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CAUTION!

- Be careful of handling thin and pointed metal bars 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.
- Be careful not to point your hands and eyes with the screwdriver in this kit to avoid injury.
- Be careful that your fingers are not caught in a machine while operation.
- Do not operate the doll on a road to avoid the risk of traffic accidents.
- Do not break up the mainspring. An inner spring may cause injury to persons.

When you dispose the kit, follow the regulations of each local government.

The plastic materials used in this kit:
- styrene
- polyacetal
- polyethylene terephthalate
- polystyrene
- polyethylene

* When you dispose the kit, follow the regulations of each local government.
**Parts in this Kit**

- **tension spring (small)**
- **tension spring (middle)**
- **tension spring (large)**
  - For each size, two springs are contained in this kit. One is a spare.
- **front wheel rubber**
- **front wheel connector**
- **driving wheel cover**
- **auxiliary wheel**
- **driving wheel**
- **driving wheel rubber**
- **bottom panel**
- **mainspring shaft**
- **mainspring**
- **adjuster**
- **reversal stopper A**
- **reversal stopper B**
- **rotary wheel A**
- **rotary wheel B**
- **rotary plate**
- **large wheel**

**A Variety of Screws**

- **A**: 8 pieces of 3-by-8 mm screws
- **B**: 3 pieces of 2.6-by-5 mm screws with a collar
- **C**: 5 pieces of 2.6-by-5 mm screws with a collar
- **D**: 4 pieces of 2-by-10 mm screws
- **E**: 8 pieces of 2-by-6 mm screws
- **F**: 4 pieces of 3-by-6 mm screws

*For handy usage, put screws on small trays separately.*
Let's Assemble the Cart!

**Parts to be used**
- Bottom panel
- Driving wheel
- Auxiliary wheel
- Front wheel bridge
- Front wheel bearing
- Front wheel connector
- Front wheel rubber
- Tension spring (large, middle, small)
- Looped string (large, middle, small)

**Screws to be used**
- 3 pieces of screw C's (2-by-5 mm with a collar)
- 1 piece of screw E (2-by-6 mm)

**Instructions**

1. Move the front wheel connector back and forth and make sure the front wheel turns right and left smoothly.
2. Place the bottom panel with its face down and turn the screw E just a few times at this point.
3. Hang the string attached to the tension spring (small) on the hook of the front wheel connector with tweezers.
4. Connect the front wheel bearing and the front wheel connector with the front wheel bridge and fasten with screw C's.
5. Fit the front wheel rubber around the front wheel. Put the wheel into the front wheel bearing. Front wheel bearing.
6. Put it in until it snaps.
7. Fasten the front wheel bearing to the bottom panel with a screw C.
8. At this point the front wheel connector comes off easily. Pay attention not to lose the connector.
9. When you use the tweezers it may turn white at the pivot, yet it is usable.
10. Bend the tension spring (small) with your fingers until the string reaches the hook, then hang the string on the hook.
11. However, the front wheel connector might twist reversely at the center, it is no problem.
12. Please see p.22 for the adjustment of screw E.
13. Select correct screws since all screws resemble in shape.
14. At this point the front wheel connector comes off easily. Pay attention not to lose the connector.
15. Make sure the direction of the connector is like this figure.
16. If the front wheel does not move smoothly, loosen the screw and make an adjustment.

**Note:** In this "Let's make the cart" section, only tension spring (small) is used. At this time, however, prepare all three tension springs by inserting strings to avoid mistakes, since the three parts look alike and may be mistaken. Keep these springs back in the bags when they are ready.
Set the escape wheel in the socket of the left body.

Push the escapement bridge into the left body.

Fasten the escapement bridge to the left body with screw E's from the backside.

Let's Install the Escapement!

Parts to be used

- 3 pieces of screw E's, 2-by-6 mm
- 2 piece of screw C's, 2-by-5 mm with a collar
- 4 pieces of screw F's, 3-by-6 mm

Select right screws since all screws resemble in shape.

Now the cart is completed!

You've finished the cart. Keep it as it is until you use it at p.18.

- Insert the point of the shaft in the hole at the bottom of the socket.

- At the same time, push the shaft of the escape wheel into the center hole of the escapement.

- Cover the projections on the driving wheel and the auxiliary wheel with U-shaped parts of feet.

- Fit the feet with the guides on the bottom panel.

- Push the shaft of driving wheel in shaft bearings of the bottom panel.

- Be careful not to install right foot and left foot inversely.

- Insert the point of the shaft in the hole at the bottom of the socket.

- At the same time, push the shaft of the escape wheel into the center hole of the escapement.
Pay attention to the direction of the neck joint (upper).

Attach screw B's on the chest (upper) as the figure shows. Turn them a couple of times and fasten them loose, so that a small space remains between collars of screws and the chest. Fit the projection of the neck into the groove.

Hold the chest and the neck as shown in the figure, and fasten them with screw B's.

**Let's Assemble the Chest Unit!**

**Parts to be used**
- 4 pieces of screw E's, 2-by-6 mm (2-by-6 mm)
- 1 piece of screw D, 2-by-10 mm
- 2 pieces of screw B's, 2.6-by-5 mm with a collar

**Screws to be used**
- 2 pieces of screw F's, 3-by-6 mm
- 1 piece of screw E, 2-by-10 mm
- 4 pieces of screw E', 2-by-6 mm

Select right screws carefully since all screws resemble in shape.

**Note:** Tension springs (middle and large) are going to be used. Strings have already been put through these springs at the "Let's assemble the cart!" section.

**IMPORTANT**
Pay attention to the direction of the neck joint (upper).

**The roll of the escapement**
The main components of the escapement are two cylindrical parts with pallets attached on the upper part of the shaft. The escapement controls the speed of the rotation by hanging the pallets on the wheels. The heavier are the sheet weights around the bottom parts of the shaft, the more slowly the wheel rotates, and the lighter, the faster.

Now the left body is completed!

You've finished installing the escapement to the left body. Look at the figure to make sure that the escapement is correctly attached.
Check if the neck and the neck joint (upper) move back and forth smoothly.

Turn over the lower chest and put the neck joint (lower) on the projection of the lower chest.

Put tension springs (large and middle) into frames on the chest (lower) to the end as shown in the figure.

Fasten the upper chest and the lower chest with screw E’s paying attention to the direction of each part.

Put the neck bridge in the hole of the neck joint (lower).

Hang the string of the tension spring (large) on the projection of the neck joint (upper).

Put in the upper part of the front chest first, then, fit the lower part in the groove below.

Hold the bridge softly and fit the front chest in the groove of the lower chest. Turn the screw D for adjustment just a couple of times.

Hold the neck softly and fit the front chest in the groove of the lower chest. Turn the screw D for adjustment just a couple of times.

Now the Chest Unit is Completed!

You've finished the chest unit. Look at the figure to make sure it is correctly assembled.
Let's Assemble the Motive Power Unit!

### Parts to be used
- 1 piece of screw B, 2.6-by-5 mm with a collar
- 1 piece of screw D, 2-by-10 mm
- 8 pieces of screw A's, 3-by-8 mm

### Screws to be used
- 1 piece of screw D, 2-by-10 mm
- 1 piece of screw B, 2.6-by-5 mm with a collar

#### Select right screws since all screws resemble in shape.

1. **Attach the adjuster to the rotary plate.**
   - Put the adjuster on the projection and fasten with a screw B.
   - The adjuster can move left and right to some extent by loosening the screw B.

2. **Turn over the rotary plate and attach the reversal stopper A and rotary wheel A in the right direction.**
   - Place the rotary plate with its backside (without a screw) up and put the reversal stopper A on the projection.
   - Put it on to the end.

3. **Put the mainspring shaft through the rotary plate first, then though the large wheel in the direction as shown in the figure.**

4. **Put the rubber band into the mainspring shaft to the end so that the parts don't come apart.**

5. **Attach the reversal stopper B and the rotary wheel B to the large wheel.**
   - Put the reversal stopper B on the projection of the large wheel.
   - Fit the rotor wheel B in the center hole of the large wheel.
   - Make sure that the rotary wheel B turns in the only one direction clattering.

6. **Attach the adjuster to the rotary plate.**
   - Put the adjuster on the projection and fasten with a screw B.

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### Screws to be used
- 8 pieces of screw A's, 3-by-8 mm
- 1 piece of screw B, 2.6-by-5 mm with a collar
- 1 piece of screw D, 2-by-10 mm

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### Parts to be used
- Large wheel
- Rotary plate
- Rubber band
- Reversal stopper
- Rotary wheel
- Mainspring shaft
Insert the mainspring shaft into the center hole of the mainspring, while holding up the neck joint (lower) so that it isn’t in the way.

Fasten a screw D for adjustment to the arm shaft loose. Then, put the arm shaft through the front chest till the tip comes out from the hole of the right body.

Attach the mainspring to the right body in the direction like the figure below.

Attach the chest unit finished at p.13 to the right body.

Fasten the chest unit to the right body with screw A’s.

Fasten the mainspring to the right body with screw A’s.

These two screw A’s have to be fastened firmly, not temporarily.

Put four projections of the chest unit in the holes of the right body.

Fasten these two screw A’s a little bit loose and leave a room to screw firmly as a finishing.

Fasten the mainspring to the right body with screw A’s.

Fasten a screw D for adjustment to the arm shaft loose. Then, put the arm shaft through the front chest till the tip comes out from the hole of the right body.

Screw just four or five times to fasten loose.

Put your finger through the front chest and push the neck bridge to raise the neck joint (lower).

See p.22 for the adjustment of the screw.

After the mainspring shaft was put in, the neck joint (lower) goes between the rotary plate and the large wheel as shown in the figure.
Let's Install Other Parts!

**Parts to be used**
- head
- shoulder unit
- auto-adjustment pin

**Screws to be used**
- 2 pieces of screw D’s (2-by-10 mm)

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1. **Snap!**
   - Attach the left body to the chest unit.
   - Place the body unit you assembled above on the cart you've finished on page 8.
   - Put four projections of the chest unit in the holes of the left body.

2. **Fasten the right body and the left body with screw A’s from the backside of the cart.**

3. **Fasten these two screw A’s a little bit loose at this point.**
   - Make sure there is no distortion all over, then fasten screw A’s (not only the two screw A’s fastened now but also screw A’s fastened loose at 9 and 12) again firmly.

4. **Bend the tension spring (middle) with your fingers until the string reaches the hook, then hang the string on the hook with tweezers.**

5. **Install the auto-adjustment pin.**
   - Put the point of the pin in the hole of the escapement bridge first, and then snap it to fit in the groove between the arm shaft and the lower chest.

6. **Hang the string of the tension spring (middle) on the hook of the arm shaft.**

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**Install the auto-adjustment pin.**
- Put the point of the pin in the hole of the escapement bridge first, and then snap it to fit in the groove between the arm shaft and the lower chest.

**Attach the right and the left arms to the arm shaft and fasten with screw D’s.**

**Put four projections of the chest unit in the holes of the left body.**

**Put six projections of the left body and the right body in the holes of the cart firmly.**

**The projection of the mainspring comes to the front.**

**Thrust the tips of the arm shaft and the mainspring shaft out of the hole of the left body.**

**Bend the tension spring (middle) with your fingers until the string reaches the hook, then hang the string on the hook with tweezers.**

**Put four projections of the chest unit in the holes of the left body.**

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**Fasten the right body and the left body with screw A’s from the backside of the cart.**

**Fasten the right body and the left body with screw A’s from the backside of the cart.**

**Fasten these two screw A’s a little bit loose at this point.**

**Fasten these two screw A’s a little bit loose at this point.**

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**Insert the head into the neck and insert the both arms into the tray. Now you've done!**
After the doll goes straight for a while, it makes a bow. Then, take the teacup and the doll stops. After the turn, it goes straight. When the doll gets back to the starting point, take the teacup and the doll stops.

When you put the teacup on the tray, the doll starts moving. First, it goes straight. Do not fill the cup with tea during the test so that the tea might not be spilled.

Let's Do the Test Run

1. Set the doll on the flat place and wind up the mainspring with the winding knob.
2. When you put the teacup on the tray, the doll starts moving again. Then, it makes a turn.
3. Return the teacup on the tray and the doll starts moving again. Then, it makes a turn.
4. After the turn, it goes straight. When the doll gets back to the starting point, take the teacup and the doll stops.

* When you don't use the doll for a long time*

1. Be sure to take off the teacup from the tray, otherwise the tension spring might deteriorate and become useless.
2. Be sure to leave the mainspring unwound. Loosen it completely. It might become out of order, if it is left wound for a long time.
Make Fine Adjustments to each part

1. The angle of the neck
   Adjust the screw at the chest. The screw at the front chest is to adjust the neck angle. Turn it clockwise or counterclockwise to adjust.

2. The angle of the tray
   Adjust the screw at the arm shaft. Adjust the angle of the tray so that it becomes level when you put on the teacup.

3. Course
   Adjust the screw at the bottom panel. Adjust the doll so that it goes straightforward. (If you don’t make this adjustment, the doll tends to go rightward.) When the doll doesn’t go straight, adjust this screw.

4. The angle of the turn
   Move the adjuster at the rotary plate. Loosen the screw before you move the adjuster. Adjust the angle of the turn. Look at the consecutive action of the doll and adjust so that it makes good turn.

The screw at the front chest is to adjust the neck angle. Turn it clockwise or counterclockwise to adjust.

When you turn the screw clockwise, the doll looks downward. When you turn the screw counterclockwise, the doll looks upward.

Adjust the angle of the tray so that it becomes level when you put on the teacup.

When you turn the screw clockwise, the arms go up. When you turn the screw counterclockwise, the arms go down.

Adjust the doll so that it goes straightforward. (If you don’t make this adjustment, the doll tends to go rightward.) When the doll doesn’t go straight, adjust this screw.

Before your performance in front of guests, test a couple of times and grasp how each part works, how long the doll moves and how it turns. Then make fine adjustments to each action as follows if necessary.

Check the Move of the Doll

If the doll moves as follows, you’ve made good adjustments. Check it now!

Wind up the mainspring. Put the teacup on the tray. Then, the arm goes down, the auto-adjustment pin becomes off and the doll starts moving. First, the doll goes straightforward.

When you make a turn, the doll goes straight. Now the doll repeats the same move as actually.

When the doll comes back, pick up the teacup. Then, the doll stops. This is the end of a series of moves.

These are the three basic moves of the doll.
1. The doll starts moving when the teacup is put on the tray and stops when the teacup is taken.
2. The doll goes straight about a fixed distance (90 cm at the longest).
3. The doll turns after it makes a bow.
**Make the Final Adjustment Before your Performance**

When you finish the adjustments on p.22, make the final adjustment before you show the doll to your guest. (This adjustment is possible after the doll is dressed. In that case, pull the hakama up.)

- **Align the collars of both tops.**
- **Parts to be used**
  - hakama skirt
  - parts side adhesive tape
  - kimono top 1
  - kimono top 2
  - chanchanko vest

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**How to Dress the Doll**

**Before you start dressing**

Put on guards (upper and lower) beforehand so that the dress is not caught in wheels.

- **Dress the kimono tops.**
  1. Cut a both side adhesive tape into 10cm. Put it on the inside of the back margin of the kimono top 1 (the left side when you face it).
  2. Put each arm through sleeves of the kimono top 1 and the 2. Peel the thin paper from the adhesive tape and paste the both sides of kimono tops together at the back.
- **Dress the hakama skirt.**
  1. Unfold the hakama skirt and put through the doll from the bottom. Bring the front laces back and tie them at the back. (The laces at the height as shown in the figure below. Adjust the skirt so that the insteps come out a little bit.)
  2. Bring the back laces to the front and tie them at the front. (Cover the back knot with the hakama skirt. Make the back part higher and the front part lower.)
- **Dress the chanchanko vest.**
  1. Take off the head and dress the chanchanko vest. (Tie the front laces.)
  2. Attach the tray. Be careful that the front laces do not touch the tray.

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**Wind up the mainspring.**

When you wind up the mainspring, the adjuster at the rotary plate comes to the position shown in the figure below. Turn the rotary plate clockwise and change the position to suite the distance between you and the guest. (The more you turn, the less the distance becomes. Take a look at the figure below and adjust the distance.)

- Be sure to turn the rotary plate always clockwise.

- If the mainspring is wound, the adjuster comes to this position. The doll goes straight about 90 cm (the longest). If you set the doll in motion in this condition.

- When the adjuster is at this position, the doll goes straight about 45 cm.

- Note: Keep the screw of the adjuster as it is. (Do not lose it and change the position of the adjuster itself.)

- If the doll doesn't move successfully after all adjustments, check the following points.
  - The doll starts right after you wind up the mainspring without putting the teacup on the tray.
  - The tension spring (middle) might not be working well. Knot the string twice and make the loop smaller or change the tension spring (middle) with a spare.
  - The doll doesn't go back and tie them at the back. (The laces at the height as shown in the figure below. Adjust the skirt so that the insteps come out a little bit.)

- The doll bows from the beginning. The tension spring (large) might not be working well. Knot the string twice and make the loop smaller or change the tension spring (large) with a spare.

- The doll doesn't make a bow at all. If the doll is dressed already and if it is too tight around the neck, the doll can't bow. In this case, loosen the Kimono a little so that the doll can move the neck.

- The doll doesn't go back and tie them at the back. (The laces at the height as shown in the figure below. Adjust the skirt so that the insteps come out a little bit.)

- The tension spring (small) might not be working well. Knot the string twice and make the loop smaller or change the tension spring (small) with a spare.

- The doll doesn't go back and tie them at the back. (The laces at the height as shown in the figure below. Adjust the skirt so that the insteps come out a little bit.)

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- The doll doesn't go back and tie them at the back. (The laces at the height as shown in the figure below. Adjust the skirt so that the insteps come out a little bit.)
Mechanisms of the Karakuri Mechanical Doll

What mechanisms make this doll move?

This karakuri doll is basically modeled after the mechanisms described in the “Karakuri Zui”. The very best technologies of the Edo period (1603–1867) are applied to the mechanisms of the doll.

The mechanism of a start and a stop

What takes on the switching system for a start and a stop is the auto-adjustment pin connected with the arms. (The in the figure of the “Karakuri Zui”.) When you put the teacup on the tray, the arms go down and the pin goes up. This pin plays the role of the stopper for the cogwheel. When the pin goes up, the stopper becomes off and the cogwheel starts turning. When you take the teacup, the arms go up and the stopper works and the cogwheel stops.

The mechanism of going straight

When the mainspring loosens, it generates power. This power first effects on the No.1 wheel. This wheel has 80 cogs. The power is transmitted to the No.2 wheel, and it has 12 cogs. Based on the calculation, the No.2 wheel turns about 7 times while No.1 wheel turns once. After 5 turns, however, the projection at the rotary plate begins to push the front wheel. The doll moves about 18 cm while the No.2 wheel turns once; so it goes straight about 80 cm long before the projection catches the front wheel (and the doll begins to turn). For the mainspring, the “Karakuri Zui” specifies that a whale fin should be used.

The mechanism of a turn

What takes on a turn is the little wheel at the bottom. The angle of the wheel decides the course of the doll just like the front wheel of a tricycle determines its route. The angle of the wheel changes by being pushed by the rotary plate. The doll continues to turn right while the wheel is pushed. When the front wheel connector gets off the projection, the wheel goes back to the former position and the doll goes straight. You can control the angle of the turn by adjusting the projection.

The mechanism of adjusting the speed

What controls the speed is a cogwheel at the back part called “gyojirin”. (See the picture.) Being caught in the cogwheel, the two stoppers at the escapement controls the rotation. The technology used for the escapement of a Japanese clock is applied to this mechanism. The sheet weights around the speed control bar have made the finer speed control possible.

The mechanism of a bow

This doll makes a bow politely when it brings a cup of tea to the guest. What a charming action it is! The part that controls this action is the rotary plate. When the projection catches the part extended from the neck, the front of the neck is pulled and the head goes down. When the projection gets out of the place, the neck is released and the head goes back to the former position. Since the rotary plate also controls the front wheel, the doll always makes a bow before it makes a turn coordinately.

The mechanism of the shuffle walk

While the doll is moving, its feet move back and forth. It looks as if the doll conforms to the manners of the tea ceremony and shuffles forward. This unique walk style is realized by the crane movement made by the pivots controlling the move of each foot, since their shafts are not aligned with the center of the driving wheels. The “Karakuri Zui” instructs that the left pivot should be attached forward and right pivot backward.

References: