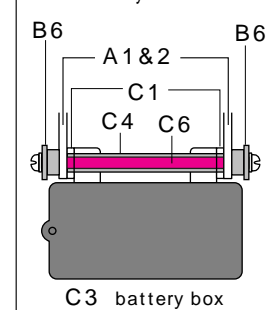
There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.



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Figure—10  
Attach the C1 battery box holder to the hinder part of the body and fasten the B6 vertical crank at the same time.

The placement of the hinder part of the body and the C1 battery box holder



Full-scale Check the size with this.

C4 pipe( 48×6mm )

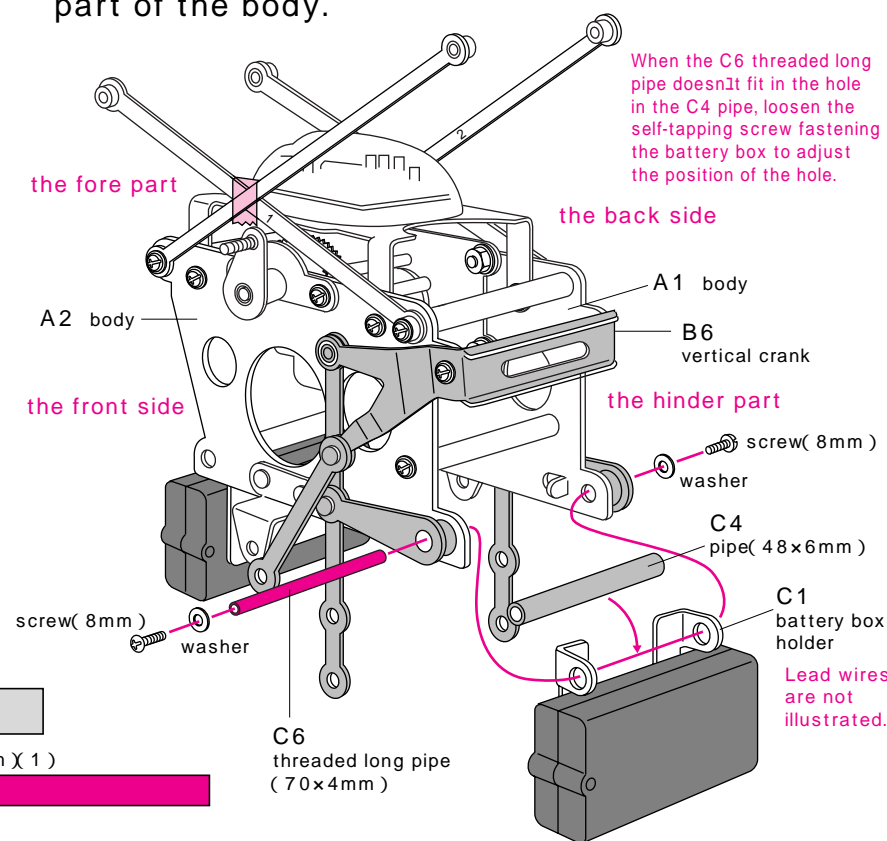


C6 threaded long pipe( 70×4mm X 1 )

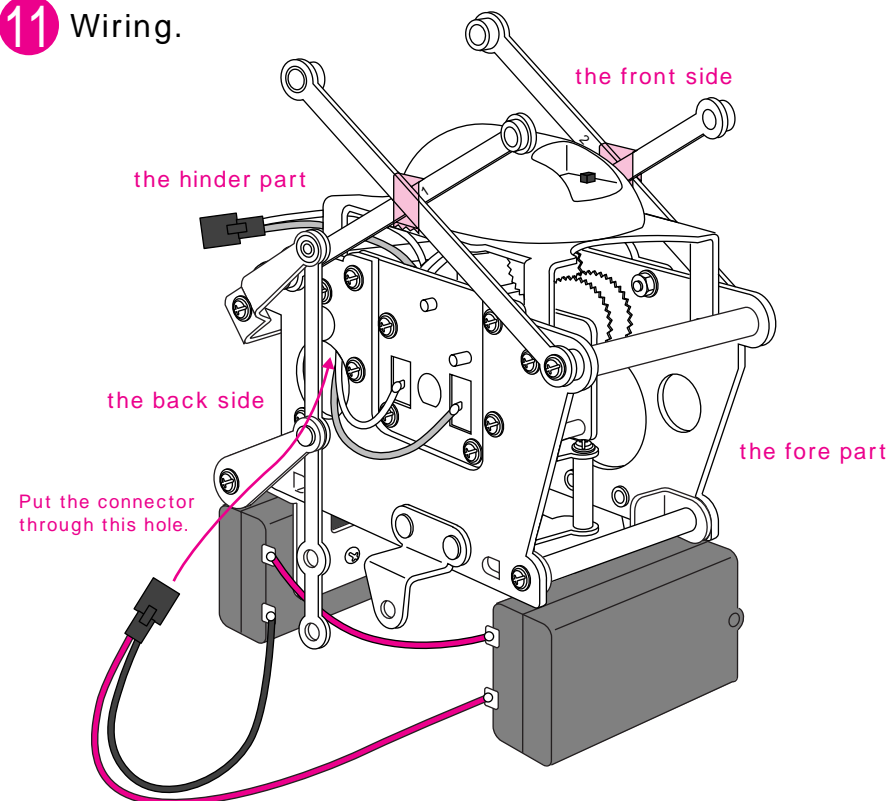


Figure—11  
After attaching the C1 and the C2 battery boxes, wire as shown in the figure.

### 10 Attach the C1 battery box holder to the hinder part of the body.

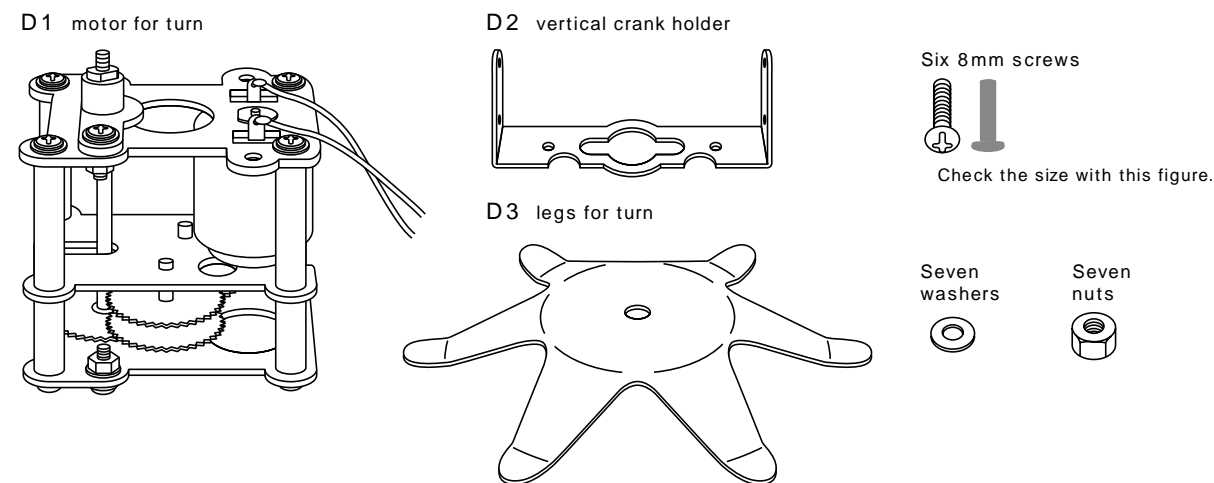


### 11 Wiring.

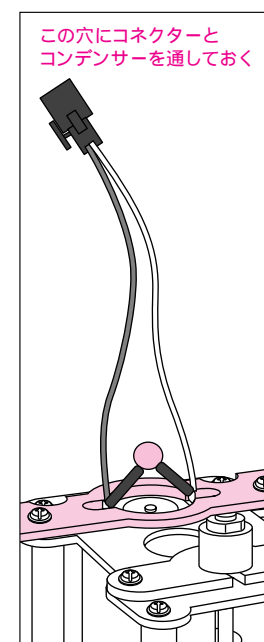


## 4 Assembling the Motor for Turn

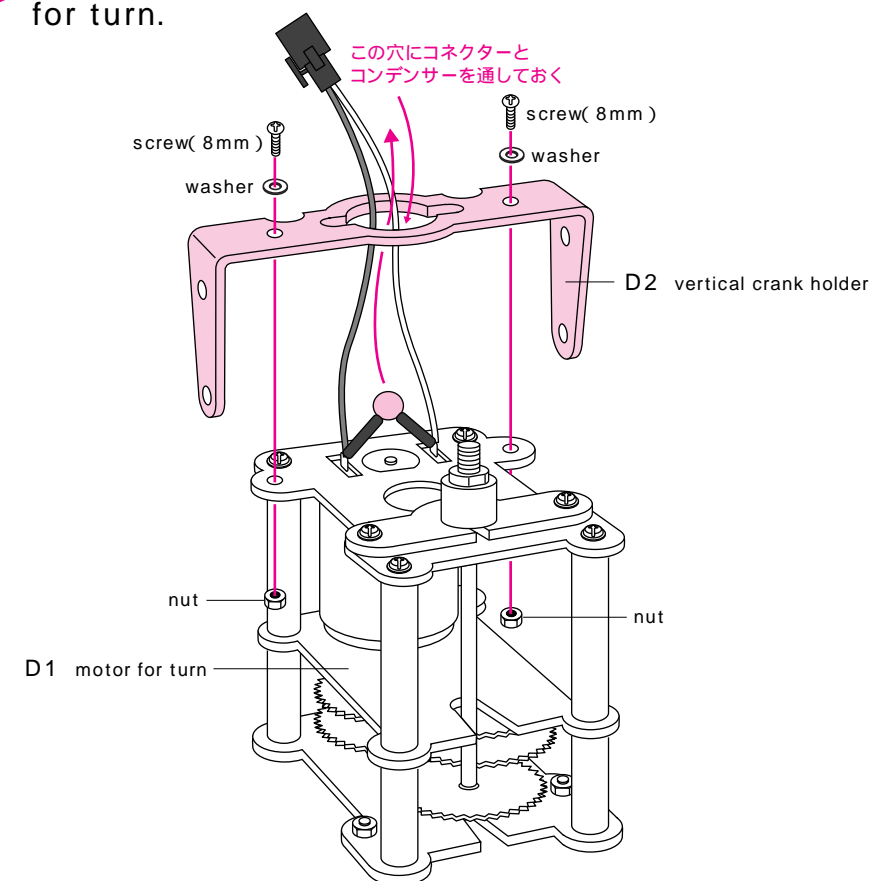
Parts to be used PARTS D There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.



Figure—12  
Attach the D2 vertical crank holder to the D1 motor for turn. At this point, don't forget to put the wiring connector of the motor through the hole in the D2 vertical crank holder.



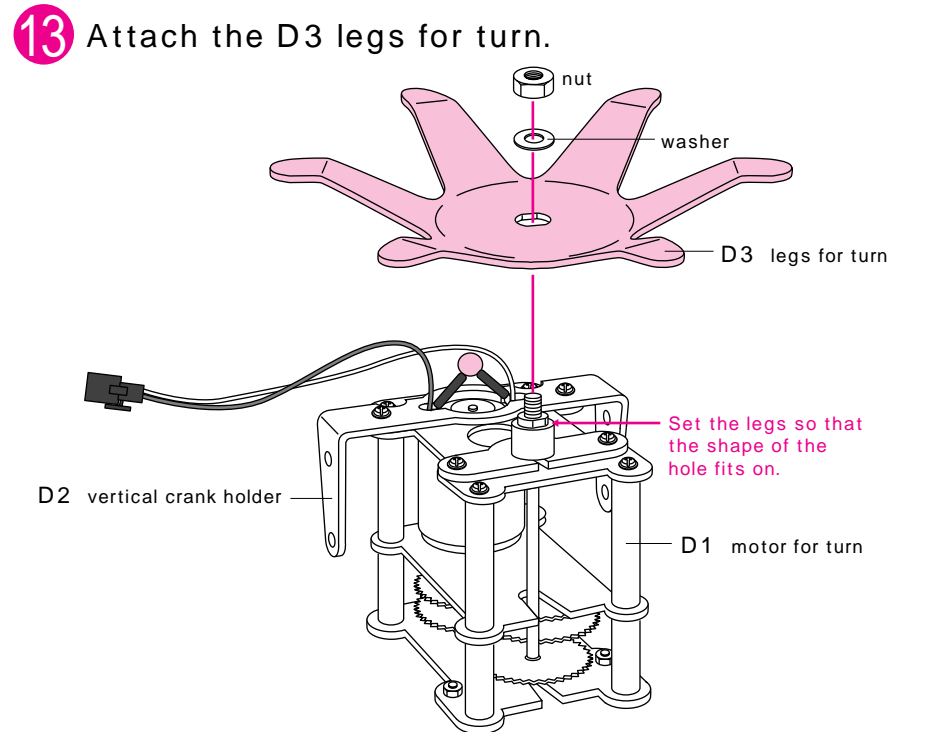
### 12 Attach the vertical crank holder to the D1 motor for turn.



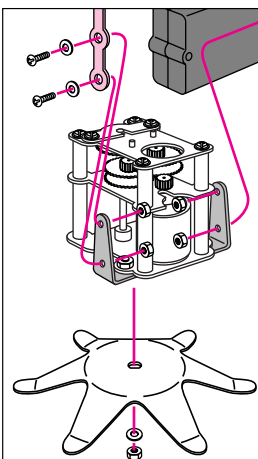
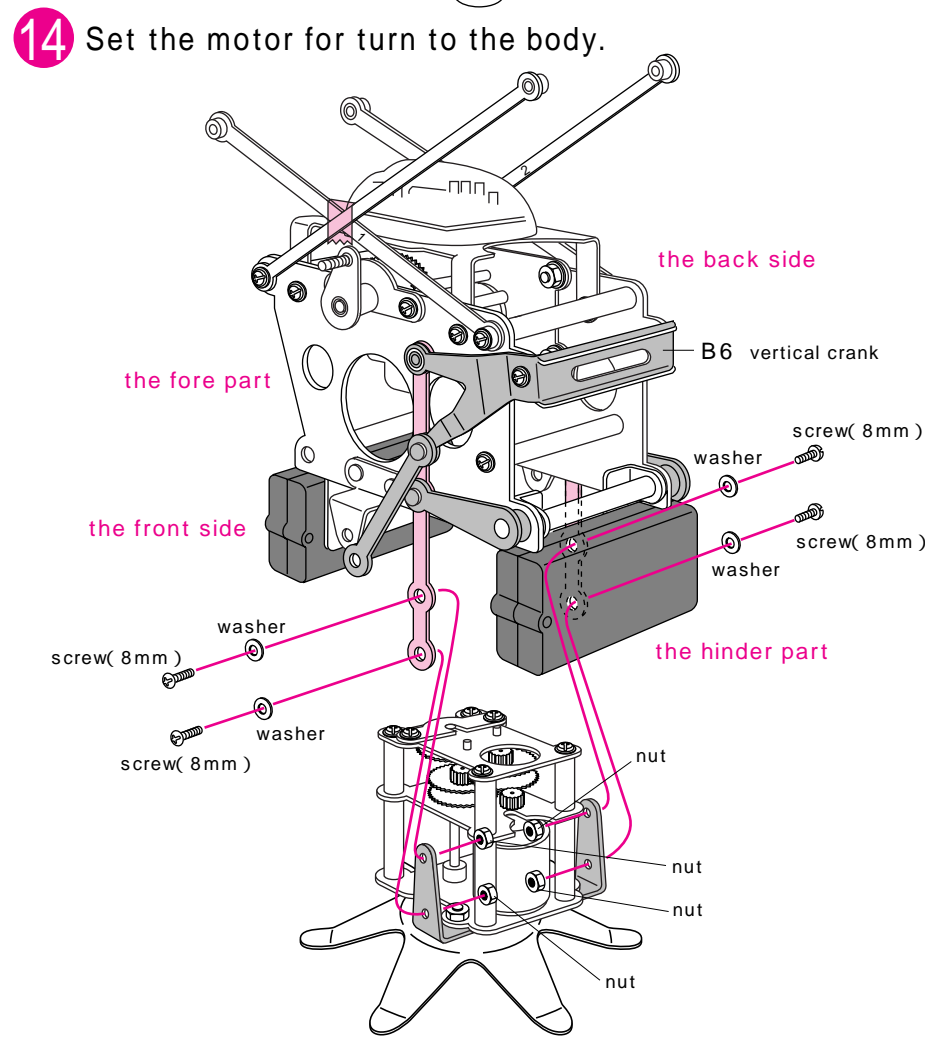
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**Figure— 13**  
Set the D3 legs for turn on the D1 motor for turn and fasten firmly with a nut.



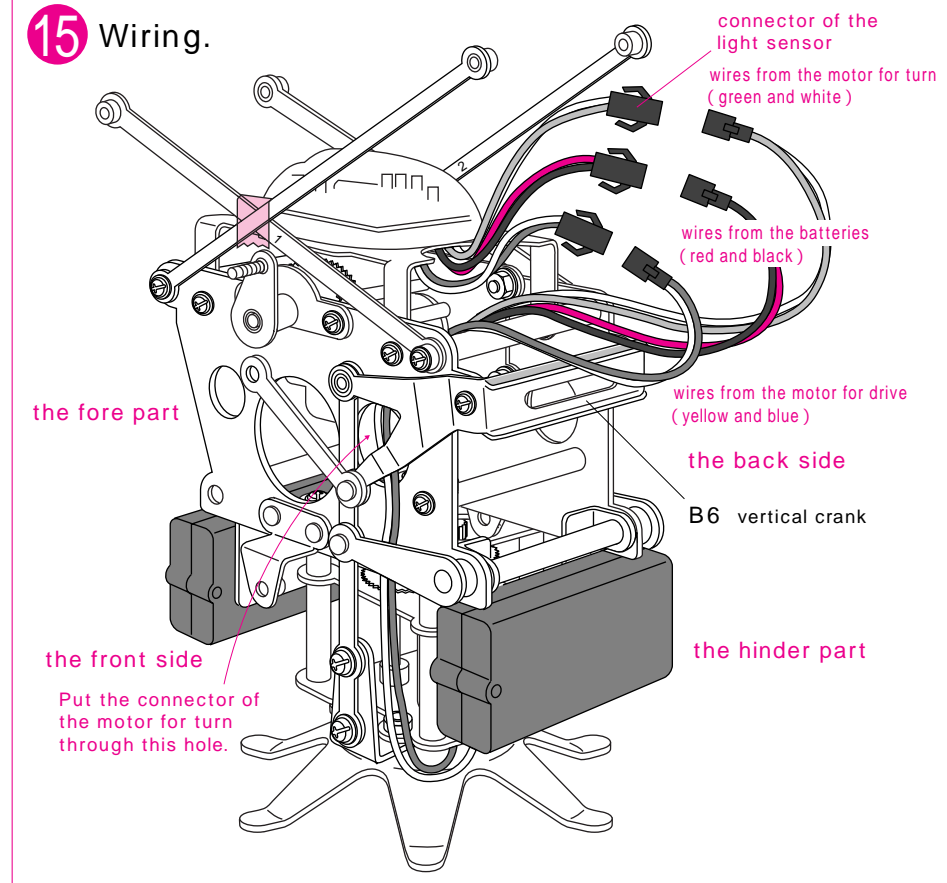
**Figure— 14**  
Set the body assembled at Figure— 11 on the motor for turn assembled at Figure— 13.  
(Attach the motor for turn to the body at the B6 vertical crank.)



When it is difficult to set the body on the motor for turn, try the following two things for easy assembling.

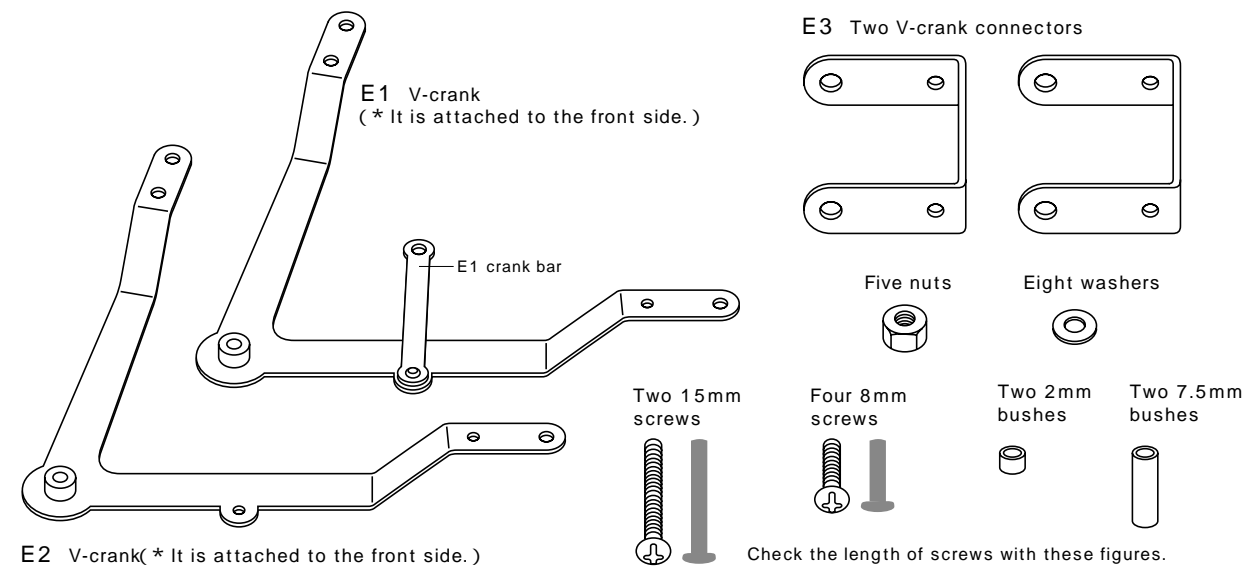
1. Put the B6 vertical crank up and the motor for turn down.
2. Remove the legs for turn temporarily.

**Figure— 15**  
Set the lead wires from the motor for drive, the motor for turn, and the battery boxes into the lead wire connectors of the light sensor so that the same color wires are connected. Be sure to set the wires at this point because it becomes difficult to wire afterward.



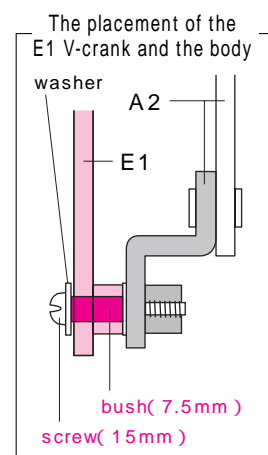
## 5 Attaching V-cranks

**Parts to be used PARTS E** There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.

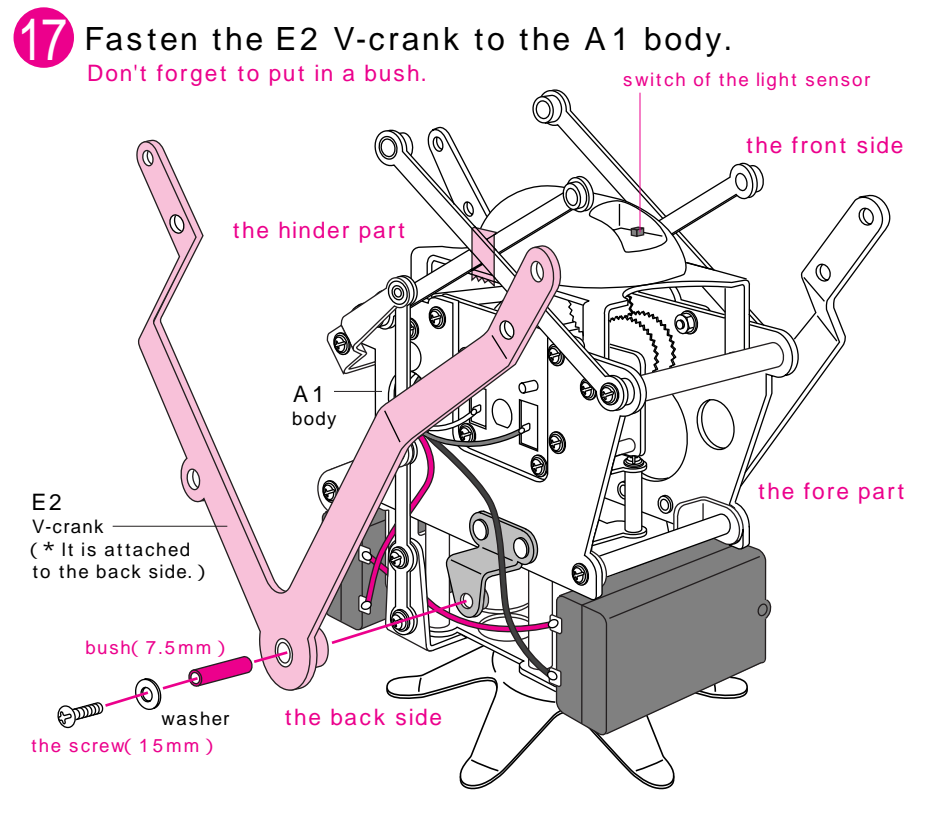
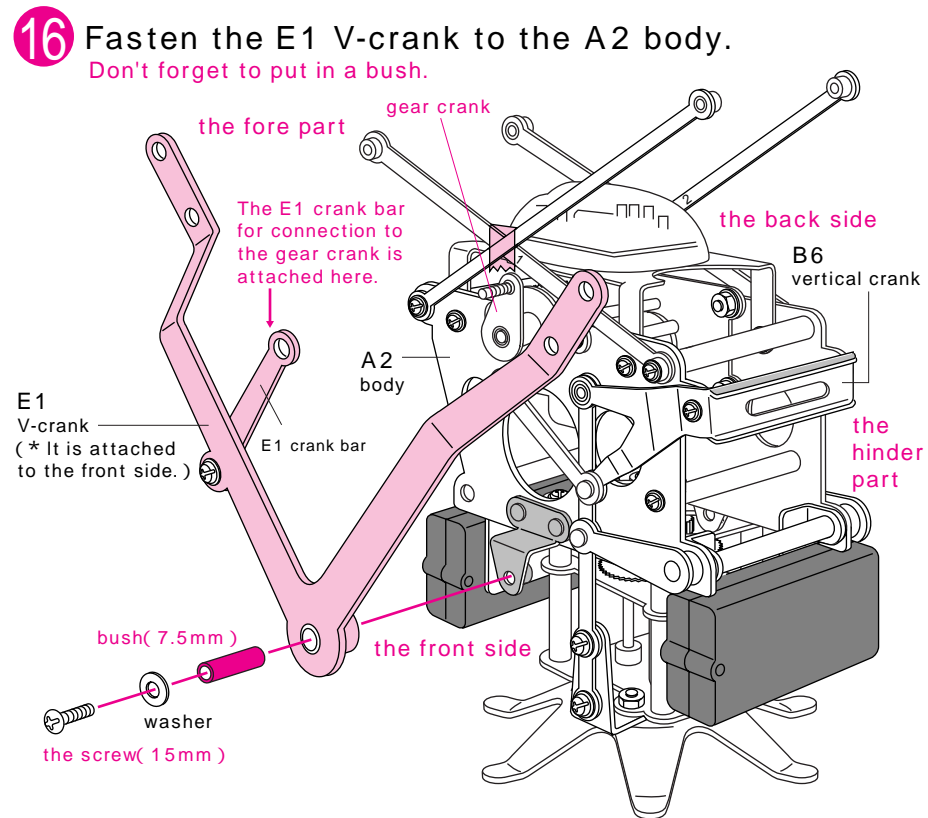
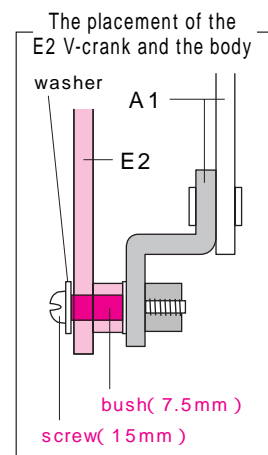


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**Figure— 16**  
Fasten the E1 V-crank to the A2 body. Be careful not to mistake the E2 V-crank for the E1 V-crank.  
Don't forget to put in a bush.



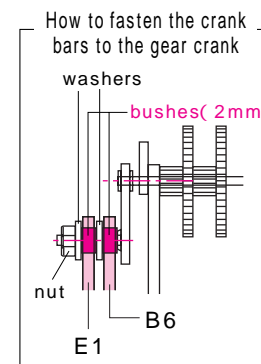
**Figure— 17**  
Fasten the E2 V-crank to the A1 body.  
Don't forget to put in a bush.



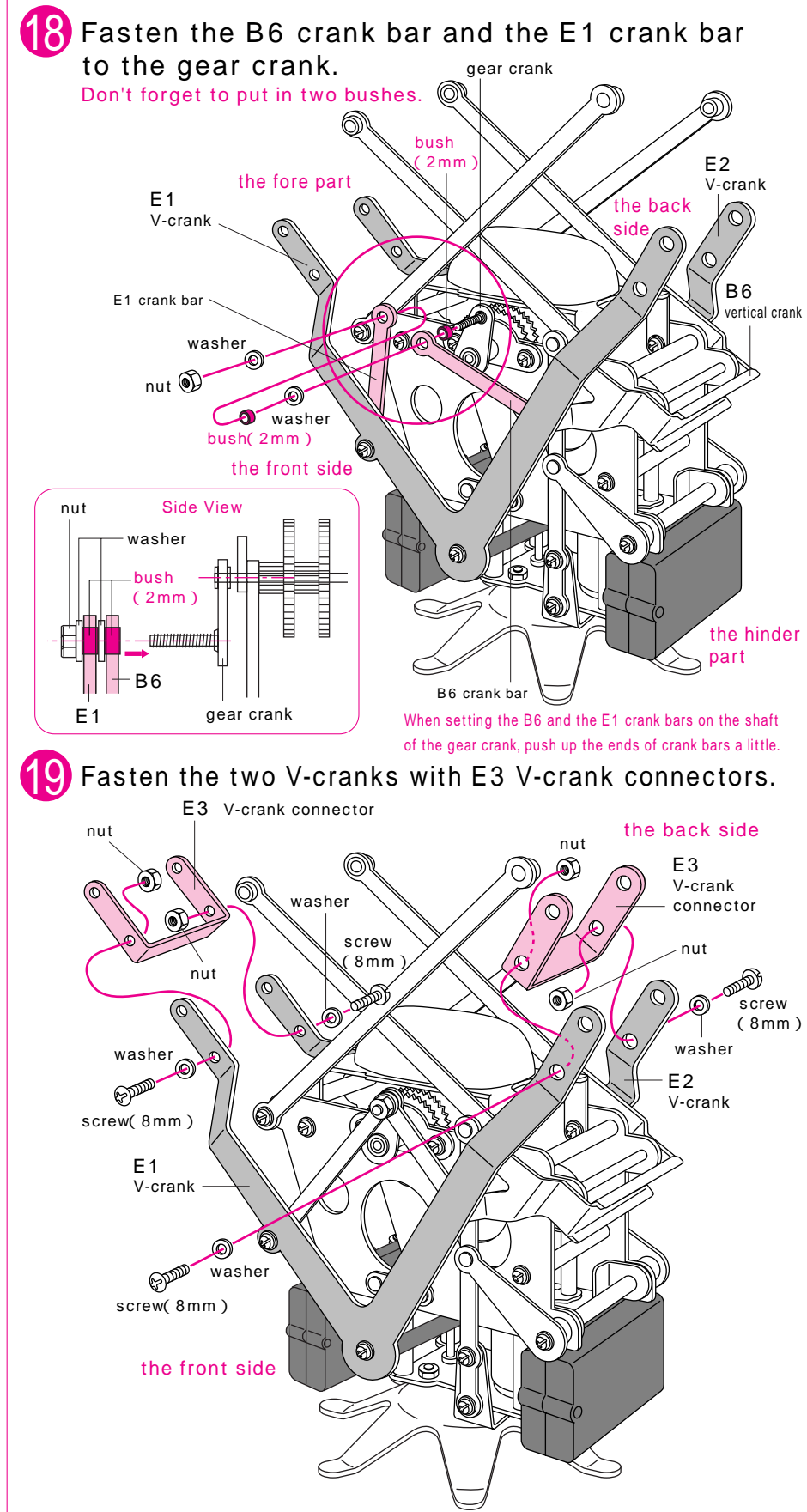
**Figure— 18**  
Fasten the B6 crank bar and the E1 crank bar to the gear crank.  
Don't forget to put in two bushes.

**Notice**  
Attach the parts in the following order.  
bush( 2mm )  
B6 crank bar  
washer  
bush( 2mm )  
E1 crank bar  
washer  
nut

Put the bushes in the holes in the bar or the crank first, then screw the nut on. (Two bushes are needed.)



**Figure— 19**  
Fasten the E1 and the E2 V-cranks with two E3 V-crank connectors.



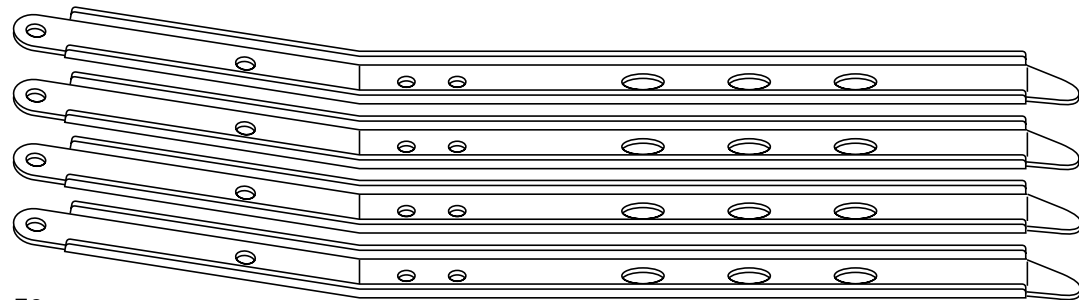
**Warning** Do not touch the Mechamo while it is operating. It is very dangerous. Particularly, never let small children touch it.



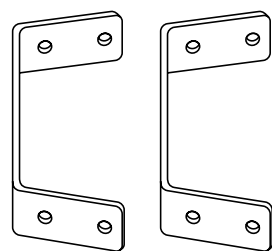
# 6 Attaching Legs to the Body

**Parts to be used PARTS F** There are some more numbers of screws, washers, nuts and bushes included for spare than are actually used.

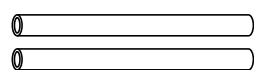
F1 Four legs



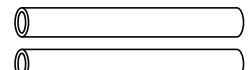
F2 Two leg connectors



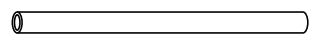
F3 Two 52x4mm threaded long pipes



F6 Two 48x6mm pipes



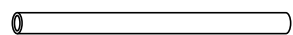
F4 One 64x4mm threaded long pipe



Sixteen 8mm screws Sixteen washers Eight nuts

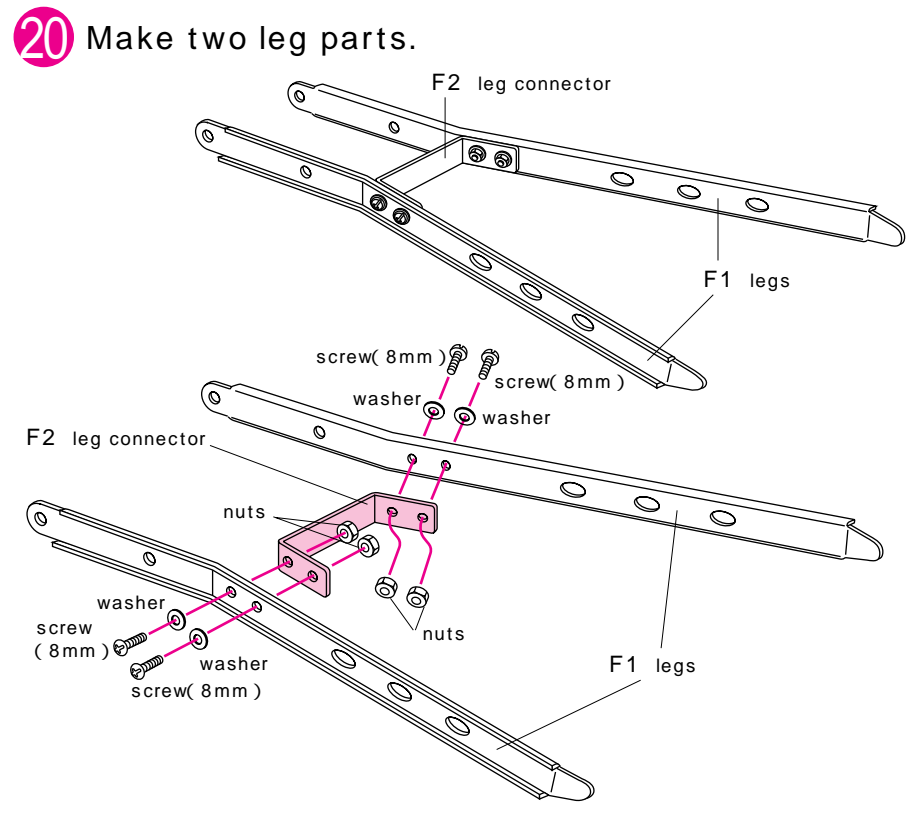


F5 One 60x4mm threaded long pipe



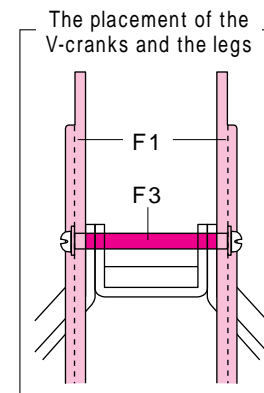
Check the length of screws with this figure.

Figure-20 Assemble two leg parts using F2 leg connectors.



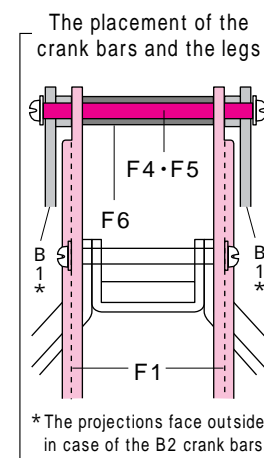
**Warning** Do not touch the Mechamo while it is operating. It is very dangerous. Particularly, never let small children touch it.

Figure-21 Attach leg parts assembled at Figure-20 to the fore and the hinder tips of the V-cranks. Set both leg parts.



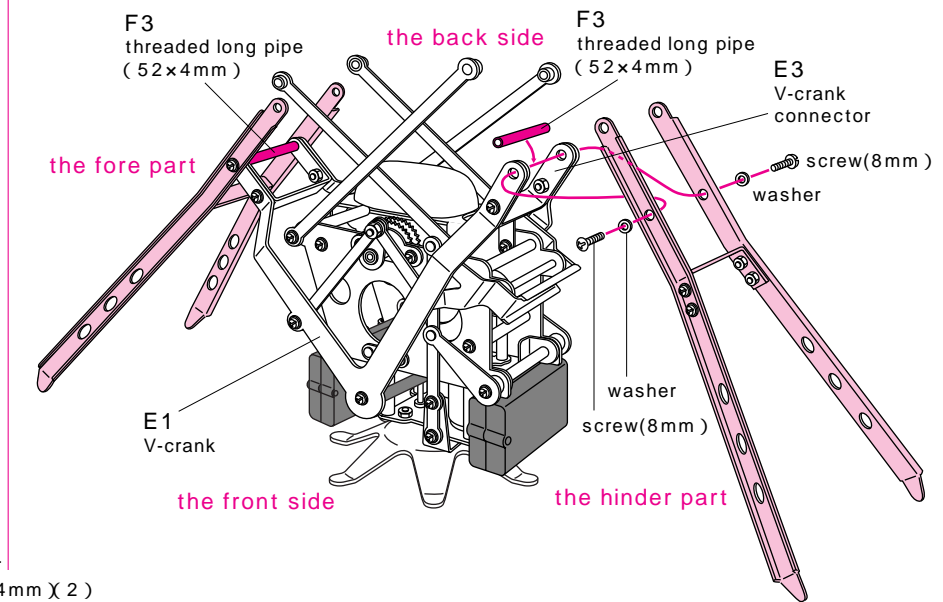
Full-scale Check the size with this. F3 threaded long pipe( 52x4mm X 2 )

Figure-22 Connect the crank bars attached at Figure-5 and 6 to the top of both fore and hinder leg parts.

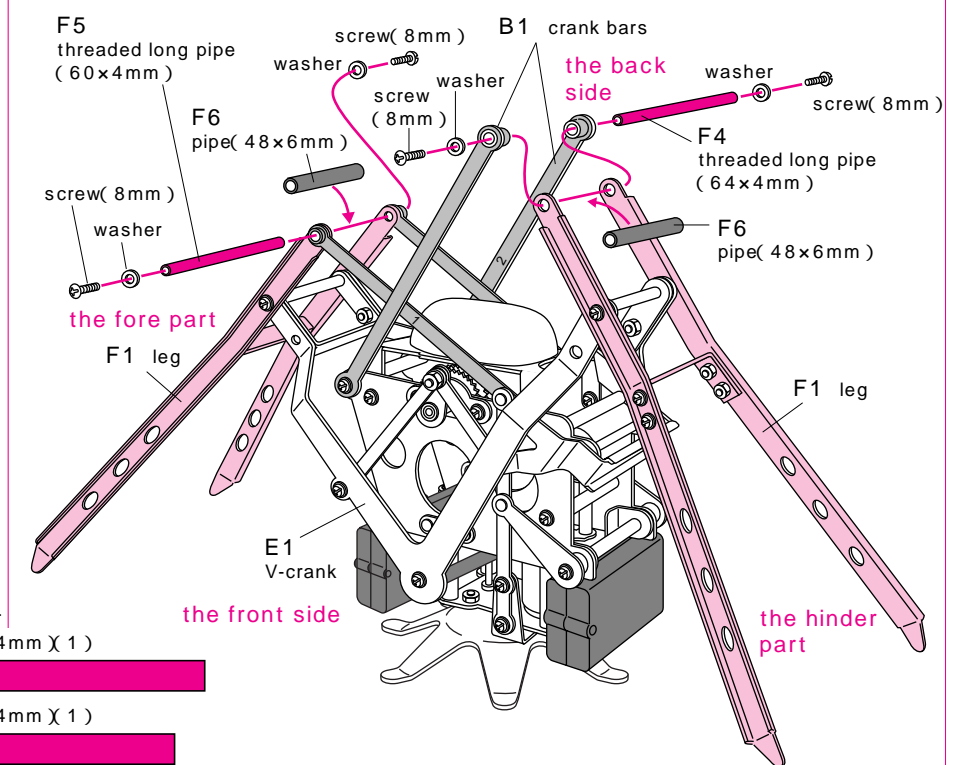


Full-scale Check the size with this. F4 threaded long pipe( 64x4mm X 1 ) F5 threaded long pipe( 60x4mm X 1 ) F6 pipe( 48x6mm X 2 )

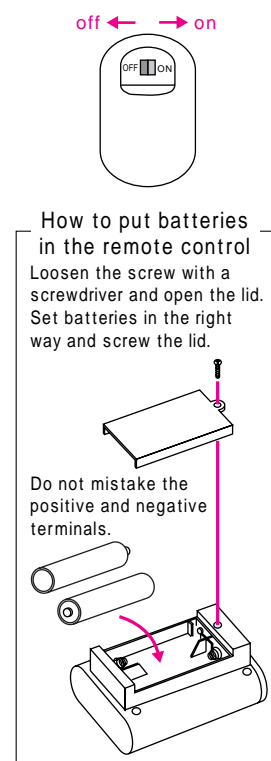
21 Attach leg parts to the fore and the hinder parts of the V-cranks.



22 Connect the leg parts and the crank bars assembled at Figure-5 and 6. Remove the tapes tying temporarily the crank bars together.

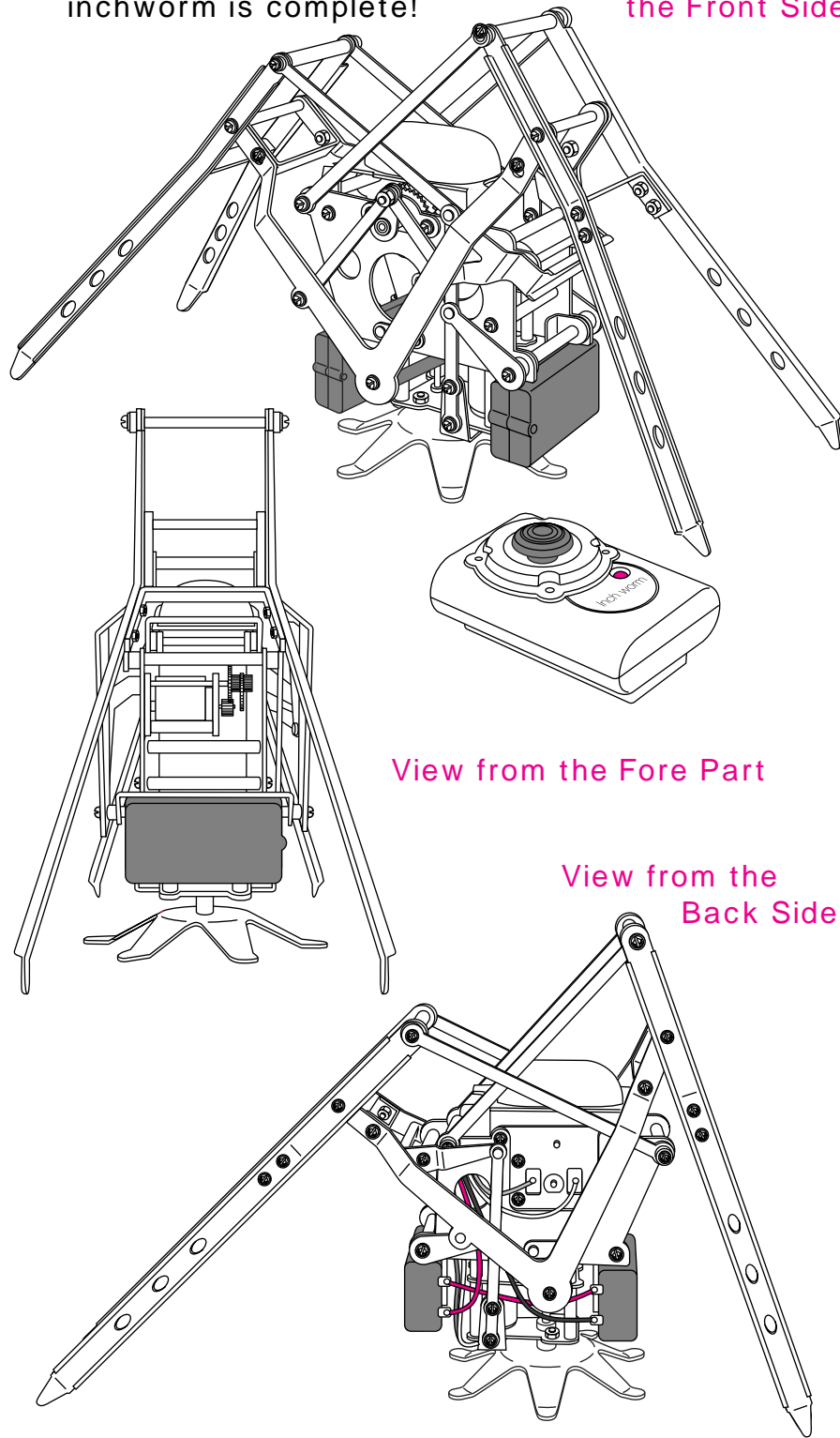


Figure— 23  
You've finished the assembly.



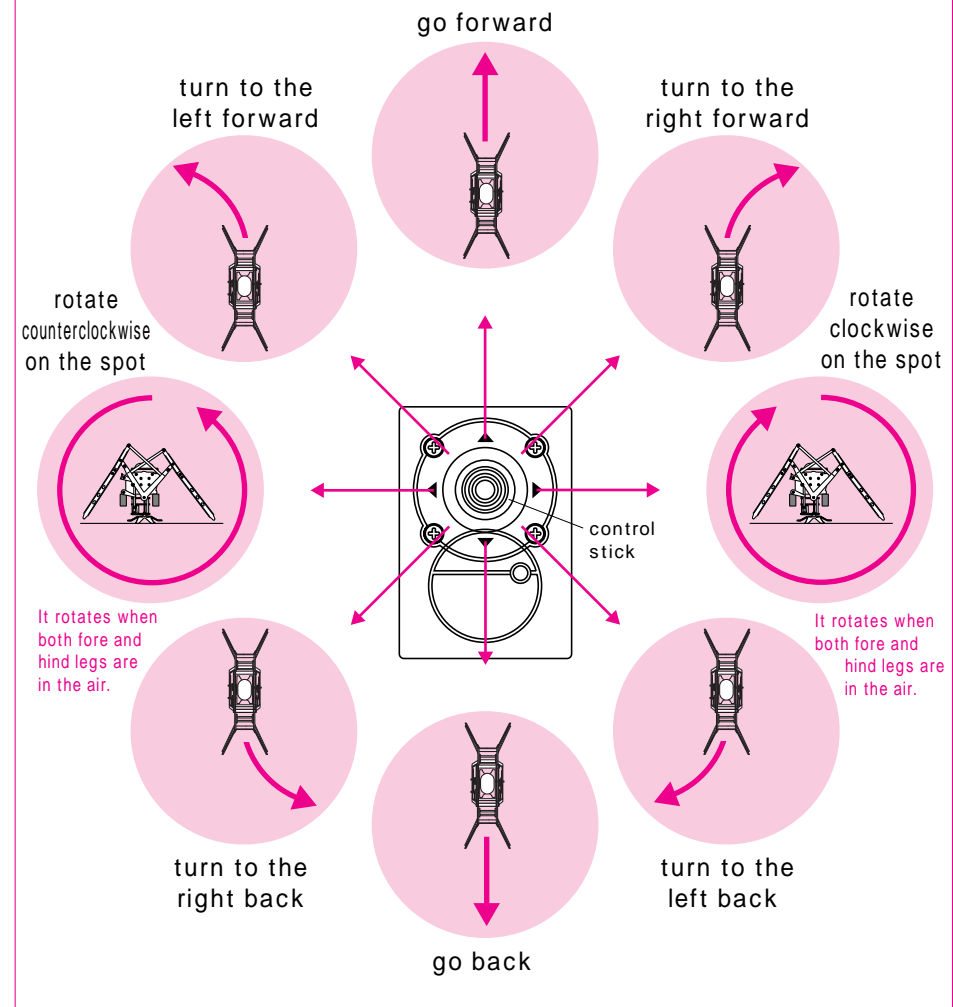
Remove the batteries when not using. Also, oxyride dry cell batteries are unsuitable because they are too powerful.

**23** Now the Mechamo inchworm is complete! **Oblique Top View of the Front Side**



Figure— 24  
First, turn on the switch of the light sensor. Then, you can operate the machine with the remote control. The machine goes forward and back or turns right and left according to the operation of the control stick. See the right illustrations for the operation.

**24** How to operate.(How to use the remote control)



## Trouble Shooting MECHAMO

**Q : The Mechamo doesn't react to the control stick**

**A :** Check the following points.

1. Have you turned on the switch of the light sensor?
2. Are the six batteries new? (four for the motors and two for the remote control)
3. Have you wired battery boxes, the motors and the light sensor correctly?

**Q : The Mechamo reacts to the control stick but doesn't start moving.**

**A :** Check the following points.

1. Have you tightened every screw?
2. Have you assembled correctly? (Check the machine with the picture of the finished Mechamo at p. 18.)
3. Have you put all the bushes? (Very important. See p.14 and p.15 and check the bushes.)

**Warning :** Never touch the Mechamo while it is operating. Be sure to stop the Mechamo with the remote control and turn off the switch of the light sensor before you touch. Touching the operating Mechamo may cause injury to your fingers.