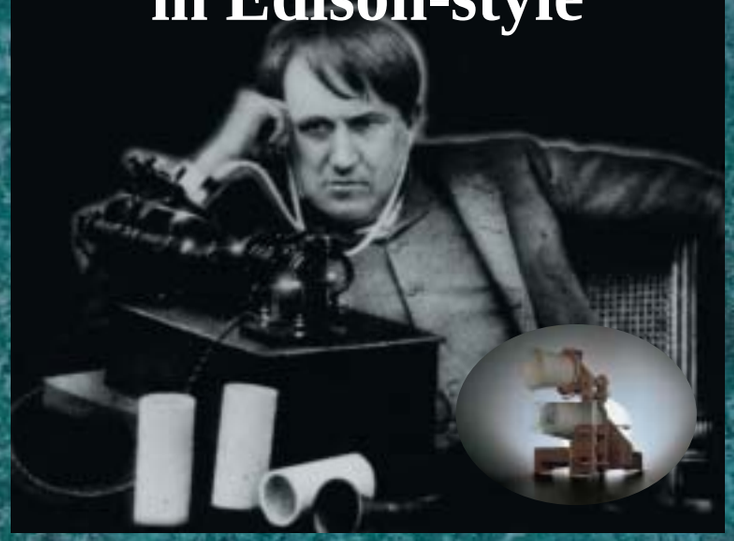
大人の科学®
Otona no Kagaku
(Sophisticated Science Kit Series for Adults)

Sound of the 19th century is coming back to life now!

Cup Phonograph Kit in Edison-style



By applying the mechanism of Thomas Edison's phonograph, you can record your own voice on a plastic cup and play it back. This experiment will help you understand how sound can be recorded and replayed.

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

- Be careful of handling needles contained in this kit. Improper use may cause injury to persons.
- Be careful of handling some metallic parts that are made thin and sharp functionally. Improper use may cause injury to persons.
- Be careful not to swallow small parts to avoid suffocation.
- Do not insert lead wires into an outlet to avoid the risk of electric shock.
- Remove the battery after using the kit and keep children from the battery.

★One size D (LR20) dry battery is needed. Improper use of the battery may cause generation of heat, explosion or leak of the battery. The following precautions should be followed.

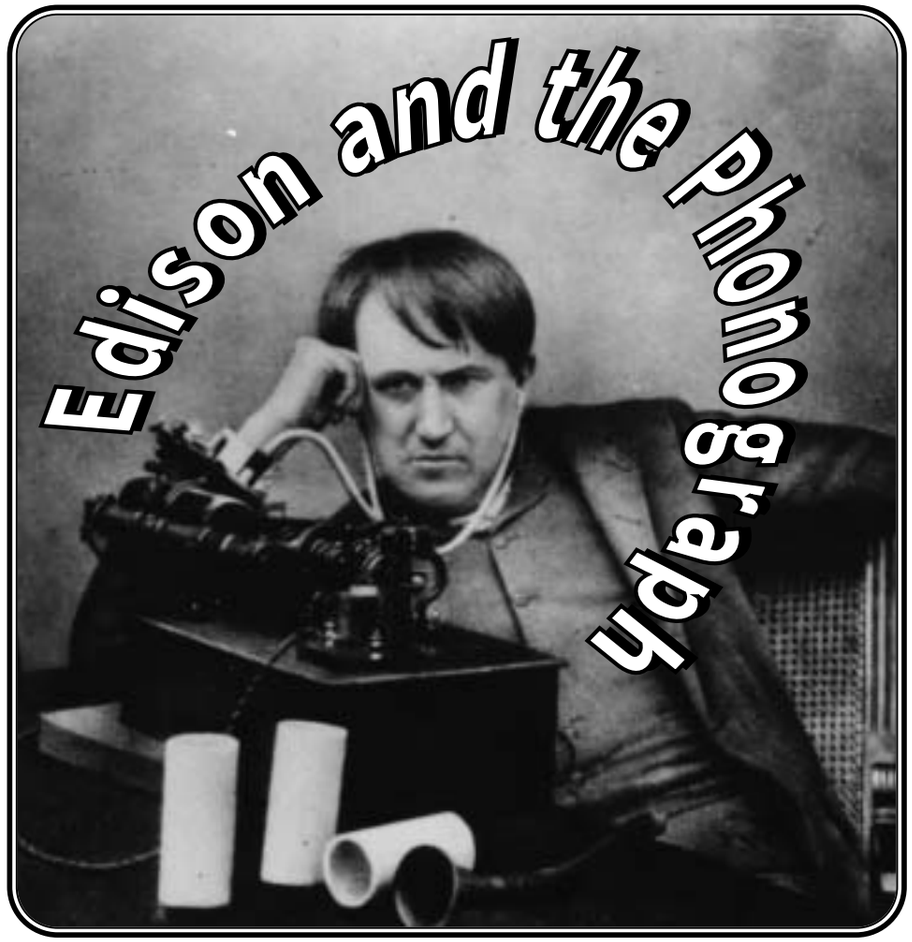
- Do not use a rechargeable battery, such as a nickel cadmium battery.
- Set the positive and negative terminal of the battery in the right direction.
- Do not short-circuit, recharge, break up or put the battery in a fire .
- If the liquid leaked from the battery gets in an eye, bathe the eye immediately in a lot of water and consult a doctor. When the liquid stuck to the skin or clothes, wash up immediately with water.

★Assembly instructions and cautions in this booklet should always be followed. Do not use deformed parts.

- The plastic materials used in this kit

battery box (white) : polypropylene
pipe(white) : ABS resin
plastic cup (transparent) : polyethylene terephthalate
styrene form cup : polystyrene
switch (black) : urea resin
needle cover (green) : foamed polyethylene
small bags : polyethylene

※ Vinyl chloride resin is used for the covers of the lead wires.
※ When you dispose the kit, follow the regulations of each local government.



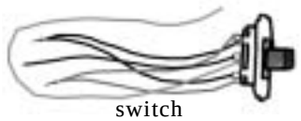
Thomas Alva Edison who is called the king of invention obtained more than a thousand patents in his life. It is said that among his inventions, the phonograph is the one that impressed Edison himself most.

This Cup Phonograph Kit in Edison Style applied the principle of the primary phonograph. Instead of using a waxed pipe and a stylus, this kit uses a plastic cup and a needle. Enjoy the exciting scientific experience of assembling this kit like Edison did in his invention!

Parts in this Kit

Parts


large wing nut (4)


switch


battery box


snap fastener


bolt1 (thick)


needle (2) ※one for a spare


needle cover


small wing nut (2)


bolt2


needle pipe


hole-making needle


screw (2)


bolt3


motor


nut (4)


long nut


large (and thin) rubber band


small (and thick) rubber band


acorn nut (2)


rubber tube (2)


washer (4)


pipe1


pipe2


pipe3


long screw


plastic cup (7)

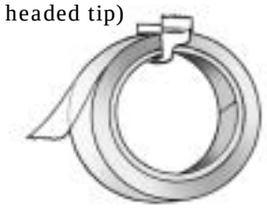

paper cup


styrene form cup


anti-slip sticker (2)
※one for a spare

Tools Needed

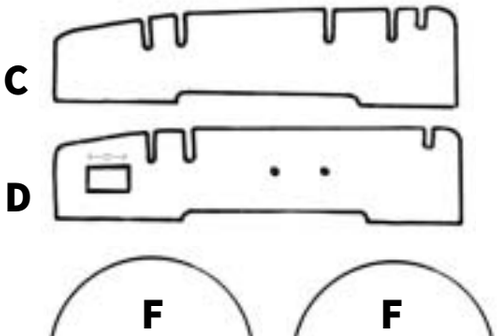

screwdriver(small cross-headed tip)

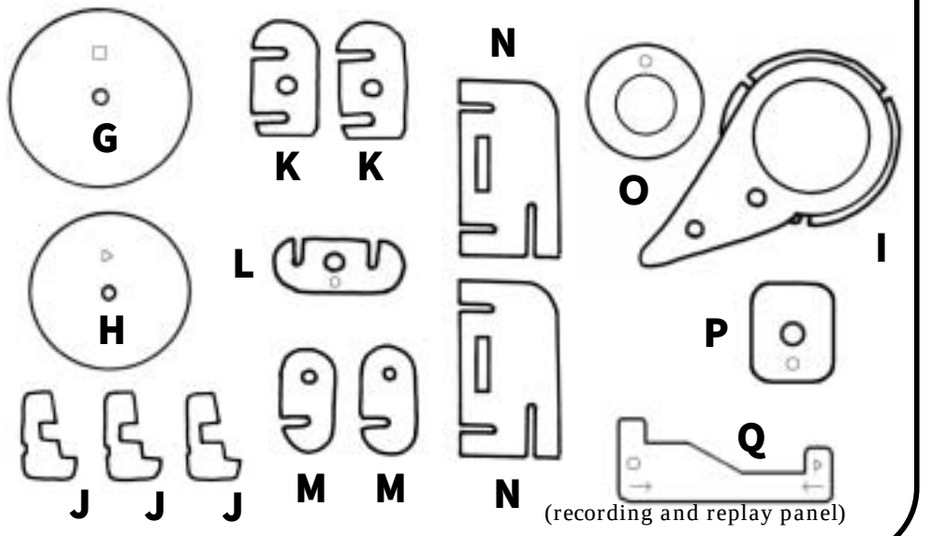

Scotch tape


scissors

unused size D (LR20) alkaline battery (1)

Panels





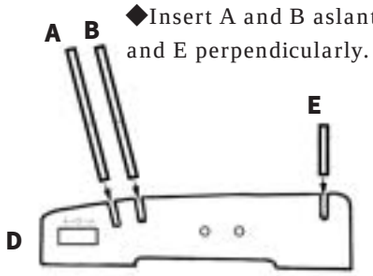
(recording and replay panel)

HOW TO ASSEMBLE THE PHONOGRAPH

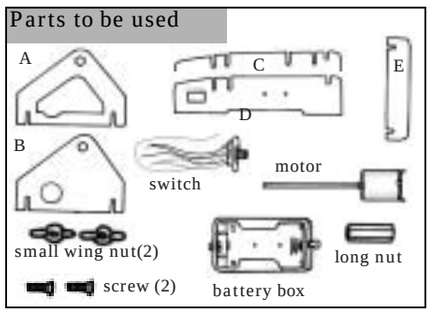
To Assemble the Body

1 Insert the panel A, B and E into the panel C and D completely.

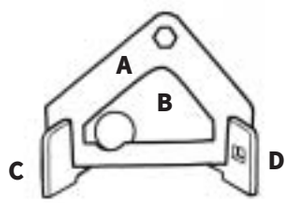
◆Insert A and B aslant and E perpendicularly.



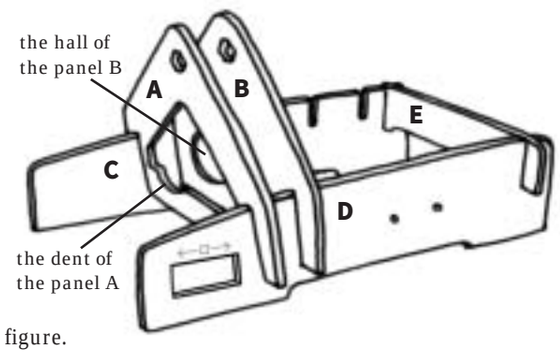
Parts to be used



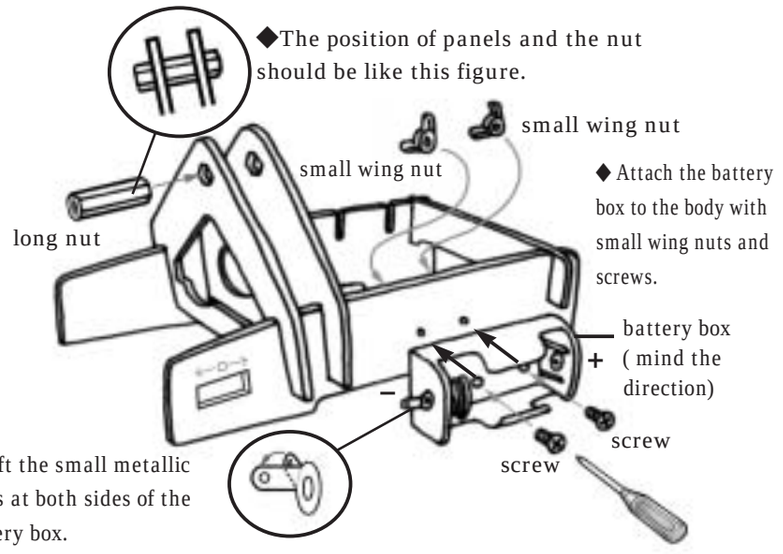
◆ Check the direction of the panel A and B!



◆The direction of A and B is like this figure.

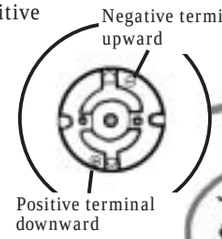


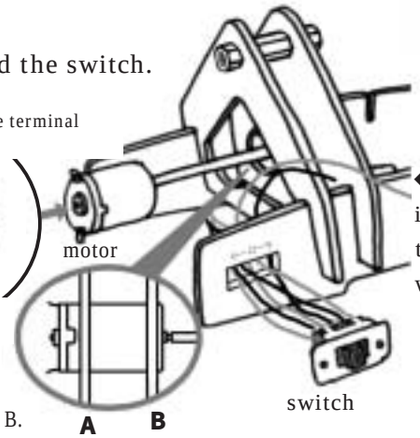
2 Attach the battery box and the long nut.



3 Install the motor and the switch.

◆Place the positive terminal downward and the negative terminal upward.



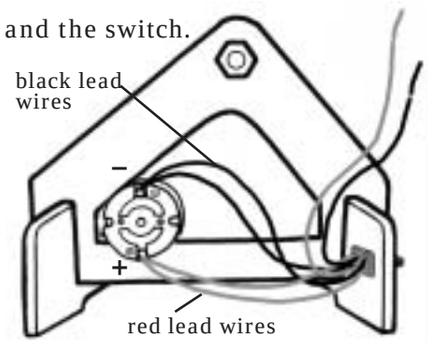


◆Push the switch into the panel D as the red long lead wire is downward.

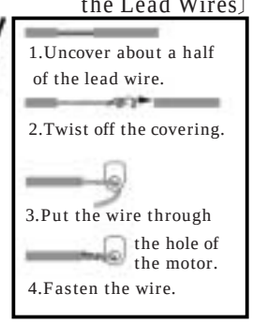
◆Insert the motor into the panel B so that its head is ahead of the panel B.

4 Wire the motor and the switch.

◆Connect the pair of black lead wires to the negative terminal (top) and the pair of red lead wires to the positive terminal (bottom).

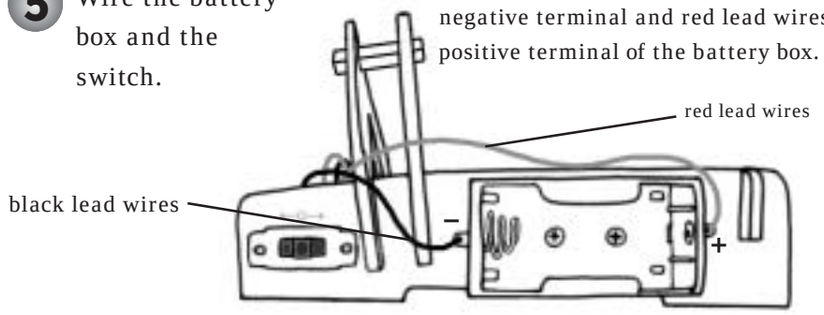


〔How to Connect the Lead Wires〕



5 Wire the battery box and the switch.

◆Connect the black lead wires to the negative terminal and red lead wires to the positive terminal of the battery box.



Check Points

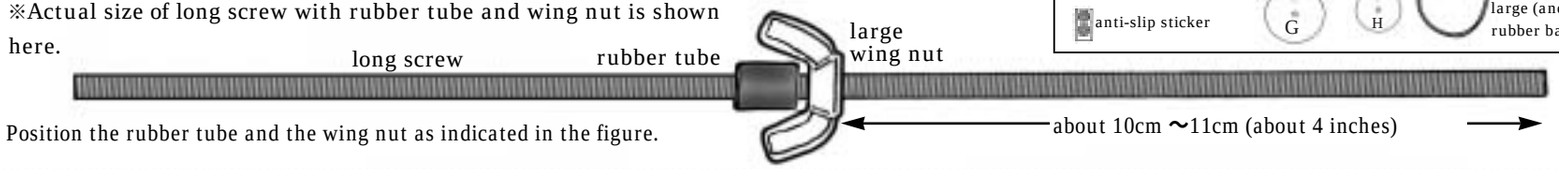
Check 1. Is your electrical wiring correct?

Check 2. Are the panels fitting well?

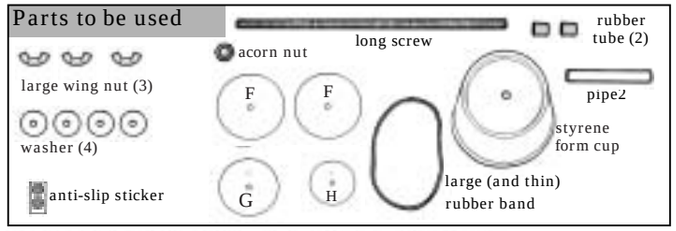
●To Assemble the Cylinder

6 Install the rubber tube and a large wing nut in the middle of the long screw like the figure below.

※Actual size of long screw with rubber tube and wing nut is shown here.

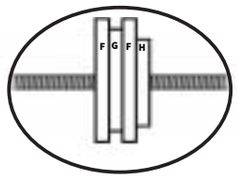


Position the rubber tube and the wing nut as indicated in the figure.



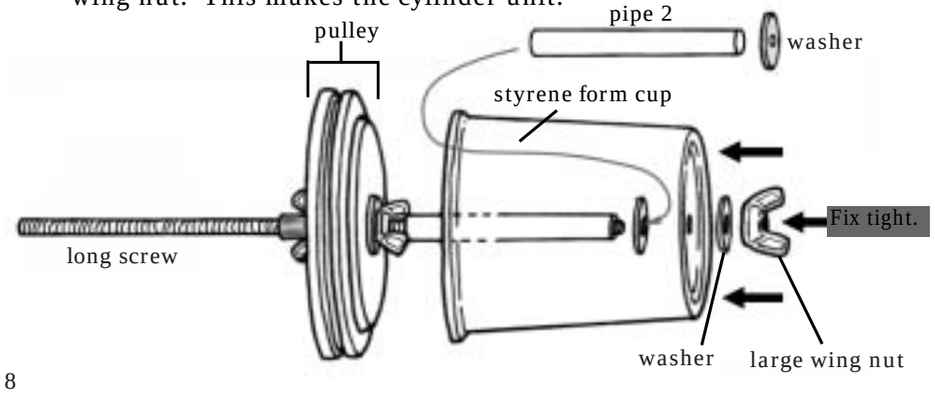
7 Put the long screw into one washer, the panel F, G, F, H in this order, and another washer. Fasten them with a large wing nut. This combination of panels makes the pulley.

◆ Note that there is a square mark on the panel G and a triangle mark on panel H.

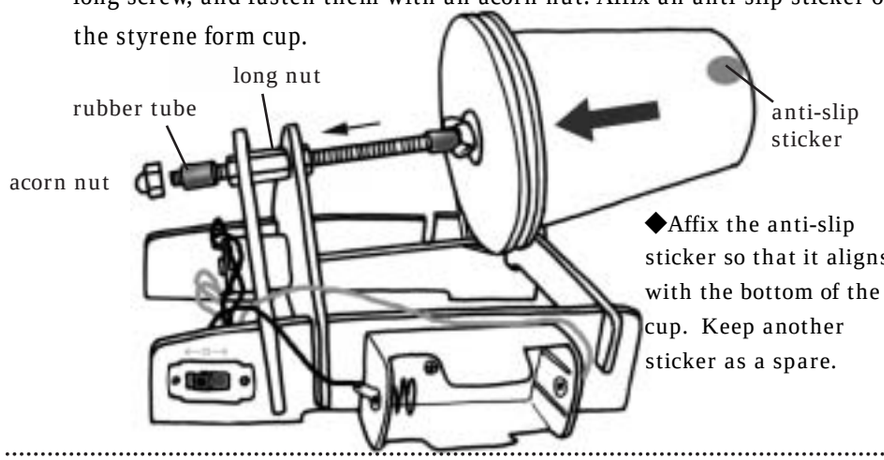


◆This is the side look of the panels.

8 Insert the long screw into the pipe 2 and a washer. Then attach the styrene form cup and another washer. Fasten them with a large wing nut. This makes the cylinder unit.

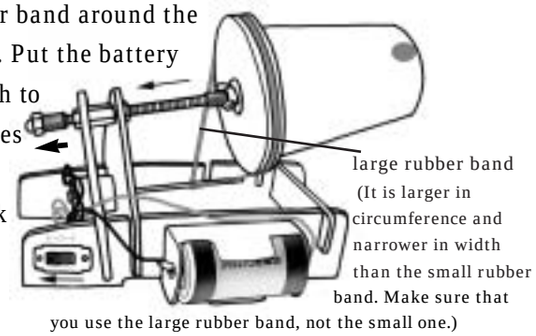


9 Twist the long screw in the long nut. Put the rubber tube at the tip of the long screw, and fasten them with an acorn nut. Affix an anti-slip sticker on the styrene form cup.



◆Affix the anti-slip sticker so that it aligns with the bottom of the cup. Keep another sticker as a spare.

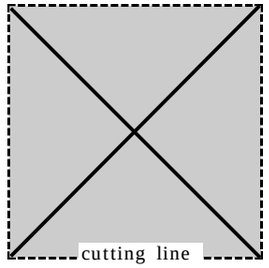
10 Hang the large (and thin) rubber band around the pulley and the shaft of the motor. Put the battery in the battery box and turn the switch to the left and check if the cylinder moves to the direction of the arrow (left). (After the check, turn the switch back to the center and stop the cylinder.)



Check Points

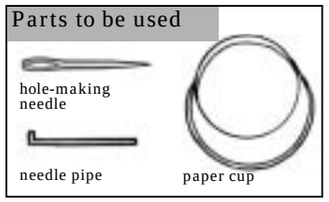
Check1. Is the pulley assembled correctly? →If the groove is too deep, the order of the panel F, G, F, H, is not right. Correct the order.

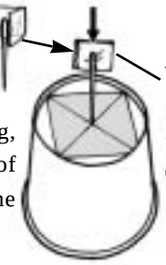
Check2. Is the large wing nut correctly positioned around the middle of the long screw correct? →Adjust the position just as the figure 6.



●To Assemble the Speaker

11 Cut the left square out of the book with scissors and place it on the bottom of the cup. Then make a hole at the center with the hole-making needle. (Keep the square paper for the check of the finished kit.)



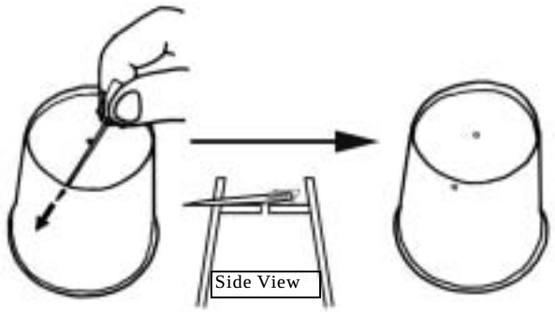


◆For easy handling, attach a piece of Scotch tape around the eye of the needle.

◆Stick the hole-making needle well enough until the half of the needle is in the cup.

12 Prick a hole with the hole-making needle at the bottom edge of the cup as the arrow indicated below. (Pay attention to the position of the hole.)

◆Stick the hole-making needle well enough until the half of the needle is stuck.

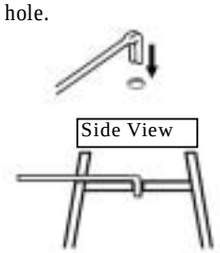


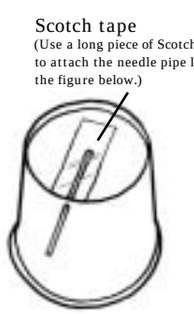
◆Make a hole as close to the bottom as possible.

13 Put the needle pipe through the hole at the bottom edge of the cup and push the L shaped part in the center hole and fasten with a piece of Scotch tape.

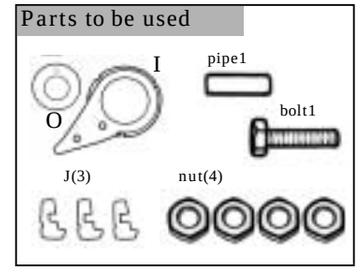
◆If it is difficult to put the L part in the hole, enlarge the hole with the hole-making needle little by little.

◆Push the L part into the hole.





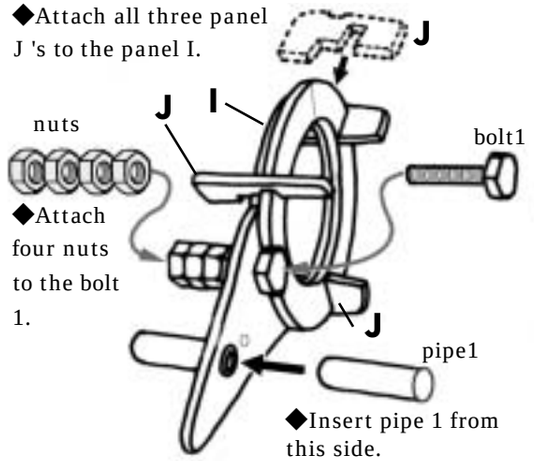
●To Assemble the Pickup



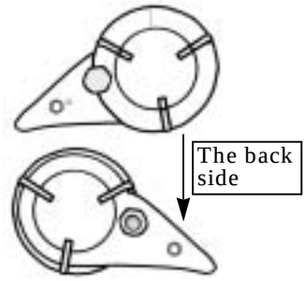
14 Attach several parts to the panel I.

◆Attach all three panel J 's to the panel I.

◆Attach four nuts to the bolt 1.

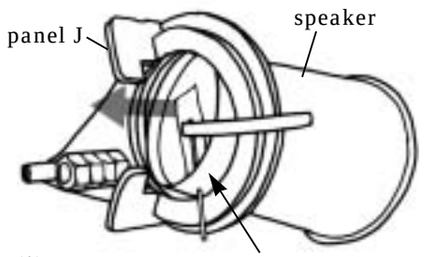


◆Insert pipe 1 from this side.

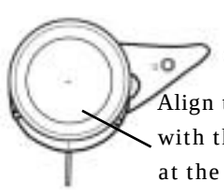


◆ This is the side view.

15 Attach the speaker to the panel I. Insert the speaker completely into the pickup until the speaker touches the panel J's.



※Push the cup in completely. Do not mind the distortion of the cup where it touches the panel I.

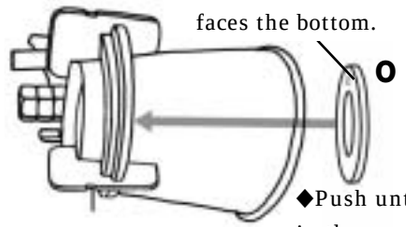


IMPORTANT

Align the needle pipe with the line marked at the back of the panel I.

16 Put the panel O into the cup.

Make sure the circle mark faces the bottom.



◆Push until it fits in the panel I.

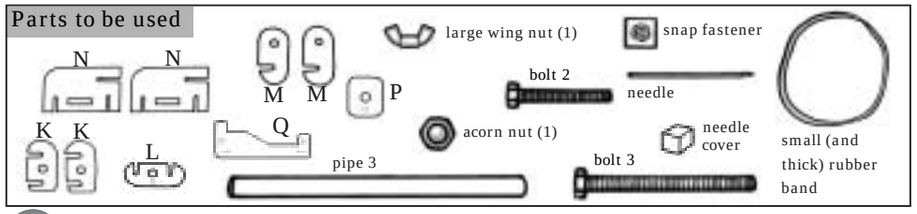
Check Points

Check1.At 13, is the L part of the needle pipe positioned at the center of the cup?→ Check with the square paper you used at 11. Fold it in half, make triangle and place it on the bottom. If the hole is obviously off the center, remove the needle pipe and make the hole again at the center.

Check2.At 13, does the needle pipe come out correctly from the side of the cup?→It is correct if the needle pipe comes out horizontally. Adjust the needle pipe if it is slant.

●To Assemble the Post

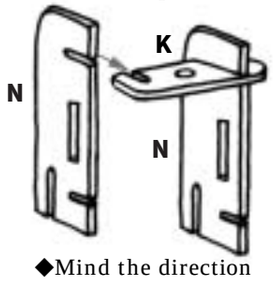
Parts to be used



17 Put the pipe 3 into the panel P about one third.

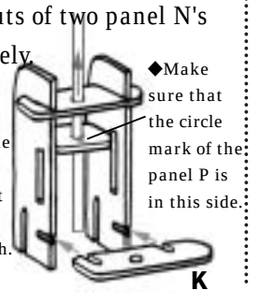
◆Make the circle mark of the panel P faces the longer side of the pipe 3.

18 Insert a panel K into the upper cuts of two panel N's.



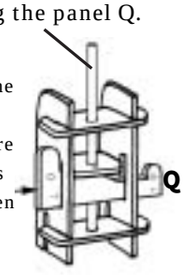
◆Mind the direction

19 Put the pipe 3 into the panel K. Then insert another panel K into the lower cuts of two panel N's completely.

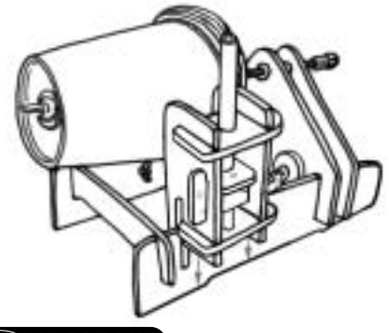


20 Insert the panel Q into the panel N's.

◆ Lift the pipe before inserting the panel Q.



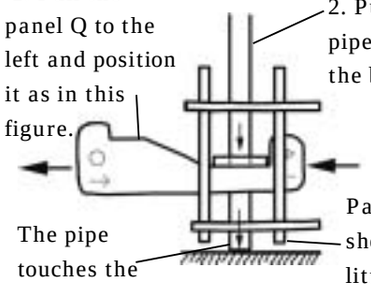
21 Attach 20 to the body.



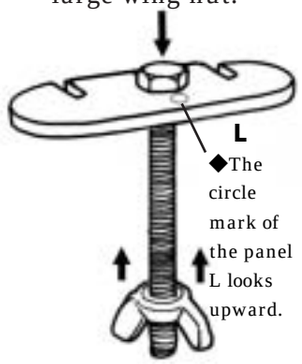
IMPORTANT

Put the post into the cuts of the body completely.

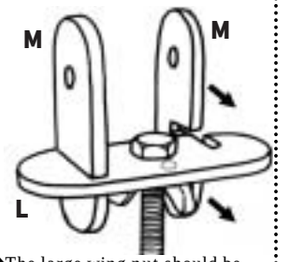
22 Slide the panel Q to the position of the figure below. Place the body on the firm base such as a table and push the pipe 3 down until it touches the base.



23 Attach the bolt 3 to the panel L and fasten with a large wing nut.

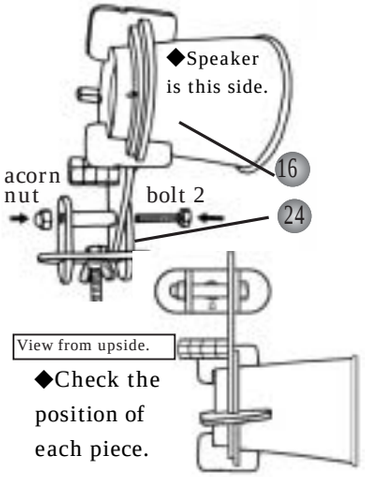


24 Put two panel M's into the panel L.



◆The large wing nut should be placed like the left figure (○) below so that it is not in the way of panel M's.

25 Fasten 16 to 24 with the bolt 2 and an acorn nut.

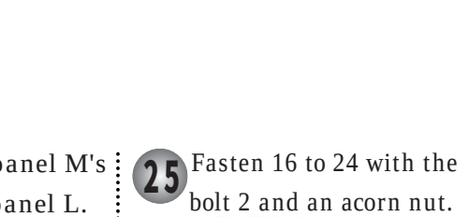


◆Check the position of each piece.

26 Attach the snap fastener to the needle. Stick the needle into the middle of the small rubber band. (Put the needle cover at the tip of the needle.) Do the same when you change a needle.

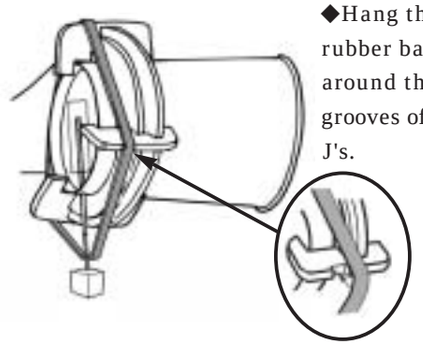
The size of a spare needle
length: 51.5mm
diameter: 0.84mm

◆Stick the needle into the middle of the small rubber band from the inside.



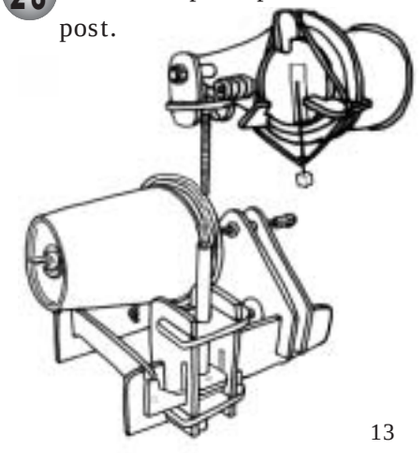
◆Remove the snap fastener from the paper and put the two parts together again. Then put the needle through the snap fastener.

27 Insert the needle into the needle pipe and hang the rubber band around the grooves of the three panel J's. The pickup unit is now completed.



◆Hang the rubber band around the grooves of panel J's.

28 Insert the pickup into the post.



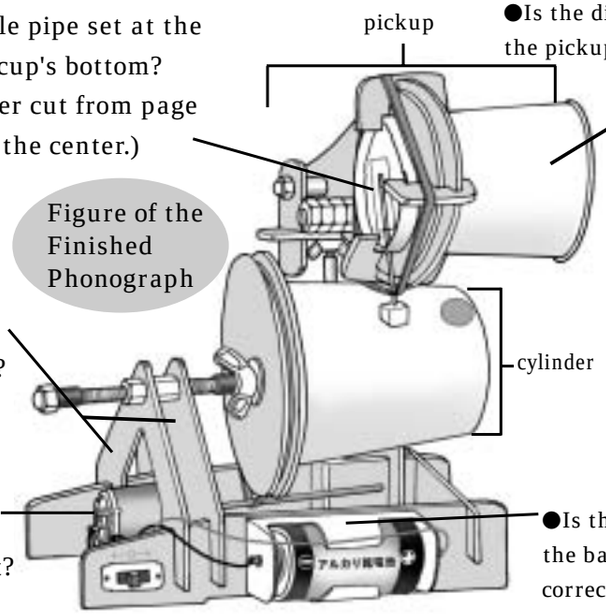
Done! Check up if your phonograph is correctly assembled.

● Is the needle pipe set at the center of the cup's bottom? (Fold the paper cut from page 10 and check the center.)

●Do the panel A and B fit in the panel C and D completely?

●Is the electrical wiring of the motor correct? (See 4)

Figure of the Finished Phonograph

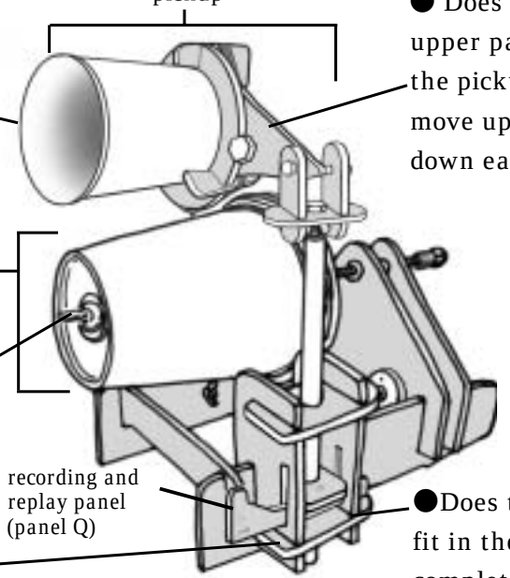


●Is the direction of the pickup correct?

●Is the speaker fastened to the pickup firmly? (If the panel J's supports the bottom of the cup well, it's OK.)

●Is the direction of the battery box correct? (See 2)

Rear View



● Is the pickup set correctly?

● Does the upper part of the pickup move up and down easily?

●Is the large wing nut at the cylinder fastened tight?

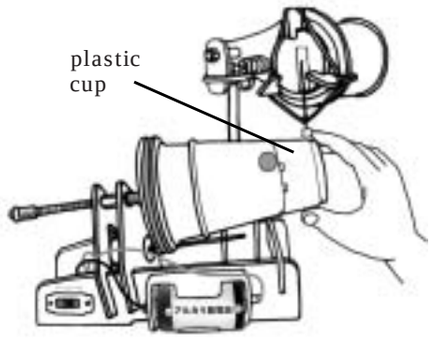
● Does the panel K fit in the panel N's completely?

●Does the post fit in the panel C completely?

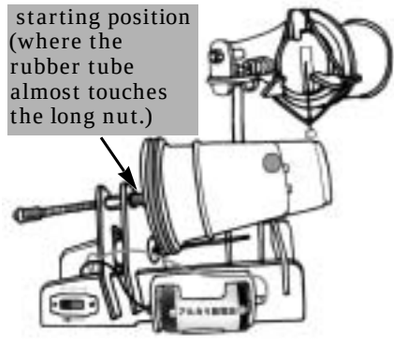
HOW TO RECORD AND REPLAY

Recording (Put the phonograph on the level.)

1 Fit the plastic cup over the styrene form cup tightly.

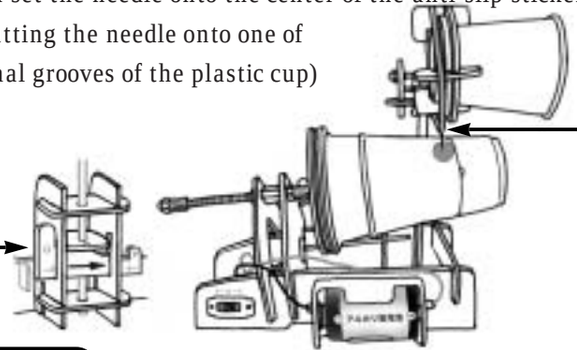


2 Turn the switch to the left (the direction of ←) and move the cylinder to the position below.



3 Set the recording and replay panel (panel Q) at the recording position (○). After checking that the cylinder is at the starting point, remove the needle cover and set the needle onto the center of the anti-slip sticker. (Avoid putting the needle onto one of the original grooves of the plastic cup)

※Set the recording and replay panel (panel Q) to the right.



Check Points Before starting recording, check the following once again.

Check1.Starting position of the cylinder→ The rubber tube should almost touch the long nut.

Check2.The position of the recording and replay panel (panel Q)→The recording (○) side should touch the post unit.

Check3.The position of the needle→The needle should be at the center of the anti-slip sticker. (but not on the original groove of the plastic cup.)

Check Points Mind the following points when recording.

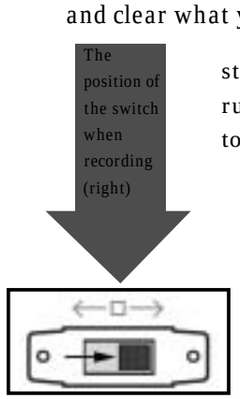
Check1.Speak loud and clear (but you don't have to shout). → The phonograph is sensitive enough to record your voice if it is clear. (You don't have to shout so loudly as to shake the pickup.) Avoid laughing because the needle may slip with the vibration.

Check2.Mind your mouth doesn't touch the speaker. → If it touches, the needle may slip.

Check3.Don't turn off the switch during the recording. →If you once turn off the switch and start recording again, the needle may make two grooves and replay may not be successful.

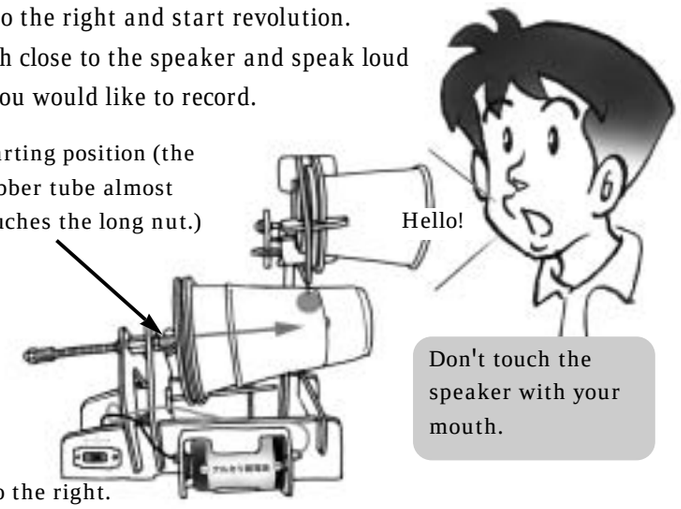
4 Turn the switch to the right and start revolution.
Bring your mouth close to the speaker and speak loud and clear what you would like to record.

The position of the switch when recording (right)



※The cylinder moves to the right.

starting position (the rubber tube almost touches the long nut.)

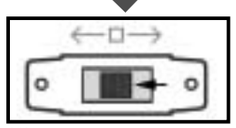


Hello!

Don't touch the speaker with your mouth.

5 When you finish recording, turn the switch back to the center and stop the motor. (The phonograph can record about 15 seconds maximum.)

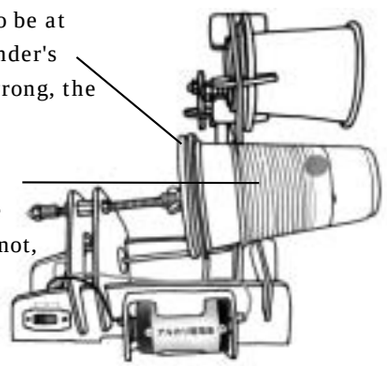
The position of the switch at the end of recording (center)



※The cylinder stops.

●The cylinder is supposed to be at this position. Check the cylinder's position. (If the position is wrong, the voice may not be recorded.)

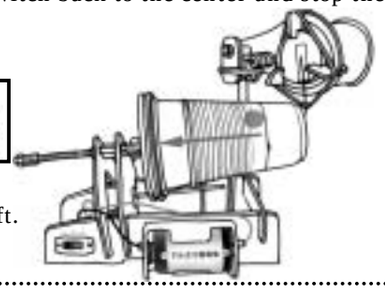
●The voice is recorded successfully if the groove goes spirally. (If it does not, the recording is unsuccessful.)



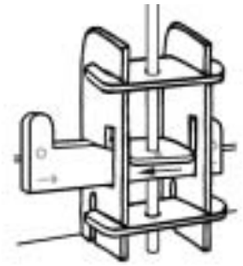
Replay (Put the phonograph on the level.)

1 Remove the pickup from the plastic cup and turn the switch to the left. After the cylinder moves to the starting position of the recording, turn the switch back to the center and stop the cylinder.

※The cylinder moves to the left.



2 Set the recording and replay panel (panel Q) to the replay position. (▷)



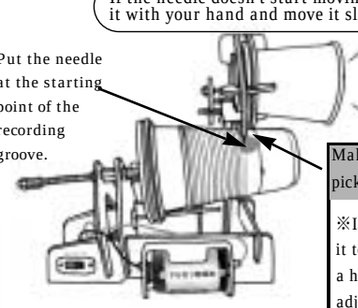
3 Put the needle on the point where the recording groove starts. When you turn the switch to the right, the plastic cup starts to revolve. The needle starts to capture the recorded sound as vibration, conveys it to the paper cup. Thus the sound is replayed as loud as ears can catch.

The position of the switch when replaying (right)

If the needle doesn't start moving, touch it with your hand and move it slightly.

Hello!

Put the needle at the starting point of the recording groove.



Make sure that the small rubber band of the pickup doesn't touch the plastic cup.

※It should be off about 2mm. If it touches, hold the panel P with a hand and lift the pipe 3 to adjust the angle of the pickup.

When you finish recording, turn the switch back to the center and stop the motor. (You can replay as many as you like by the same step. But you can't record on the same cup you once used.) Remove the battery and put the needle cover after using.

Check Points Check the points below when you replay.

Check 1. Is the position of the cylinder correct? → Check the starting position.

Check 2. Is the position where you put the needle correct? → Put the needle where the groove start.

Check 3. Is the position of the switch correct when you replay? → The switch is supposed to be right. (The cylinder is supposed to move to the right.)

Check 4. Is the recording and replay panel (panel Q) at the replay position (▷) correctly?

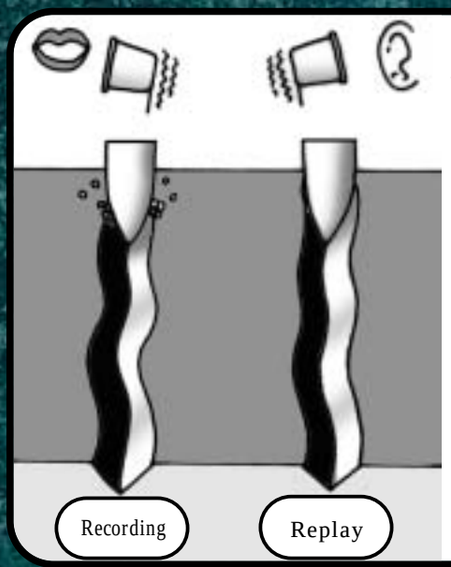
When you can't record or replay … Trouble Shooting and FAQ

●You can hear the replay sound even if you are 1 or 2 m apart when it is recorded correctly.If the sound is too small to hear, check the points below.

Check Points	How to improve the condition
①Aren't the panels combined loose?	Fasten the panels tight.
②Does pickup move easily up and down and right and left?	Loosen the bolt 2. See 25
③Is the paper cup put in the pickup at the correct angle tightly? Isn't it unstable?	Insert the cup completely. See 15
④Doesn't the needle make another groove parallel to the recorded groove when you replay?	Put the needle on the right groove if you can tell it. If you can't, try the recording again with a new plastic cup.
⑤Did you set the recording and replay panel (panel Q) in the correct position?	Check the correct position. See Recording 3 and Replay 2
⑥Is the needle pipe put into the center hole of the cup's bottom? Is it set on the panel's line?	If it is off the center or off the line wide, remove the paper cup and reset the needle pipe correctly. (You can check the center of the cup's bottom with the piece of paper you cut from page 10.) See 11 and 15

Check Points	How to improve the condition
⑦Isn't the post bent?	Combine the panels tight before the post unit is set to the body. Check if the panel K is put into the panel N 's deep enough too. See 18 19 and 21
⑧Does the pipe (pipe 3) touch the base? (Note: This is not the case if you lift the pipe and adjust the angle at page 17.)	Insert the pipe3 into the panels deep enough (unless you lift the pipe3 to adjust the angle of the pickup at page 17). Make sure that the panel K's fit in the panel N's tight. See 22
⑨Doesn't the rubber band of the pickup touch the plastic cup? (It should off the cup about 2mm.)	The length of the pipe might not be correct. See the Check Point ⑦and ⑧of this page again. Adjust the height of the pipe in the way of Replay 3 if necessary.
⑩Is the cylinder set at the starting point when you start replaying?	The cylinder should be close to the panel B at the beginning of replay, and apart from it at the end. See Recording 3 and Recording 5
⑪Does the cylinder revolve smoothly?	If the cylinder doesn't revolve, the wing nuts of the pulley may not be fastened firmly. See 7 and 8

Why can we record and replay voices?



●Your voice makes small vibration when it gets into the paper cup.
Then the vibration is conducted to the needle. The needle makes a groove on the plastic cup with waves reflecting the vibration.
●When replaying, on the contrary, the waves on the groove vibrate the needle and the vibration is conducted to the paper cup and the sound is produced from the cup.

The difference in the tones reflects the difference in the shapes of the waves.