
BYE!
See you tomorrow!!
Let's go home~
SIGNAL 3: The Kohaku-Machine


And we still haven't found the new member we need for the restoration...
SIIIGH
It's already been a week since then...
LET'S RESTORE IT!!
レストア!!
しましょっ!!

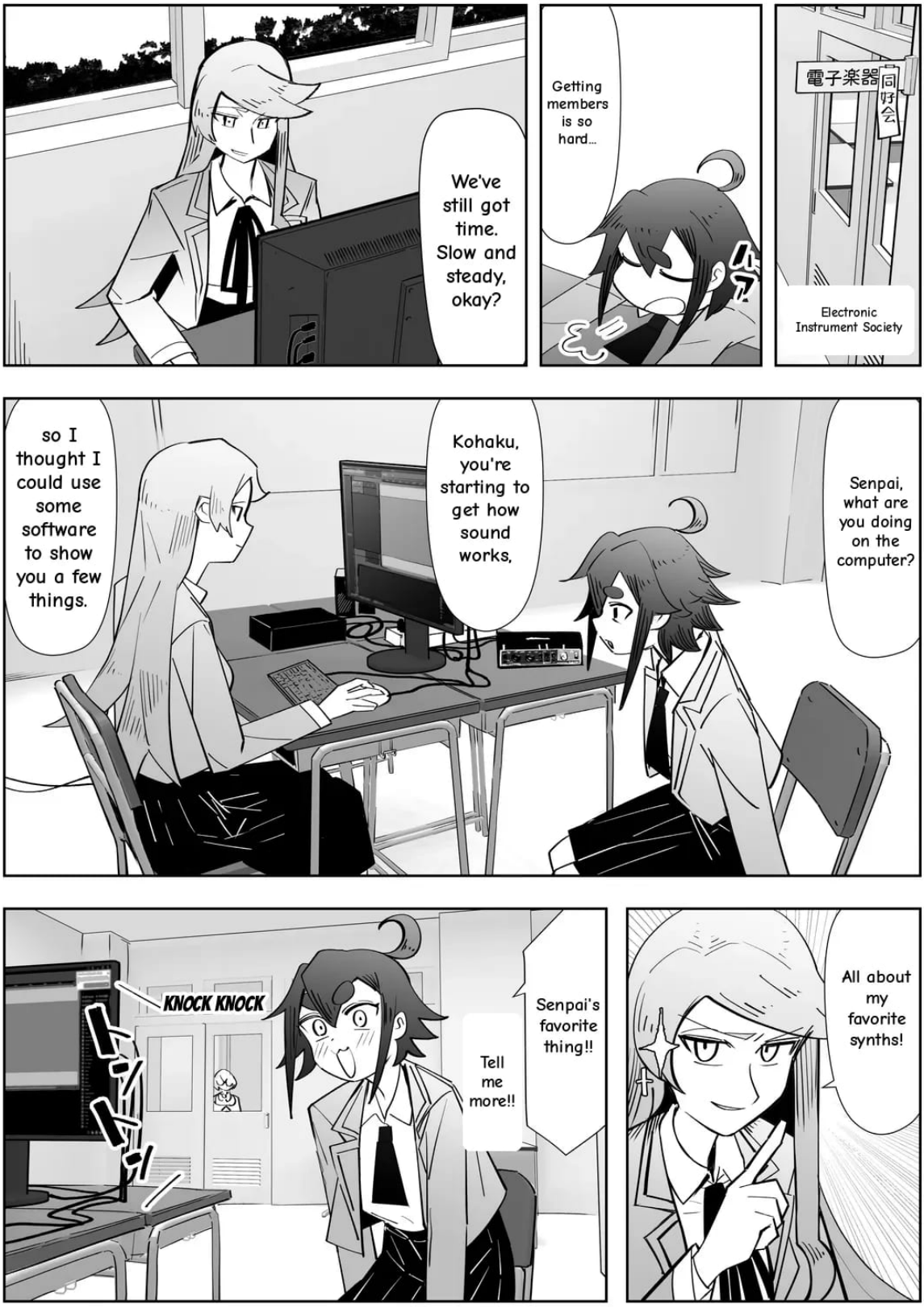

What?
I'm already in another club.
Never mind...
Um... about the Electronic Instrument Society...
Want to join the Electronic Instrument Society!?
Not interested.
I tried asking all kinds of people, but...
Nobody seemed like they would join the Electronic Instrument Society...


Hey, have you all picked a club yet?
There's nobody that convenient, huh...
ふぅ
The restoration needs someone who can do electronics, but...


I'm going with basket-ball~
And you, There-min?
Me? I totally forgot about clubs.
I like eating, so maybe the cooking club...
LOL
The cooking club isn't about eating!
Really? Then maybe the electronics club?
I like that stuff~
Sounds kinda stiff~
What's electronics DIY?
That's so not you, Theremin.
Teru Kikumoto (1st year)
You're so soft and fluffy, Theremin!
Why not be a gravure idol?
You think so...?
Totally~
THERE SHE IS!!

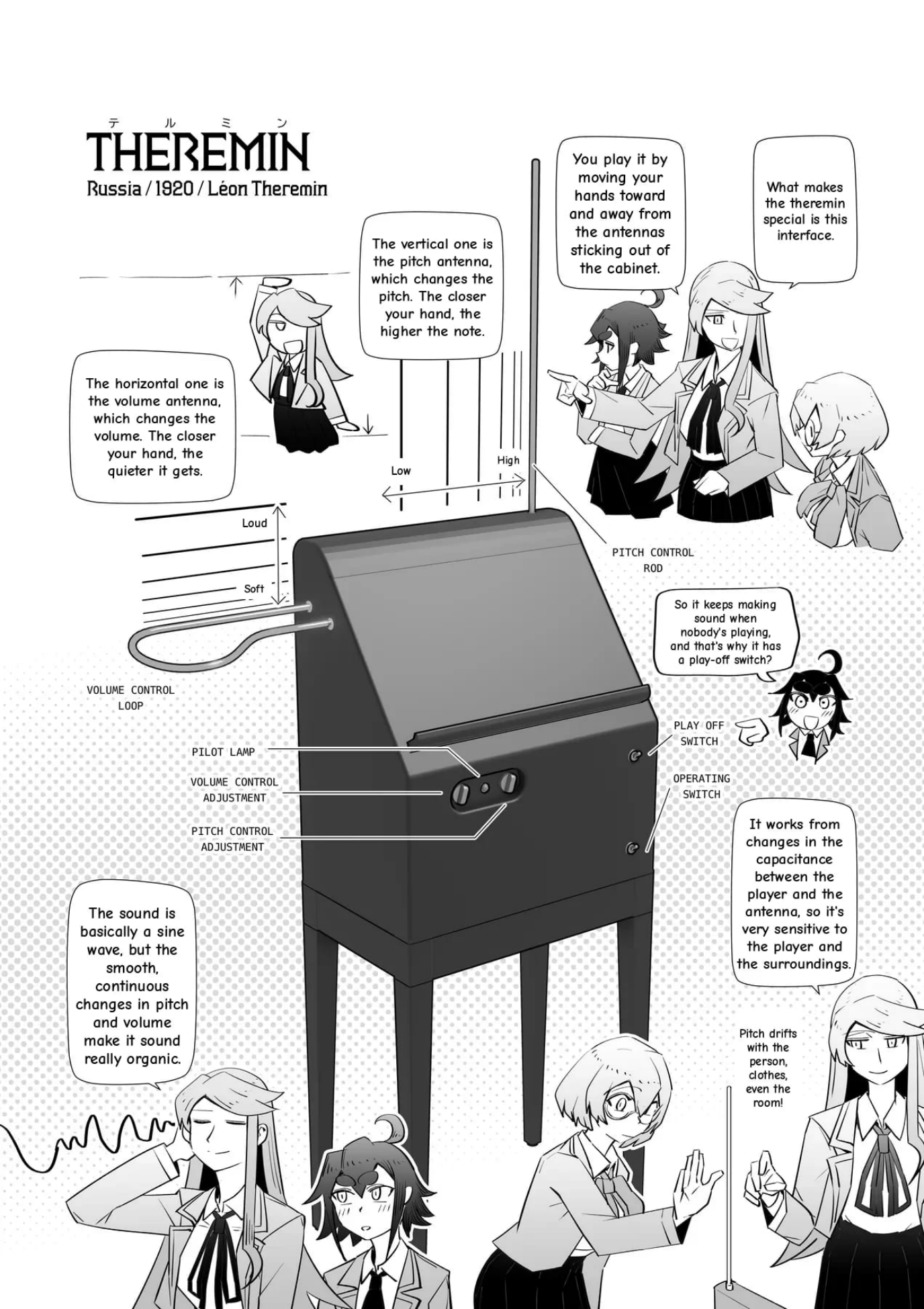

Mitsueda?
Kikumoto!
HEEEY!
おーい
PAT PAT
ぱんぱん
About clubs! If you can't decide, why not join my society?
Why me?
We've barely even talked, right?
I've been looking for someone who can do electronics.
...I do like electronics, but...
Which society are you in, Mitsueda?
Huh?
Ugh... a whole week of trauma...
E... Electronic...
in-STEW...
...ments...
Stew?
Miso dengaku
STEW!?
!?
Oden
TRUDGE...
トボトボ...
If you change your mind, come by the club room!
But...
I see...
Sorry~
UGH
Sorry, I'm thinking of trying the electronics club.
GASP


But what does stew have to do with electronics?
That was sudden, but it's the first time anyone's ever counted on me for electronics.
フッ
Excuse me~ Is this the electronics club?
I'm a first-year. I came to look around.
It is, but I haven't seen you around?
Oh! Welcome to the electronics club!
Done this before?
Basic electronic circuits, and simple micro-controller stuff.
HEH HEH...
NO FOOD OR DRINK!
I wanted to snack while I worked...
SHOCK
STARE
NO FOOD OR DRINK
HUH?
Ah, not your thing after all?
Ooh, nice! But sorry, even if you join, you might be stuck machining parts for a while... Our main thing is building robots, and we're short on people for the mechanical side.


We've still got time. Slow and steady, okay?
Getting members is so hard...
ハア…
電子楽器同好会
Electronic Instrument Society
so I thought I could use some software to show you a few things.
Kohaku, you're starting to get how sound works,
Senpai, what are you doing on the computer?
KNOCK KNOCK
Tell me more!!
Senpai's favorite thing!!
All about my favorite synths!


You came!
Long story...
Huh? Kikumoto!?
Um~ excuse me...
SLIDE
ガラガラ
So, where's the stew?
There-min!
Ooh...
Oh, right! Mitsueda, you can just call me Theremin.
Stew?
WHOOSH
NONE!!
Not here either!!
Then... my stew...
It's the Electronic Instrument Society.
Huh? This isn't the Stew Society?
Senpai, help me stop her!!
What are you doing!?
RUSTLE...
W-w-wait a sec, Theremin!
TUG TUG
Guess I'll go home.
SIIIGH


Found it!
ふー
It's a theremin!
Me?
Yep. An electronic instrument with the same name: the theremin.
TA-DA
ドンッ
Whoa~~
Doesn't look like an instrument at all.
Okay...
If you have time, want to hear a bit about it?
Not being tied to keys, strings or drumheads, and creating with any interface you like: that's part of the charm of electronic instruments.

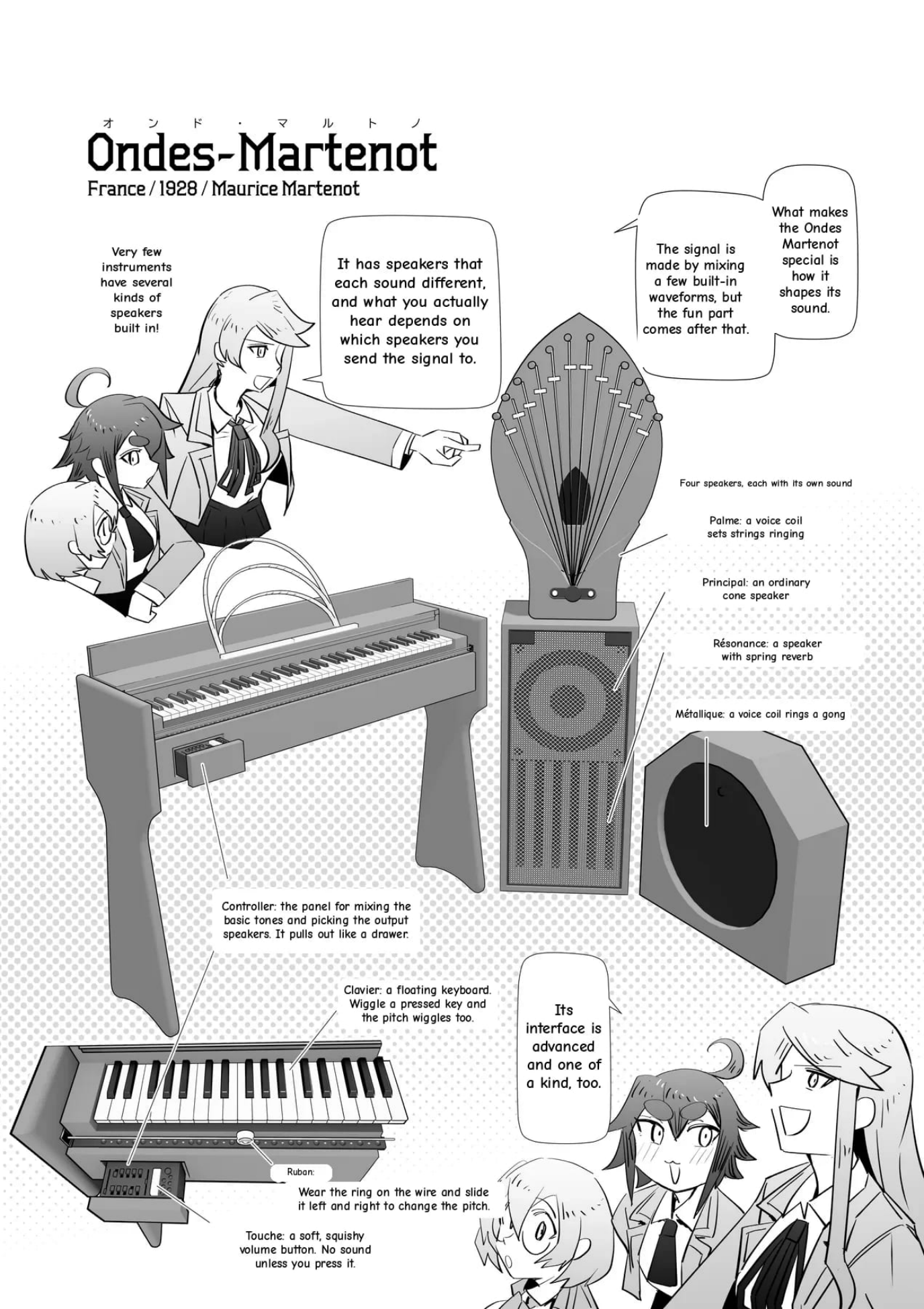

テルミン
THEREMIN
Russia / 1920 / Léon Theremin
The horizontal one is the volume antenna, which changes the volume. The closer your hand, the quieter it gets.
The vertical one is the pitch antenna, which changes the pitch. The closer your hand, the higher the note.
You play it by moving your hands toward and away from the antennas sticking out of the cabinet.
What makes the theremin special is this interface.
Loud
Soft
Low
High
PITCH CONTROL ROD
VOLUME CONTROL LOOP
So it keeps making sound when nobody's playing, and that's why it has a play-off switch?
PLAY OFF SWITCH
PILOT LAMP
VOLUME CONTROL ADJUSTMENT
PITCH CONTROL ADJUSTMENT
OPERATING SWITCH
It works from changes in the capacitance between the player and the antenna, so it's very sensitive to the player and the surroundings.
The sound is basically a sine wave, but the smooth, continuous changes in pitch and volume make it sound really organic.
Pitch drifts with the person, clothes, even the room!

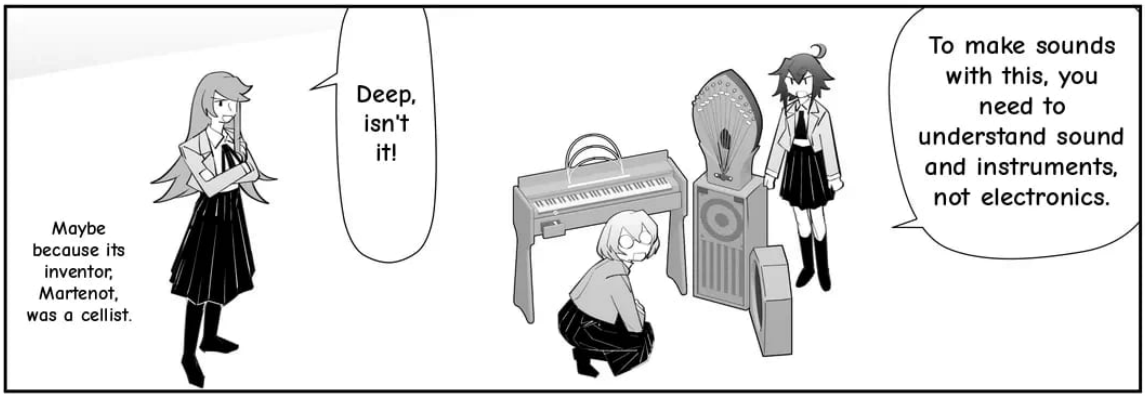

Inside, it's LC oscillators and heterodyning? Like an old radio.
Wow! You can tell!?
OOH
Here's the schematic and the service manual.
HMM
We're planning to restore the electronic instruments in here.
Think you could fix the theremin?
Sure. It's simpler than I expected.
It just puts out a sine wave at a variable frequency, right?
Ooh!!
BEAM
Kikumoto, Kohaku...
A simple circuit doesn't mean a simple instrument, you know?
HUP
Some instruments make sound on a similar principle but are totally different in how they shape it.
It's the Ondes Martenot!
THUNK
HEH HEH
HMPH

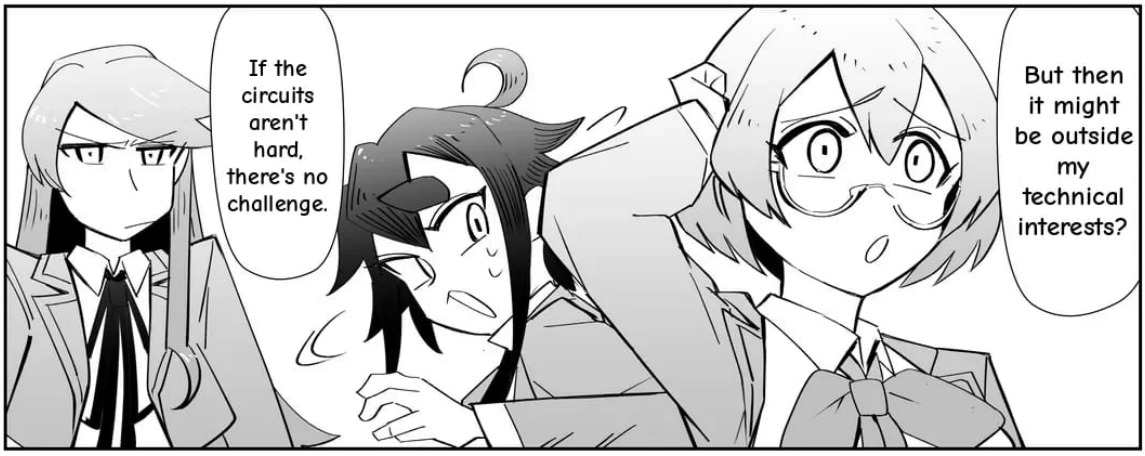
Ondes-Martenot

オンド・マルトノ

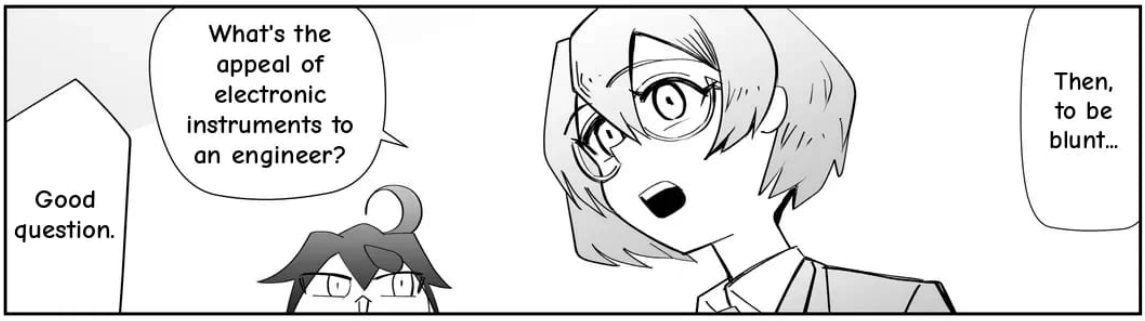
France / 1928 / Maurice Martenot

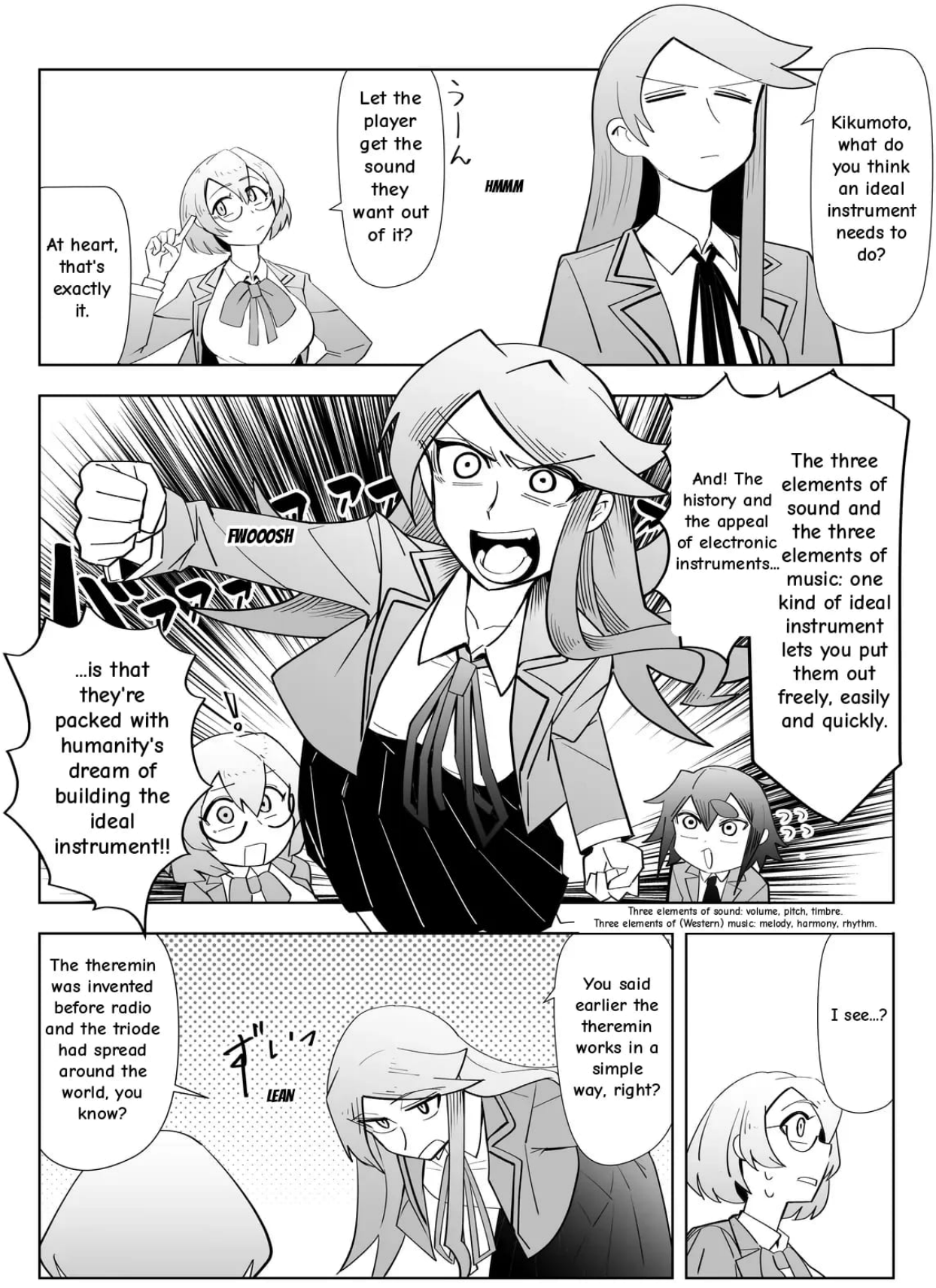



To make sounds with this, you need to understand sound and instruments, not electronics.
Deep, isn't it!
Maybe because its inventor, Martenot, was a cellist.

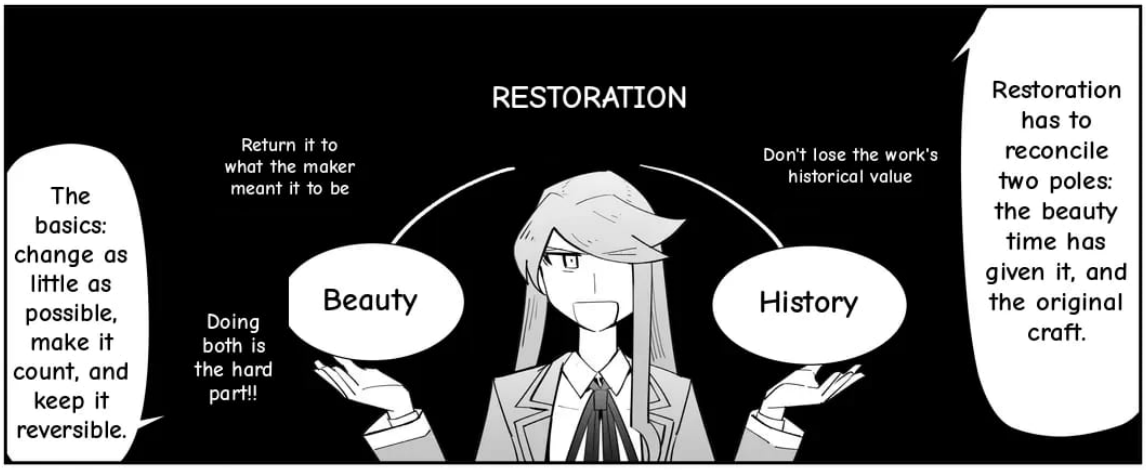

But then it might be outside my technical interests?
If the circuits aren't hard, there's no challenge.


I don't think tricky circuits are the only kind of skill, though?
That's right! There's so much you don't know yet. It's fun!

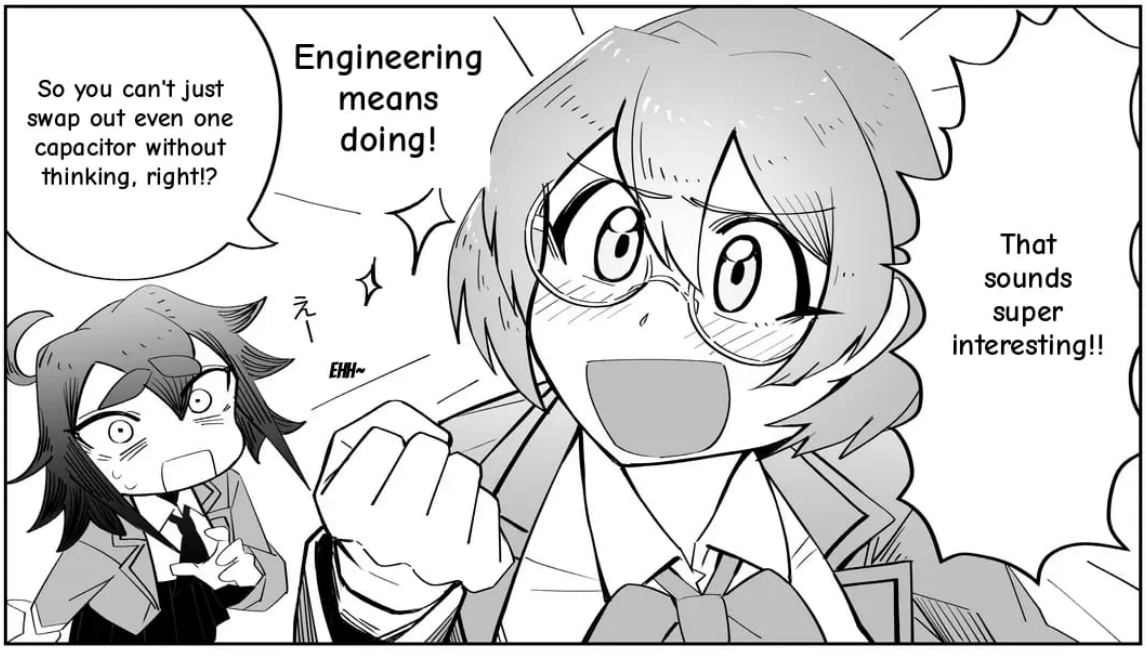

Then, to be blunt...
What's the appeal of electronic instruments to an engineer?
Good question.


Kikumoto, what do you think an ideal instrument needs to do?
うーん
HMMM
Let the player get the sound they want out of it?
At heart, that's exactly it.
The three elements of sound and the three elements of music: one kind of ideal instrument lets you put them out freely, easily and quickly.
And! The history and the appeal of electronic instruments...
FWOOOSH
...is that they're packed with humanity's dream of building the ideal instrument!!
Three elements of sound: volume, pitch, timbre.
Three elements of (Western) music: melody, harmony, rhythm.
You said earlier the theremin works in a simple way, right?
ぎぃ～
LEAN
The theremin was invented before radio and the triode had spread around the world, you know?
I see...?


Electronic instruments are built with the electronics of their time, always aiming at the ideal instrument.
Get it? The theremin was the cutting-edge technology of its day.
You know how far electronics has come in the last 100 years.
Just think how things evolved from what you called simple...
Aren't you curious?
You're taking restoration way too lightly!
Senpai!? Let's all calm down!
She'll get away!
Restoring a vintage electronic instrument is just like restoring a work of art.
And also...
Still more
!?


RESTORATION
Return it to what the maker meant it to be
Don't lose the work's historical value
Beauty
History
The basics: change as little as possible, make it count, and keep it reversible.
Doing both is the hard part!!
Restoration has to reconcile two poles: the beauty time has given it, and the original craft.


Yes!!
Don't overthink it!
Senpai, come on!
So restoring an electronic instrument takes electronics, ergonomics, acoustics, music, the history of technology, and analyzing the instrument's appeal and historical value...?


So you can't just swap out even one capacitor without thinking, right!?
Engineering means doing!
That sounds super interesting!!
EHH~


Mm-hmm!
Senpai! Teach me lots more!
Uh, sure.
Are we allowed to eat in here?
YES!!
Oh, Kohaku!
The Electronic Instrument Society!!
I'm joining!
Feeling left out...
アレ
HUH?
Paper soaked in oil, rolled up with foil and sealed airtight! The oil can't dry out, so they last almost forever.
What's an oil capacitor? Never used one.
First, don't swap out capacitors on a whim. They're the parts that fail most in electronics, but the 1929 RCA Theremin uses oil capacitors, which hold up really well.
Senpai, first thing: what do I watch out for restoring the theremin?


Hello!
Look, Kohaku! I finally got an M8!
Something about it bugs me...
I'm glad Theremin joined, but she got close to Senpai way too fast.
The next day
Ah!
Huh?
Ta-da! Kinako mochi!
ポロッ
SLIP
Let's snack while we work!
Some-thing good?
I brought something good today!
Whoops, my bad.
DWOOOOOONG
私のM8がああああ
MY M8!!!
No powdery food allowed!
HA HA HA
POINT
Senpai!?
Aww... no~
We restore things here! This isn't a restaurant!!
TO NEXT SIGNAL