RCA CED VIDEODISC WORKSHOP
JUNE 26th 2021
Indianapolis, IN

Welcome

Welcome to the 2021 CED Workshop.

Meet our Workshop Team

Josh Gibson

Ryan Garner

John Stevens

Introduction

Thank you all for coming.
Here is what we will do today.

- Learn what the RCA Videodisc system is and how it works.
- Learn what a RCA Videodisc is and how it works.
- Learn the history of the RCA Videodisc system.
- Learn about RCA Videodisc players.
- Learn how to repair and maintain those players.
- Learn what tools will be needed for our tool kits.
- Answer any questions you may have.
- Do a hands on service seminar.
- Have a swap meet and greet.
- Have an awesome time!

What is the RCA Videodisc System?

The RCA Corporation began development of a picture disc system back in the early 1960's.

They found that through capacitance a signal could be transformed from a grooved disc into a picture. (What is capacitance?)

Well CED, or the Capacitance Electronic Disc, used an electronic signal that would pass through the disc to collect information off the surface.

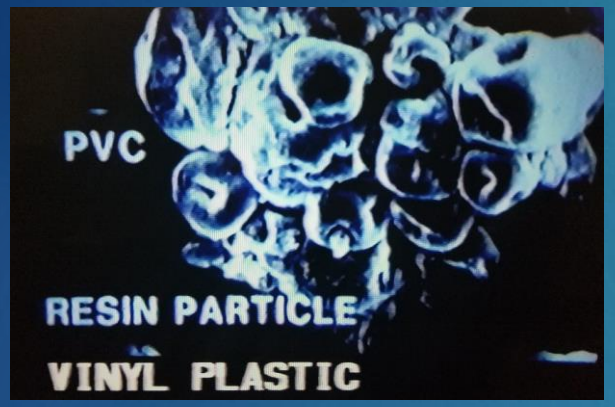
This was achieved by using a PVC (Polyvinylchloride) disc that had been laced with carbon to make the disc itself conductive to an electronic signal.

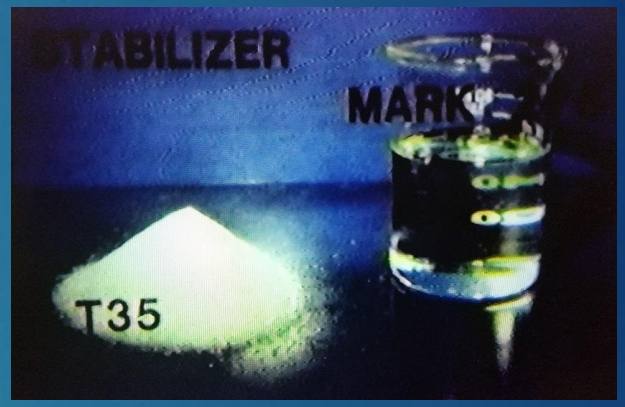
By creating a series of pits and valleys on the disc the electronic signal passing through the disc can detect how high or low the stylus moves and translate that information into data. Kind of like Morse Code, or the 1's and 0's of computer code.

The data is then compiled into a picture just like the data on your computer. It can then be displayed on your screen.

What is a CED?

A CED is made up of PVC or Polyvinylchloride mixed with 15% Ketjen EC Carbon Black manufactured by Akzochemie.





What is a CED? Page 2

The disc is 12 inches in diameter utilizing a spiral groove of V-shaped cross sections with a width of 2.66um(microns) or appx 9,541 grooves per inch.

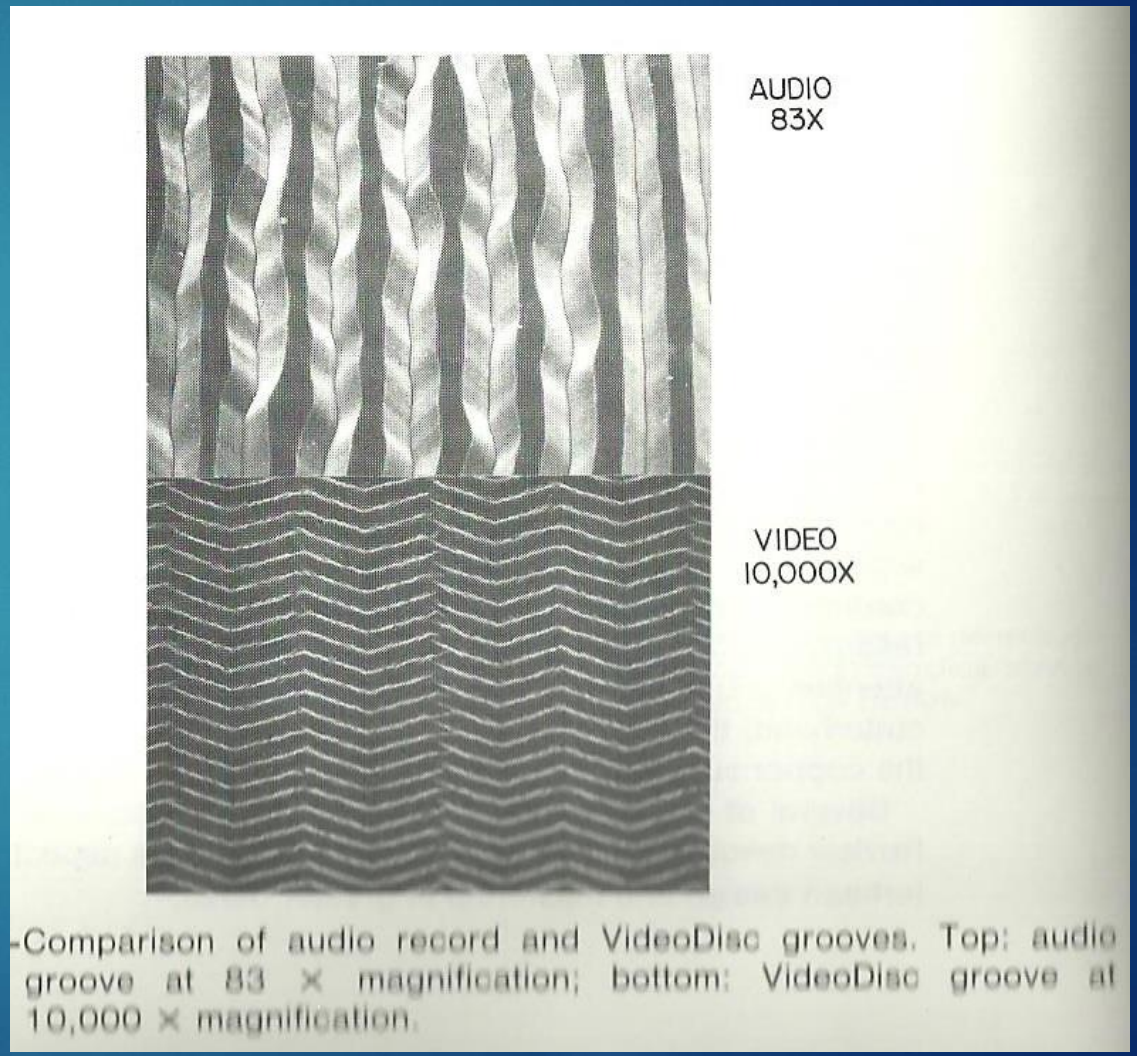
What is a CED? Page 3

The spiral groove is 13 miles long and holds 1 hour of data per side, which is 175x more data than it's audio disc counterpart.

A normal audio disc is read at 33 1/3 RPM and holds about 22 minutes of audio per side.

While the CED Videodisc is read at a speed of 450RPM and contains about 1 hour of audio and video per side.

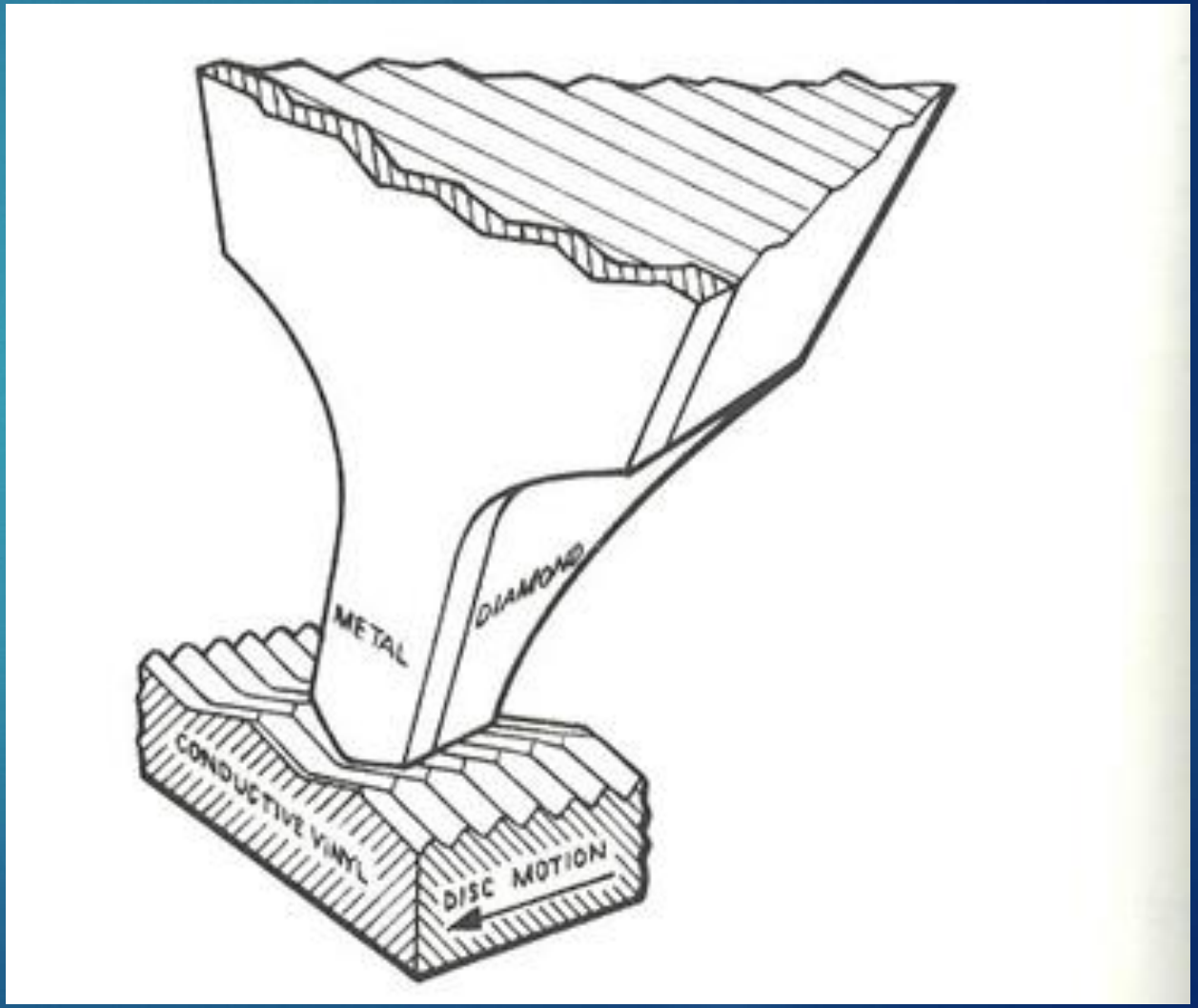
There are appx. 40 CED grooves per 1 audio groove.



-Comparison of audio record and VideoDisc grooves. Top: audio groove at 83 × magnification; bottom: VideoDisc groove at 10,000 × magnification.

What is a CED? Page 4

The information is detected by a stylus that rides in the groove, it detects the relief pattern by sensing the changes in capacitance from the tip of the electrode stylus and the surface of the conductive vinyl.



How was a CED disc made?

Film from a 35mm or Magnetic tape is used. The video, chroma, and audio signals are transferred to a cutting head of an electro mechanical recorder. The diamond cutting stylus then cuts the v-shaped groove, about 2.5 microns (.0001 inch) wide, into a heavy aluminum disc, 14 inches in diameter and coated thinly with copper. The newly cut substrate created is called a "Copper Master".

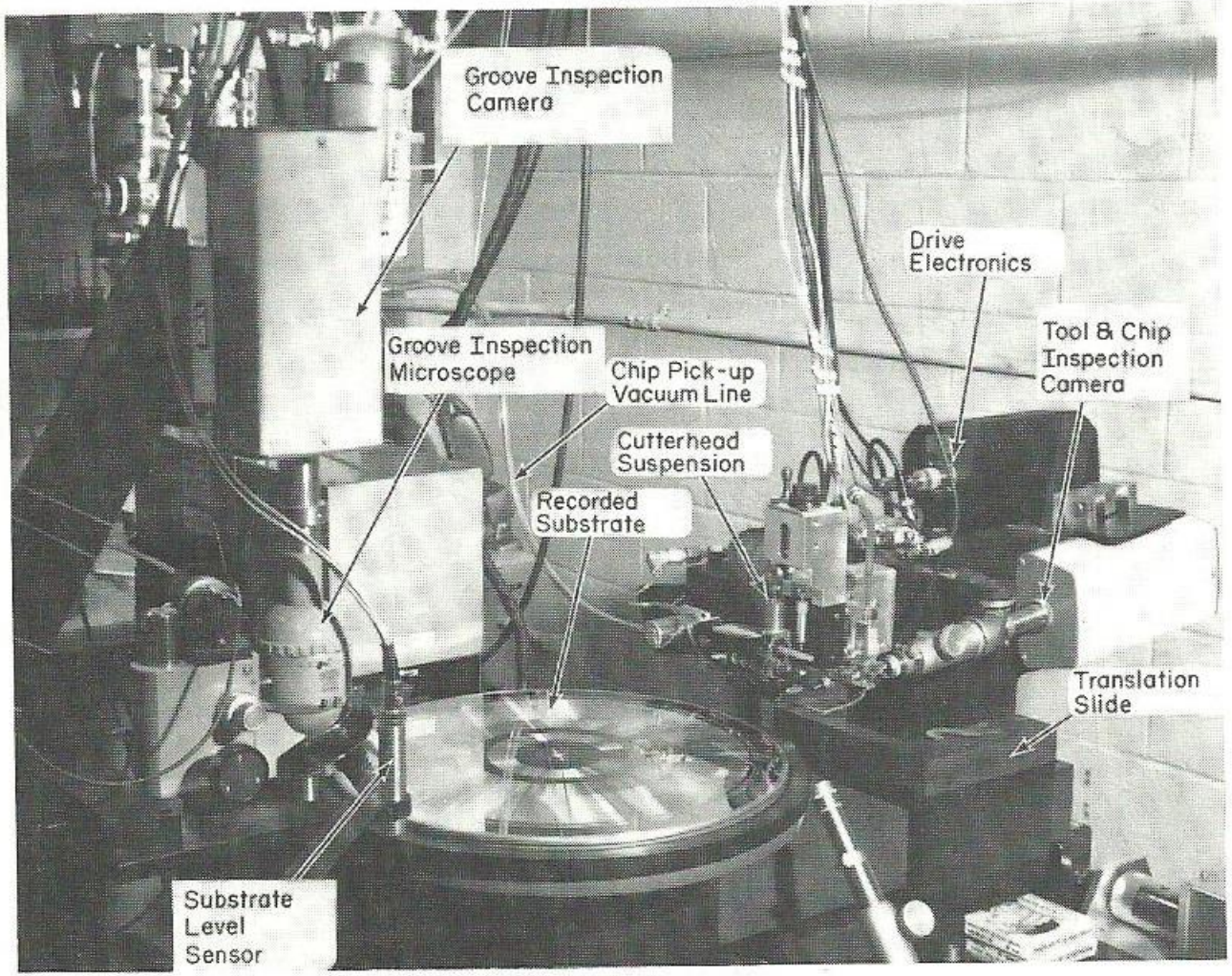


Fig. 8—Recording lathe used for CED mastering.

How was a CED disc made? Page 2

The copper master is then given a thin metal (nickel) coating which is built up by electroplating. Once removed this forms a negative replica called a "Metal Master".

The process is then repeated to form a number of positive copies called molds or "mothers", each mold can then be replicated to produce a number of negative replicas called "stampers" that are used to press the discs.

Once stampers for both halves of the disc are made they are centered in a compression molding press. A "puck" of carbon loaded PVC is placed between the stampers and they are heated to 385 degrees and pressed together for 30 to 36 seconds. The excess is trimmed away and the disc is placed on a spindle to move on to the next process.

The final step.

Once the discs are pressed they move on to be lubricated.

A normal audio disc stylus uses about 1 gram of tracking force while a CED stylus uses only about 65 milligrams. It was found that a lubricant was necessary to prevent intimate contact between the stylus and the disc surface by providing a nondestructive mechanism for dissipating the high sheers involved as the stylus slides in the groove.

A product found to provide excellent results was a compound from General Electric's Silicone Division called SF-1147 bearing a normal decyl group of [R=n-C10H21]

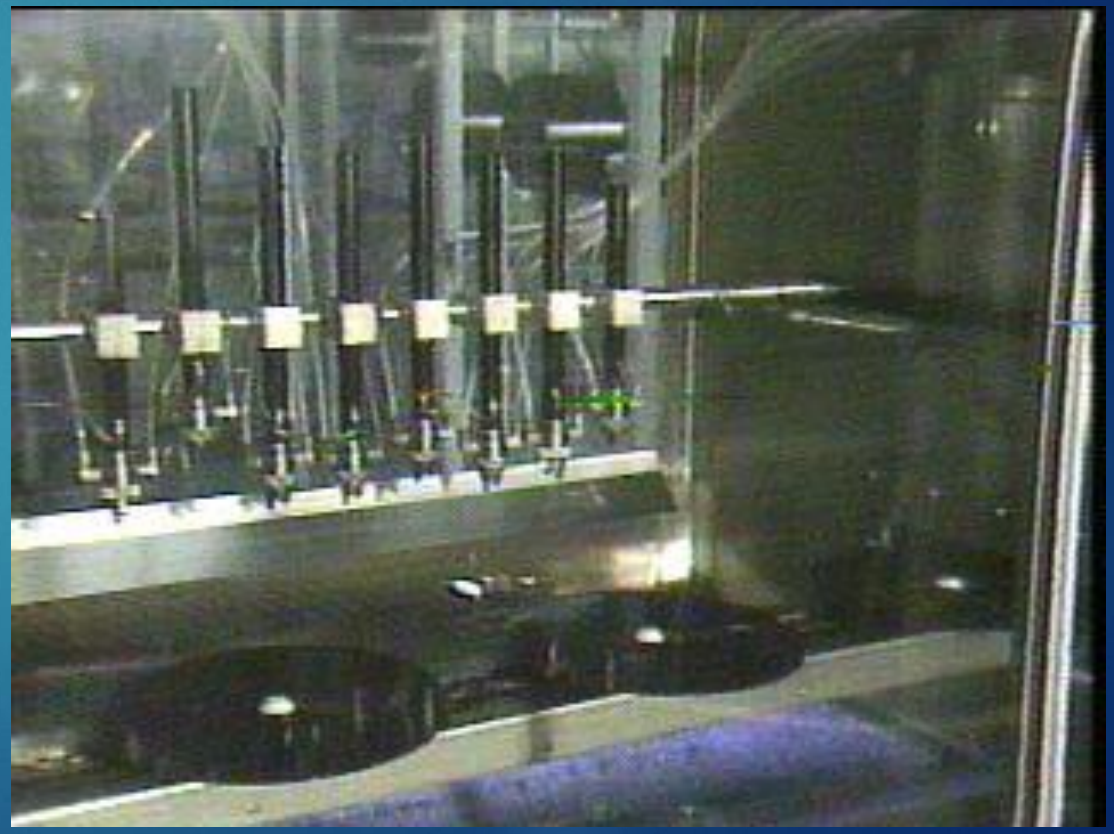
SF-1147 has a freeze point of -65 degrees Fahrenheit to a flash point of 480 degrees Fahrenheit.

(It is currently manufactured by Chemtrec and sold by Momentive Performance Materials.)

Applying the protective silicone.

The SF-1147 was applied by diluting it in a mixture of isopropanol or heptane and coating to a thickness of 200-250 Angstroms or .1 nanometer.

(Basically SF-1147 was a waxy compound that was mixed with alcohol and sprayed on the disc. The alcohol would then evaporate leaving the SF-1147 silicone bonded to the disc.



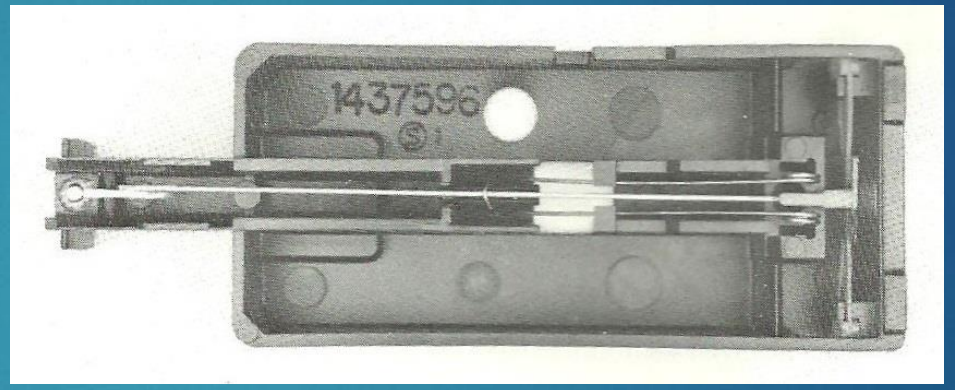
And that's why you should never "clean" a CED.

The outer layer of skin contains microscopic pores that secrete sweat and oils. Sweat is mostly water, but it contains a very small fraction (1.5%) of salt, amino acids, and proteins. These chemicals remain on the skin after the water evaporates. The skin also contains sebaceous glands, which produce oils. These sweat and oils are what causes our fingers to leave fingerprints. When you touch the surface of the disc these chemicals interact with the SF-1147 on the disc and changes it's chemical makup, making it unable to protect the disc from the sheer of the stylus tip thus causing the disc and stylus to wear more quickly. That is why you must never touch the surface of a CED, or use any type of chemical to "clean" it.

If you must "wash" a disc, rinse only with distilled water as it will evaporate leaving the SF-1147 silicone in tact, as it was. Do not use anything to rub, or dry the disc.

All about the Stylus!

The first stylus RCA created was made from sapphire. In 1976 they were able to decrease the groove with from 4.6 microns to 2.7 microns creating a playing time of 1 hour per side. But in doing so they discovered they needed a finer stylus and found diamond to be the perfect replacement.



The stylus is a titanium electrode affixed to the trailing edge of a diamond tip. It follows in the V-shaped groove of the disc spinning at 450RPMs, which means the stylus is covering about 500cm/sec. If the stylus looses contact for even .3 mm an entire line of video information is lost. If the stylus is kicked over by 2.6 microns or one groove then 133 msec of audio and video information are lost or repeated. (We call this a skip)

Perspective; The average human eye blink takes 35 msecs(milliseconds), so about 4 blinks per groove, per disc rotation.

Stylus Diagram

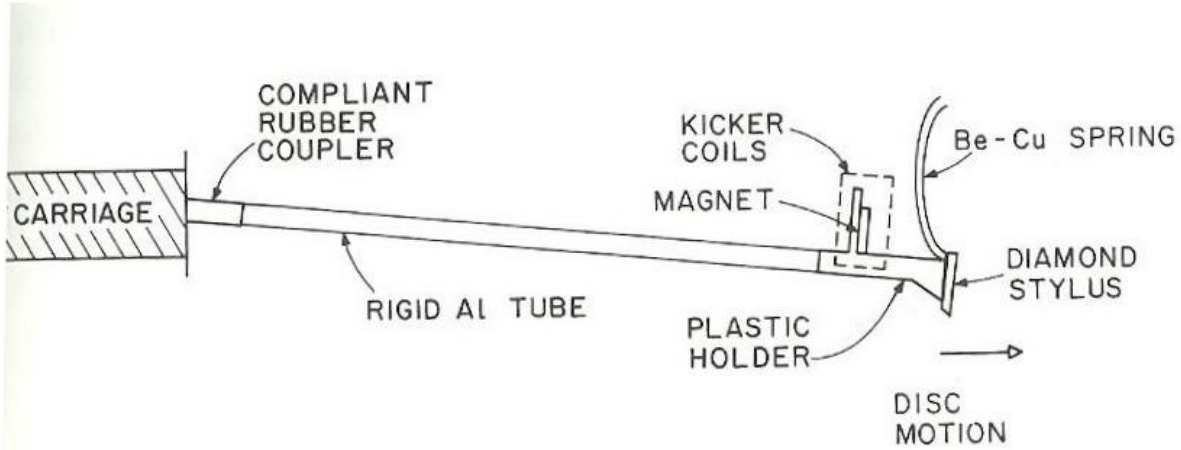


Fig. 4—Stylus arm.

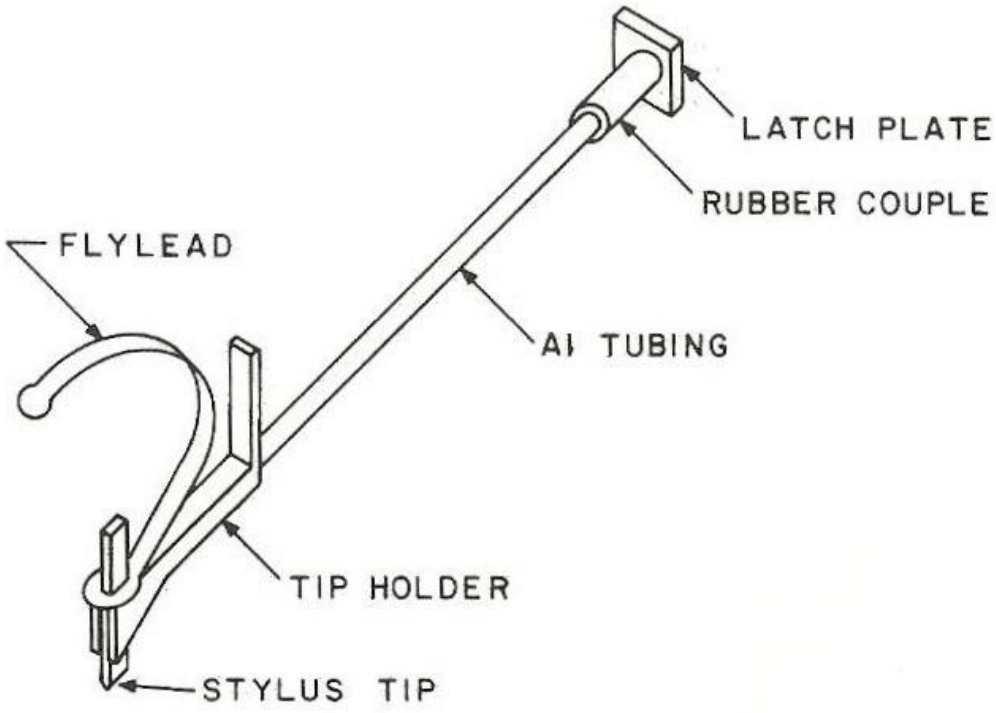
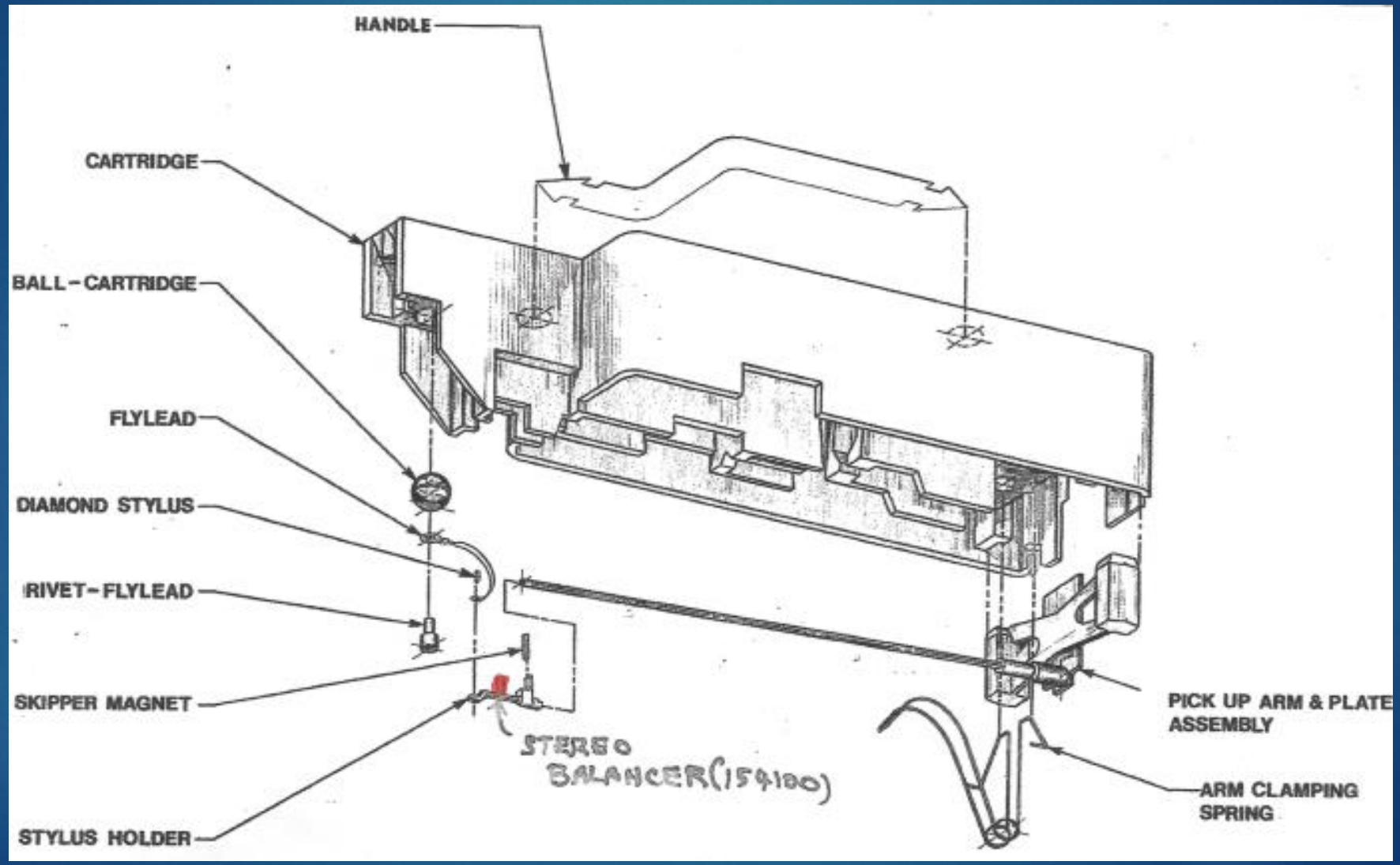


Fig. 12—Stylus support arm.

Exploded Stylus Diagram



Different Types of Styli

154216
Real
Diamond

154216
Artificial
Diamond

160211
Bally NFL
Stylus
SJT400X

J/K Stylus

149000/154100 F/G Stylus

Hitachi

Stylus wear and tear

The titanium electrode of the stylus is approximately 2500 angstroms (.25 microns) thick. A human hair is approximately 1 million angstroms thick, meaning you could fit about 400 titanium electrodes in the width of a human hair.

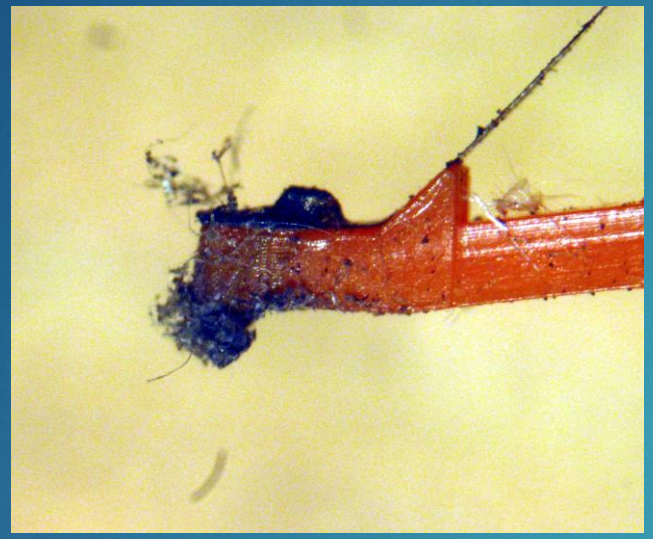
With a new stylus the titanium electrode will last 30-70 hours before it begins to form up. There is a small decrease in signal output at that time. The titanium electrode then only wears as fast as the diamond tip.

At about 65 to 70 milligrams of tracking force the stylus will last about 200 hours with no loss of signal, or at least 50 plays.

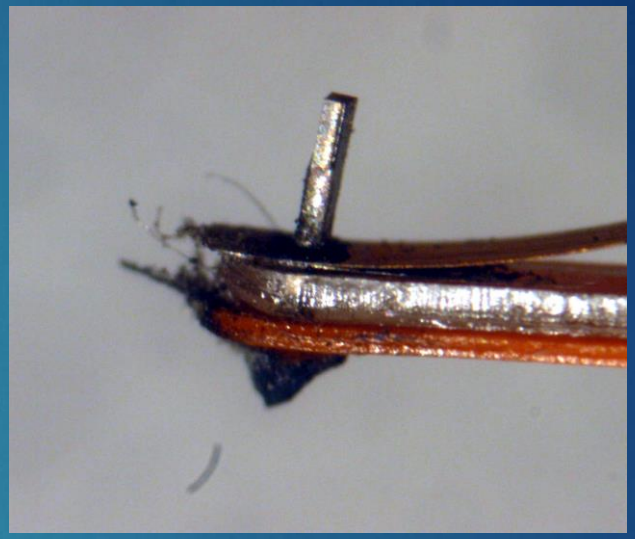
Note: Mono F/G Players use 149000, Stereo uses 154100, in production 154100 was used in some mono players (SGT100 & SGT075 coded 2155 or later), to use 154100 in a mono player you must make sure it uses stylus arm 154036 with wide stylus sensors.

Clean vs. Dirty Stylus

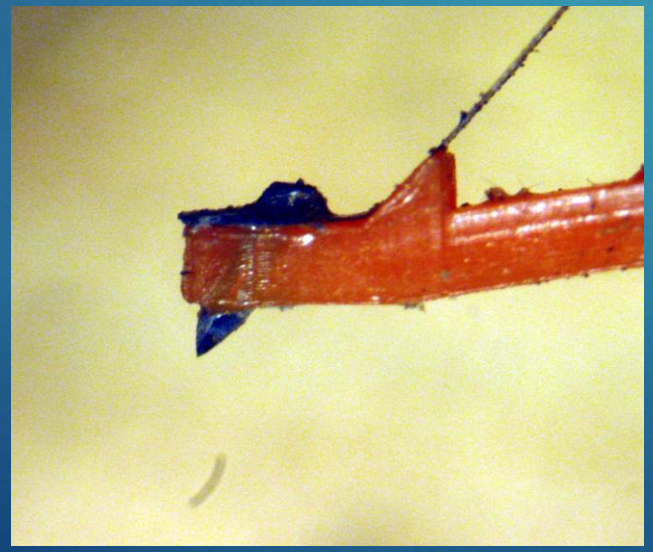
Dirty F/G



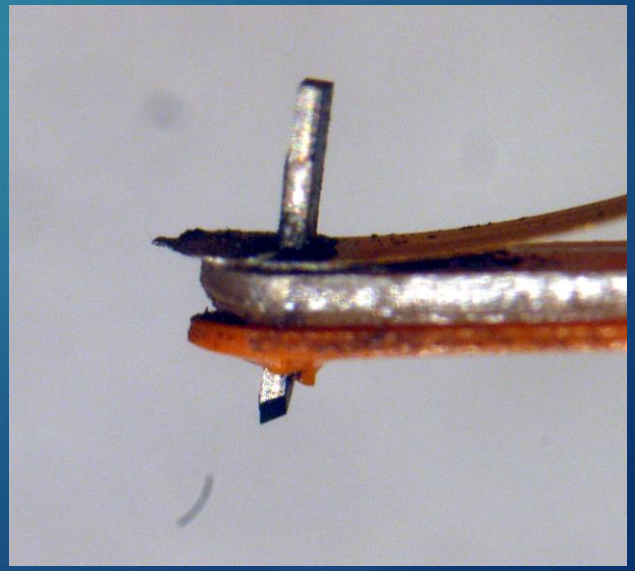
Dirty J/K



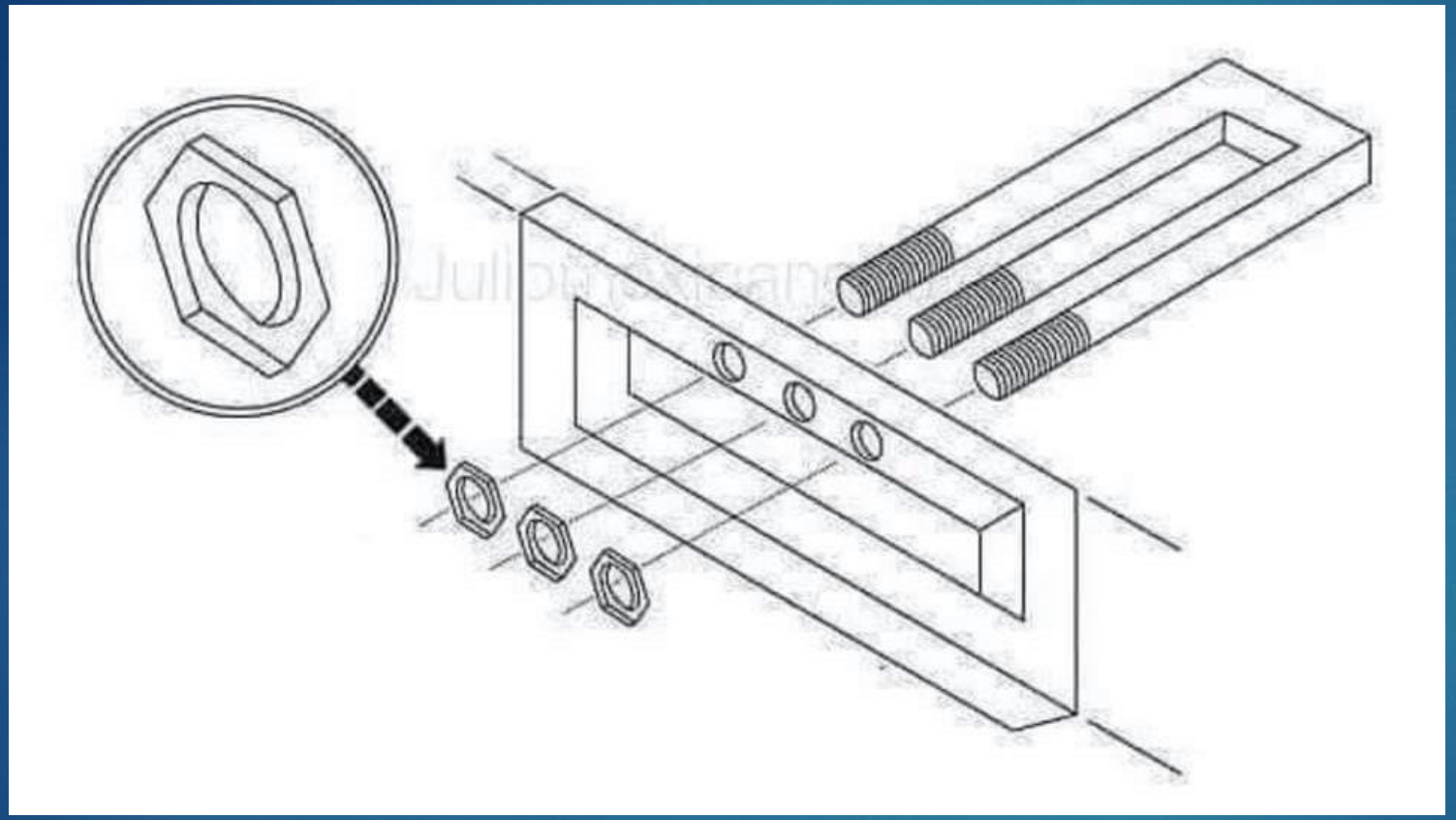
Clean F/G



Clean J/K



How discs are read by the player



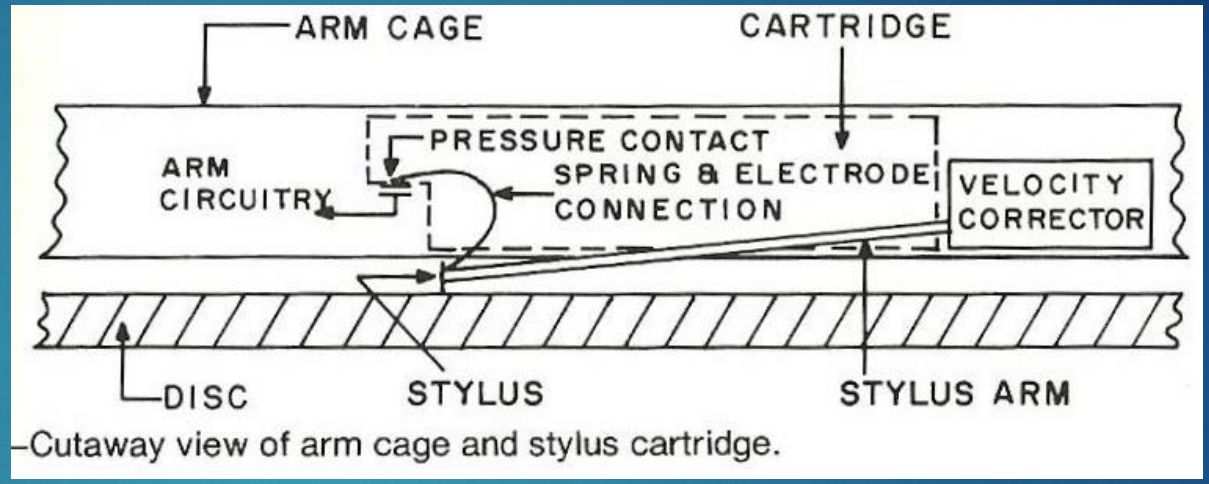
Magic…

How discs are really read by the player.

I call it magic because it is actually a very complex process, I mean this was designed by people with doctorates from MIT, or really smart dudes. I could list all the mathematical equations, frequencies, and technical jargon as described in the book but that would be boring and lets face it, incomprehensible to most. So instead I'm going to try to lay it out as simply as possible.

The disc is composed of conductive carbon, and is etched with a groove that contains a series of pits and valleys. The disc is spun at 450RPM's and a stylus consisting of a diamond with a titanium electrode trails in the groove. A 915MHz signal passes through the disc, through the electrode, up the stylus and into an oscillator, the frequency is then adjusted by a frequency control and compared to the starting 915MHz frequency, the difference is then sent to a preamplifier and processed by the onboard circuit chips into the picture that appears on your screen…like I said, Magic.

Cutaway of Stylus Arm



Cutaway view of arm cage and stylus cartridge.

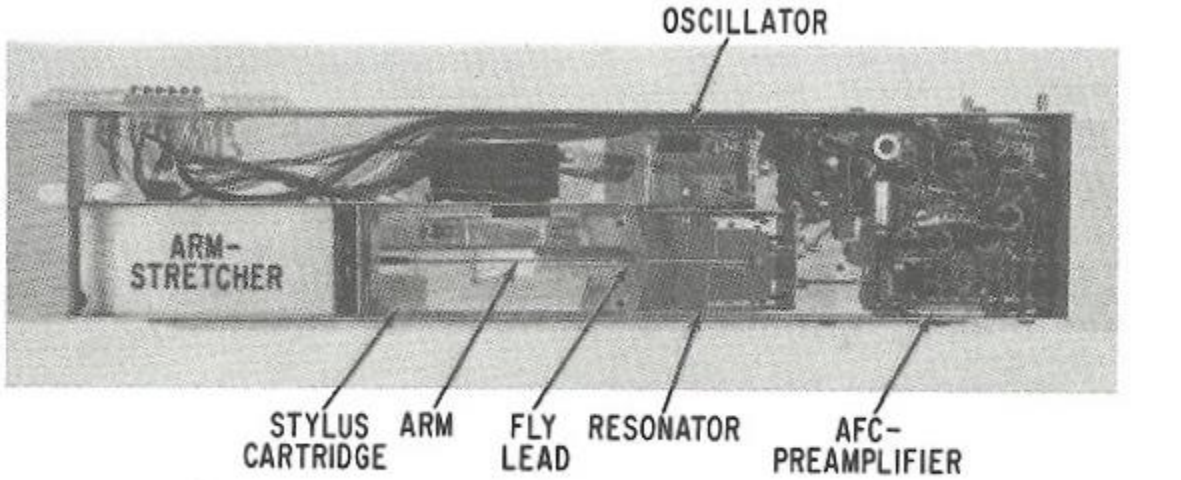


Fig.13.—Assembly of pickup circuits.

History of the CED Player

Many players and discs were made in the development process, the largest quantity of players manufactured for R&D was the SDT200W Player. It represents approximately the 6th player design. In total over 430 complete players were manufactured of this model.

—Photograph of SDT200W VideoDisc player.

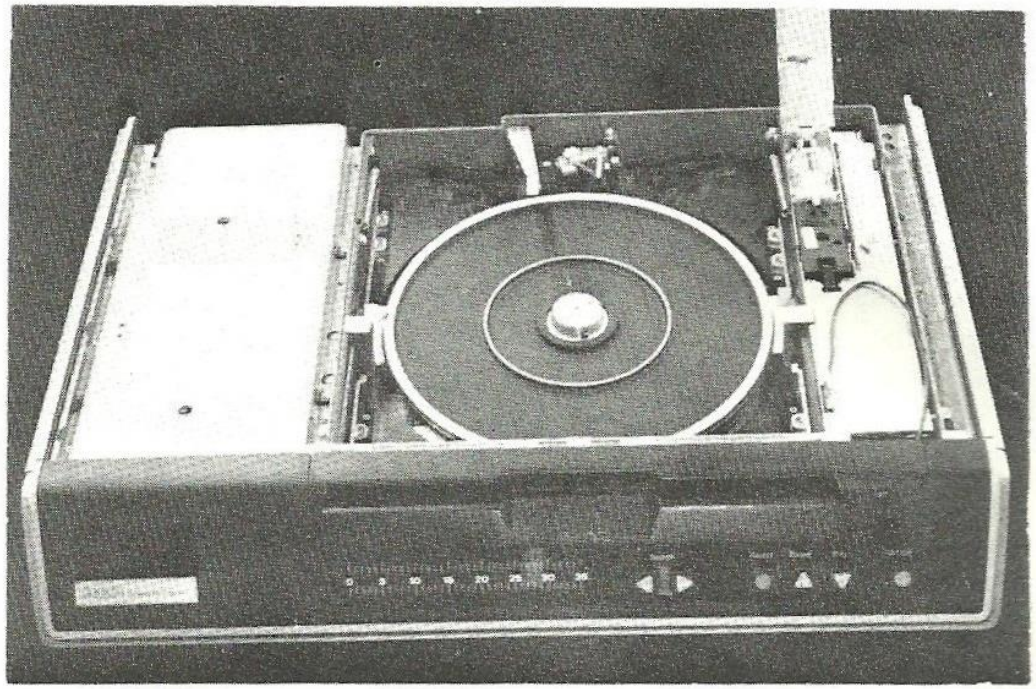


Fig. 4—Photograph of SDT200W with top removed.

History of the CED Player Page 2

As you can see it is similar in design to our beloved SFT100W with the exception that the circuit boards were designed vertical and removeable and the arm sweeps right to left instead of back to front. It also utilized push buttons instead of our familiar light switch.

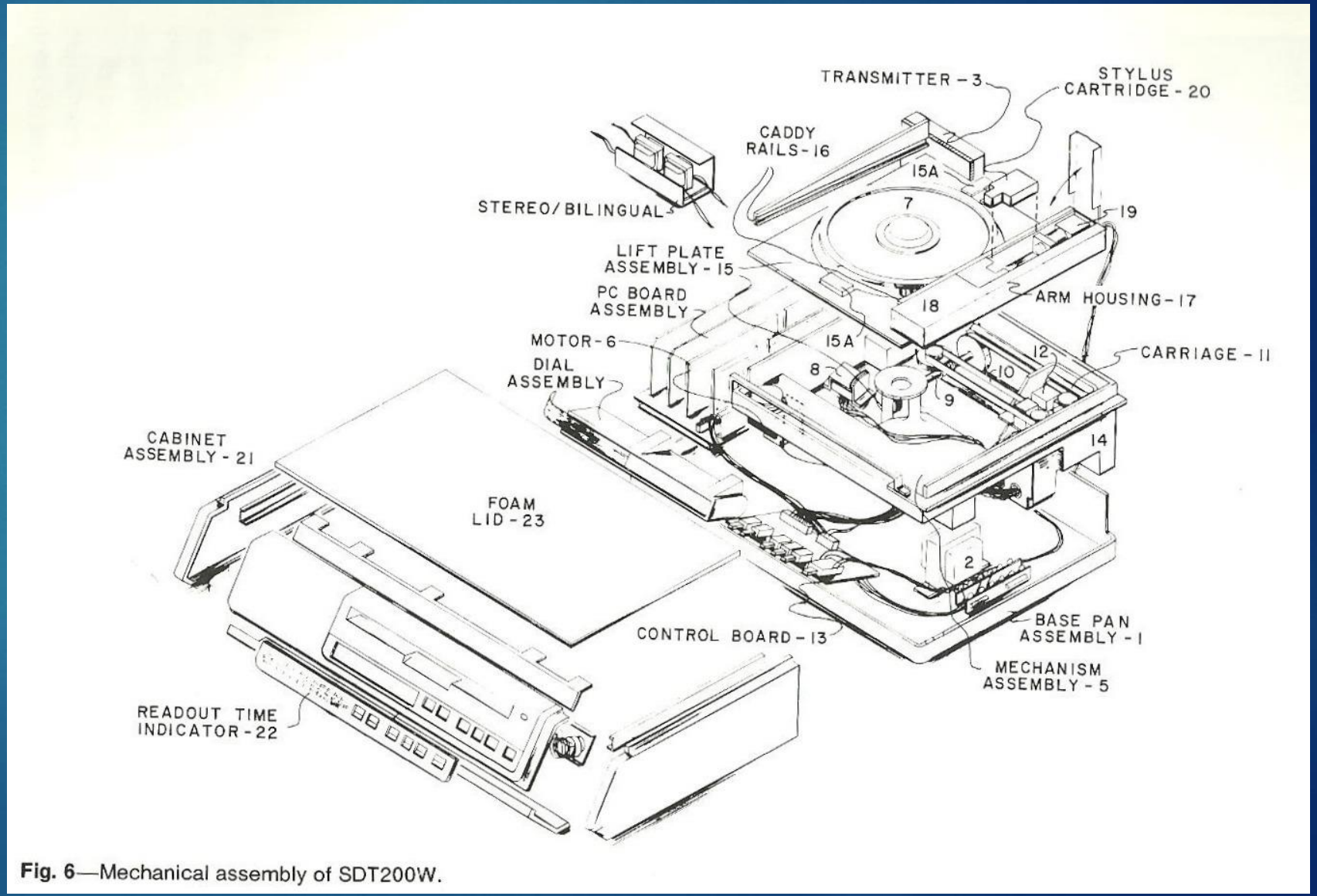


Fig. 6—Mechanical assembly of SDT200W.

CED Player Brands & Models

Elmo VEC-200	GEC McMichael V5000H	Hitachi VIP1000
		
Hitachi VIP2000	**Hitachi VIP2000R**	**Hitachi VIP201P**
		
Hitachi VIP202P	**JC Penney 686-5705**	**RCA SFT100**
		

CED Player Brands & Models Page 2

RCA SGT075	RCA SGT100	RCA SGT101
		
RCA SGT200	**RCA SGT250**	**RCA SJT090**
		
RCA SJT100	**RCA SJT101**	**RCA SJT200**
		

CED Player Brands & Models Part 3

RCA SJT300	RCA SJT400	RCA SJT400X
		
RCA SKT090	**RCA SKT100**	**RCA SKT200**
		
RCA SKT265	**RCA SKT300**	**RCA SKT400**
		

CED Player & Models Part 4

Realistic 16-301	Sanyo VDR3000	Sears 274.54740150
		
Sears 934.54780150	**Sears 934.54800250**	**Sears 934.54810350**
		
Sears 934.54811350	**Toshiba VP100**	**Toshiba VP500**
		
Toshiba VP550	**Wards GEN10301**	**Zenith VP2000**
		

CED Player and Models Part 5

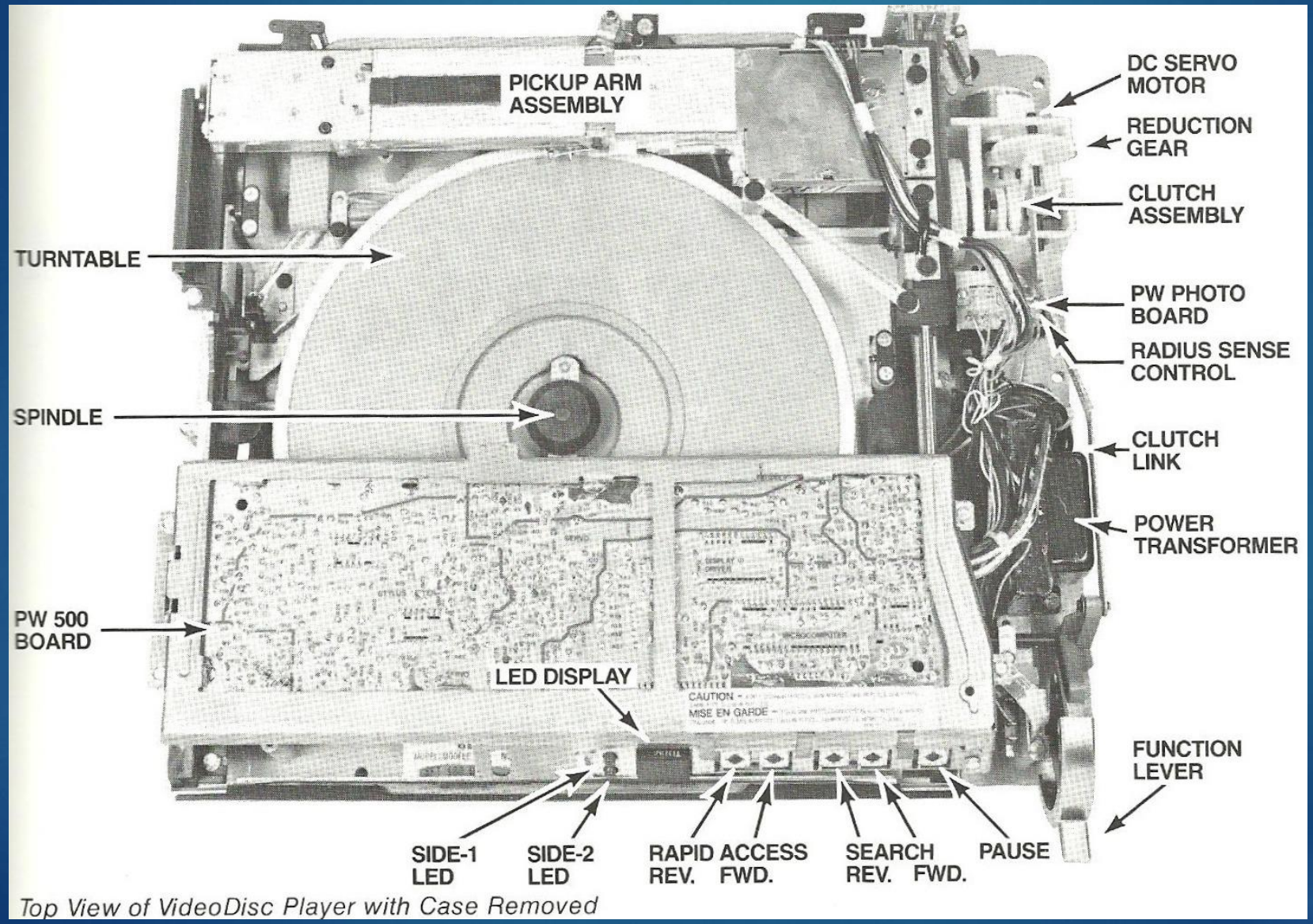
JC Penny

Zenith VP4000

CED Player and Models Part 6

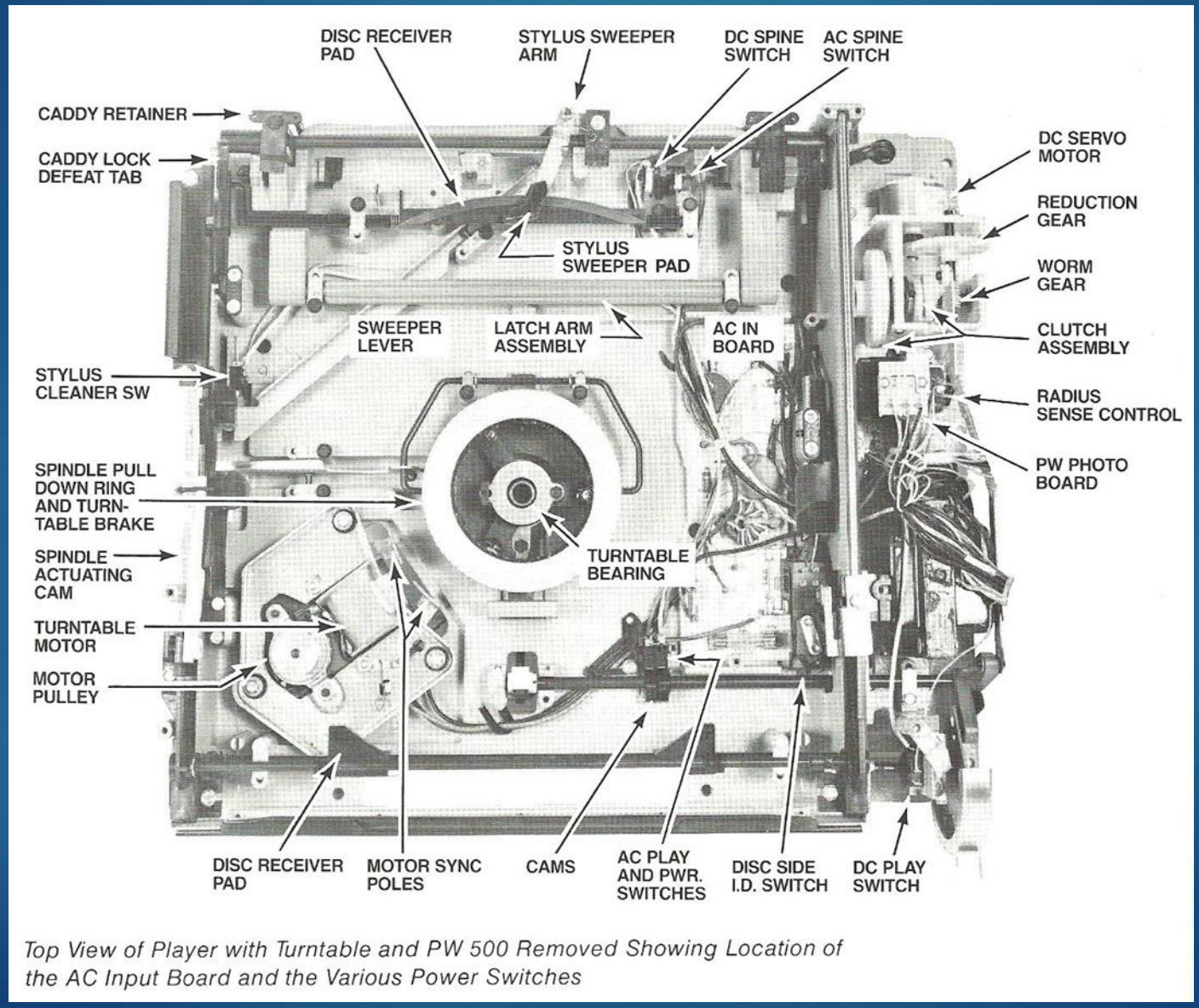
One other player that was built internally was the SKT425, which was built as a component of the RCA Dimensia system. But when CED got cancelled they decided not to include a CED player in their Dimensia system when it was release. This prototype model owned by Tom Howe is the only one known to exist. It is identical to the SKT400 with simply a different case on it.

CED Player Operation & Parts F/G



Top View of VideoDisc Player with Case Removed

CED Player Operation & Parts #2



Top View of Player with Turntable and PW 500 Removed Showing Location of the AC Input Board and the Various Power Switches

CED Player Operation & Parts #3

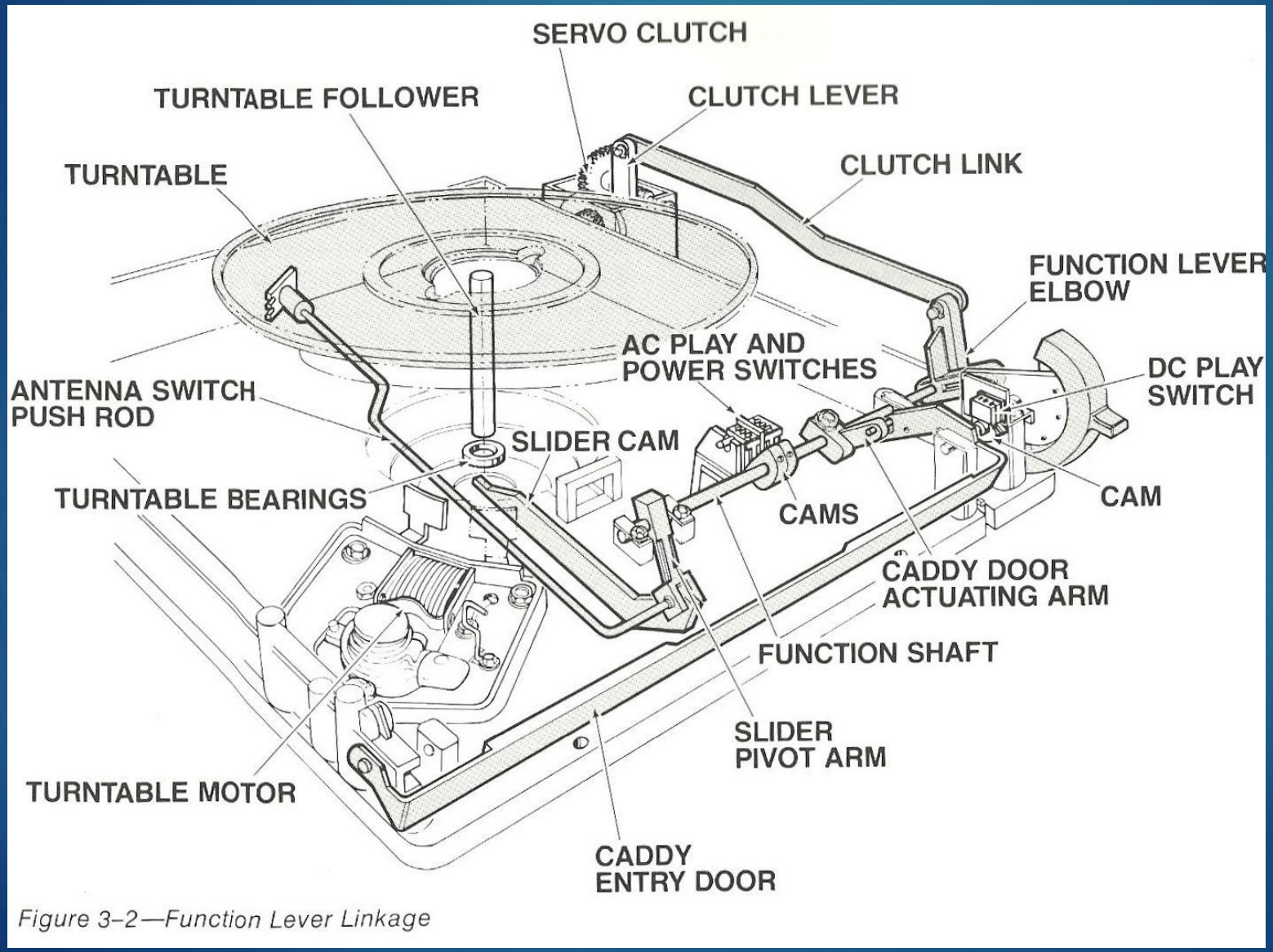


Figure 3–2—Function Lever Linkage

CED Player Operation & Parts #4

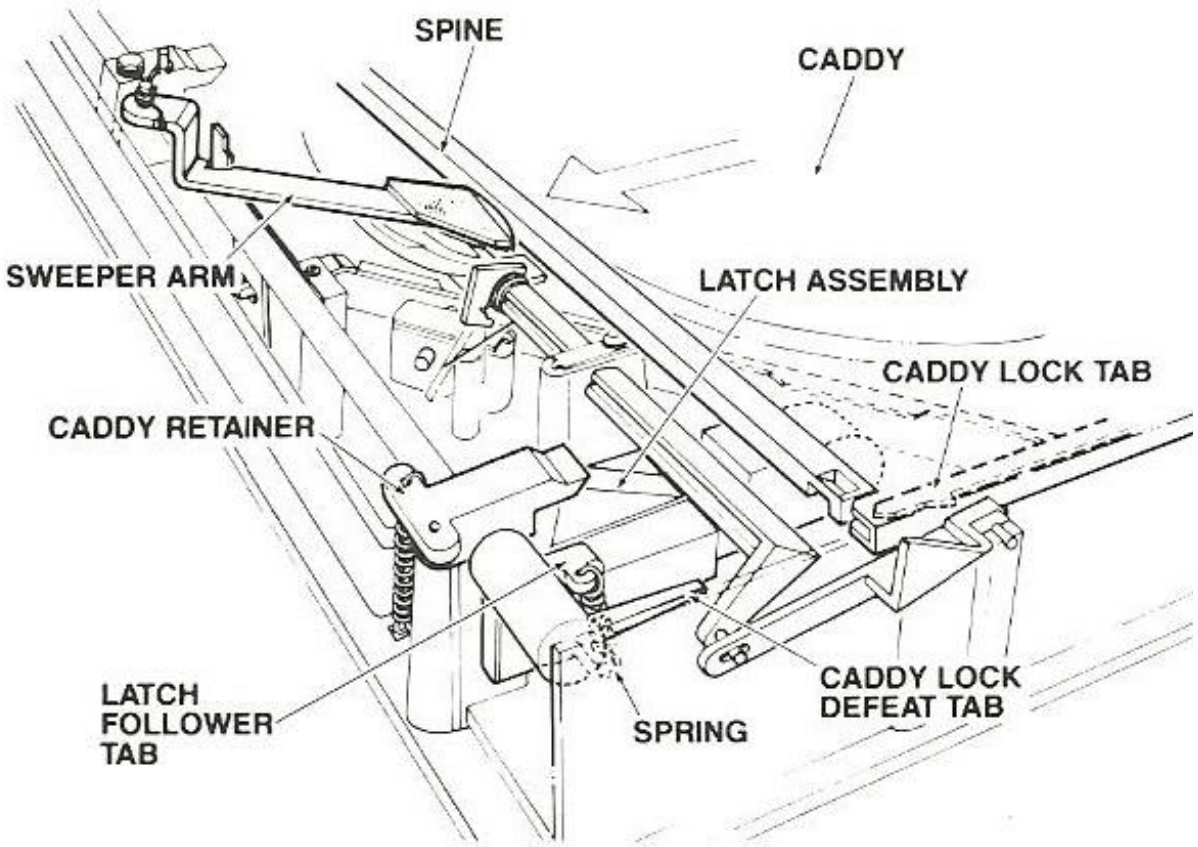
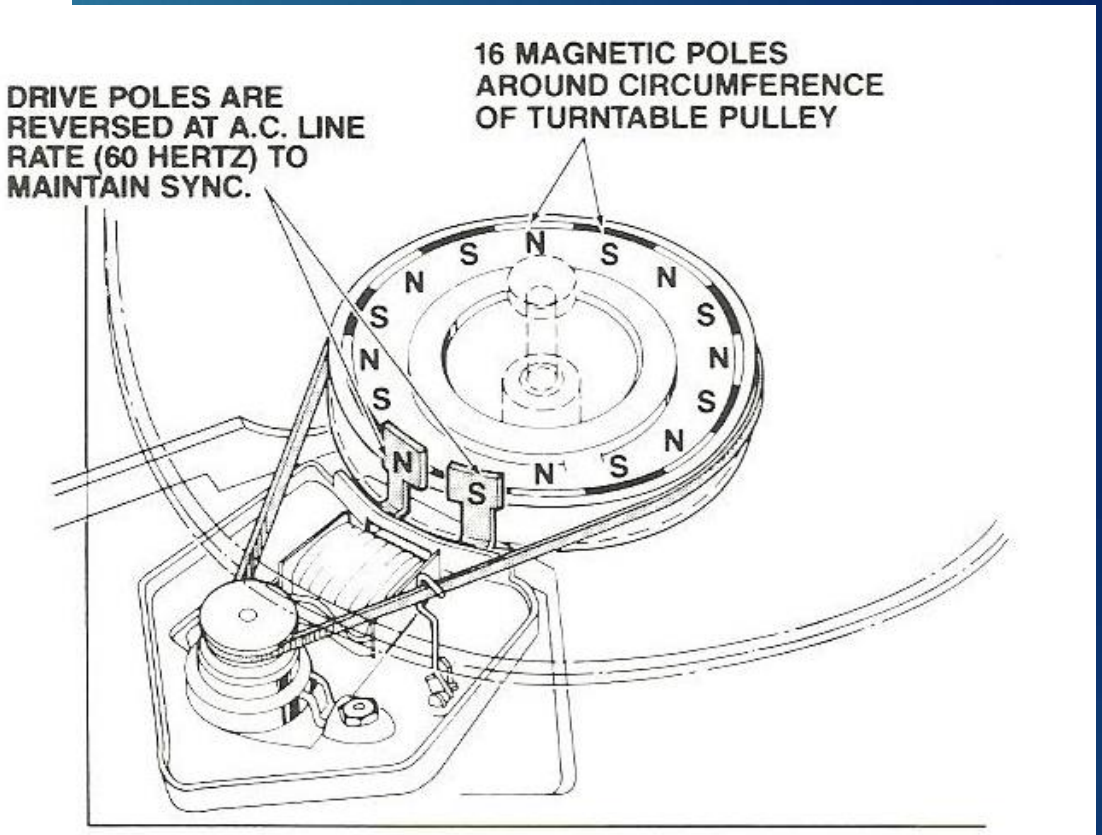
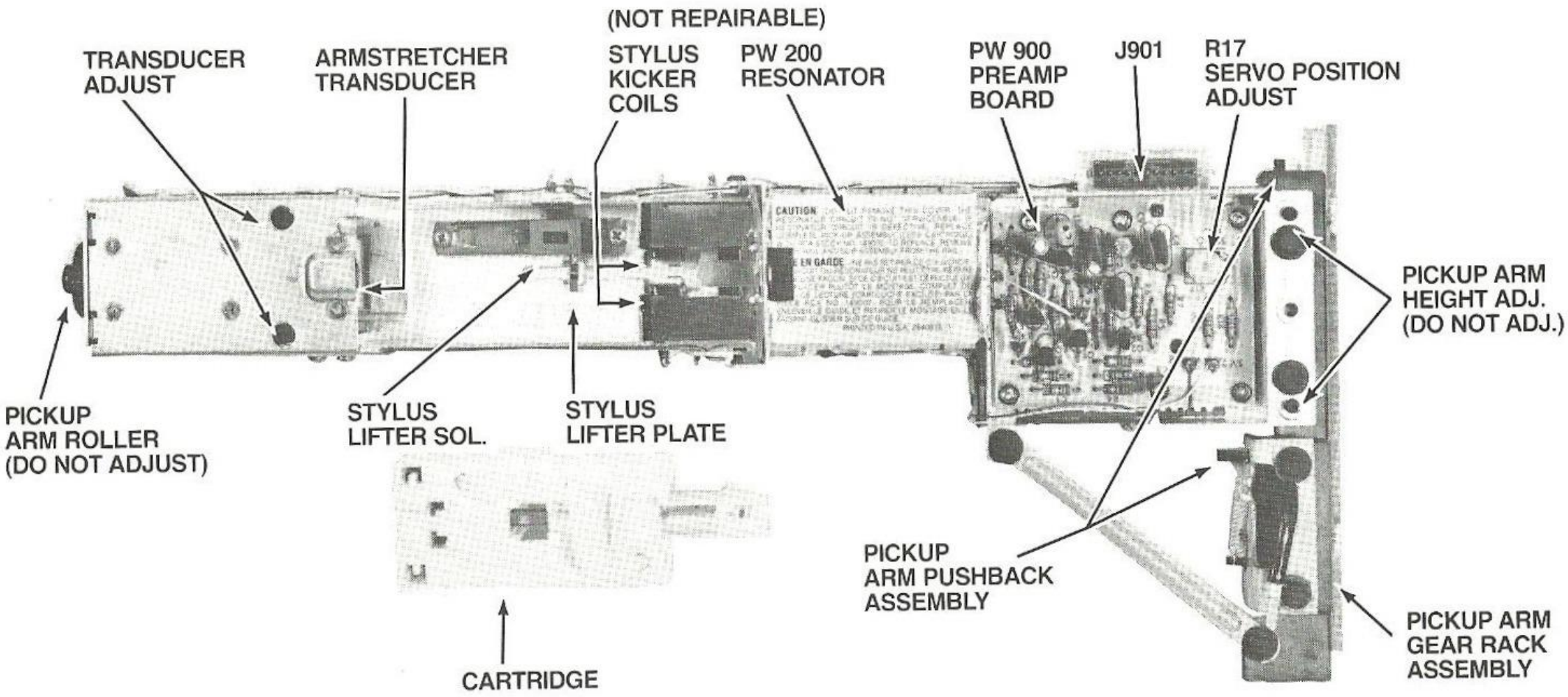


Figure 3–3—Spine Capture Assembly—Load Position



CED Player Operation & Parts #5



VideoDisc Player Pickup Arm Assembly

CED Player Operation & Parts J/K

Load Sequence

Pressing the on/off button (turning player on) applies power to the Function Motor. The function motor (running in the forward mode), drives the pulley and 1st reduction gear and the pinion and 2nd reduction gear which in turn drives the upper and lower power assist gears and caddy rollers. The upper power assist gear drives the power assist hub and rod assembly transfering power to the pawl drive gear that in turn drives the function gear. The function gear, as it rotates to the load position opens the caddy (sleeve) entry port door through mechanical linkage, operates the disc transfer rod and activates the mechanism load switch (S9). The digital display will display a flashing "L" indicating the player is in the "Load" mode (See Fig. 4).

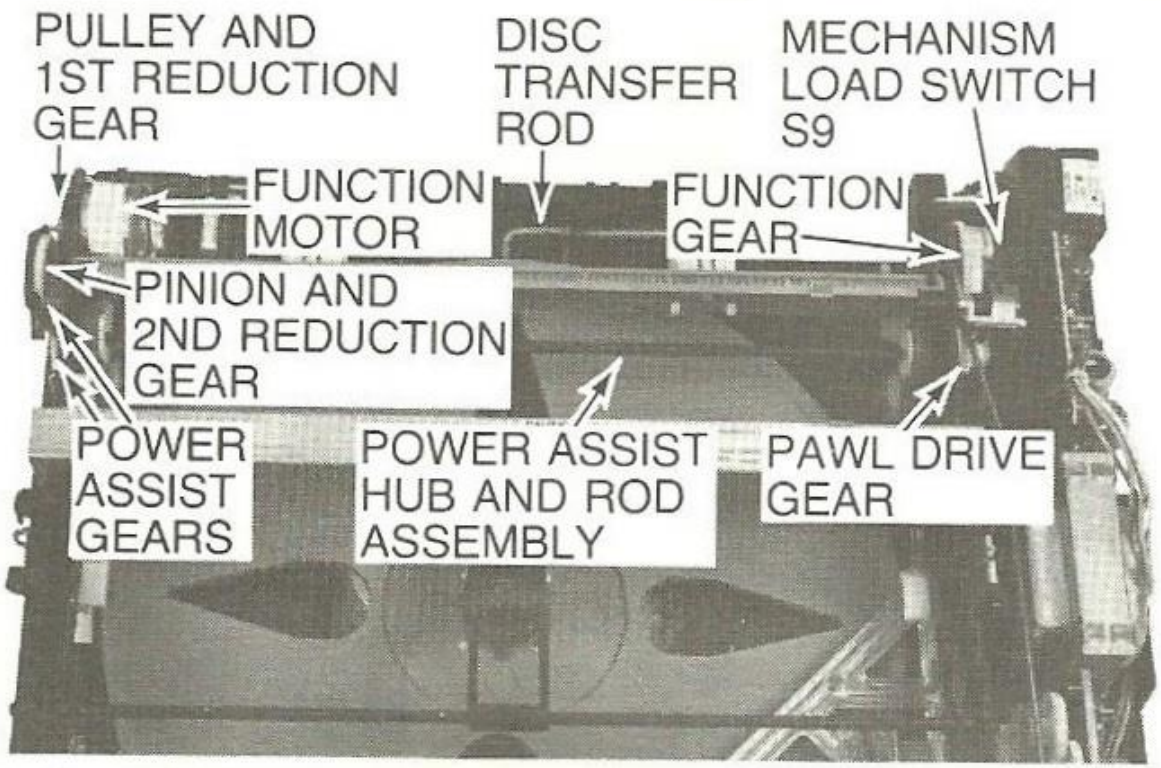


Fig. 4—Mechanism Identification

CED Player Operation & Parts #2

Insertion of the loaded Caddy (sleeve) into the player first encounters the Pawl Actuating Crank lever which, through mechanical linkage, places the function gear actuating pawl in a non-actuating position. Encountered next the spine holddown pads, caddy lockout assemblies, and front receiver pads are raised and lowered respectively to allow caddy (sleeve) entry. The spindle receiver is then raised, the side receiver pads lowered and the caddy (sleeve) sense switch S4 activated (closed) by the caddy (sleeve).

When the caddy sense switch, S4, is activated (closed), power is applied to the function motor. The caddy (sleeve) rollers begin to rotate, they grasp the caddy (sleeve) pulling it into the player. The caddy (sleeve) then activates (closes) the caddy reverse switch, S8. As caddy (sleeve) insertion nears completion the rear receiver pads are lowered, the caddy (sleeve) lock defeat tabs enter the end of the caddy (sleeve) on either side unlocking the spine tabs which hold the spine and VideoDisc captive in the caddy (sleeve). At the same time the spine latch tabs, are pushed up and over the end of the spine and drop into their latching position holding the spine and VideoDisc captive in the player. The spine sense switch, S5, is also activated (closed) at this time and the side indicator switch, S6, is either activated (closed) or left "off" (open) depending upon which side of the disc is being played. The function motor stops for approximately one (1) second before it begins running in the reverse mode (See Figs. 5 & 6).

With the function motor running in the forward mode the caddy (sleeve) rollers will be driven in the reverse mode. This causes the caddy (sleeve), now empty, to be ejected automatically to a point just beyond the caddy (sleeve) entry door where it must then be manually removed.

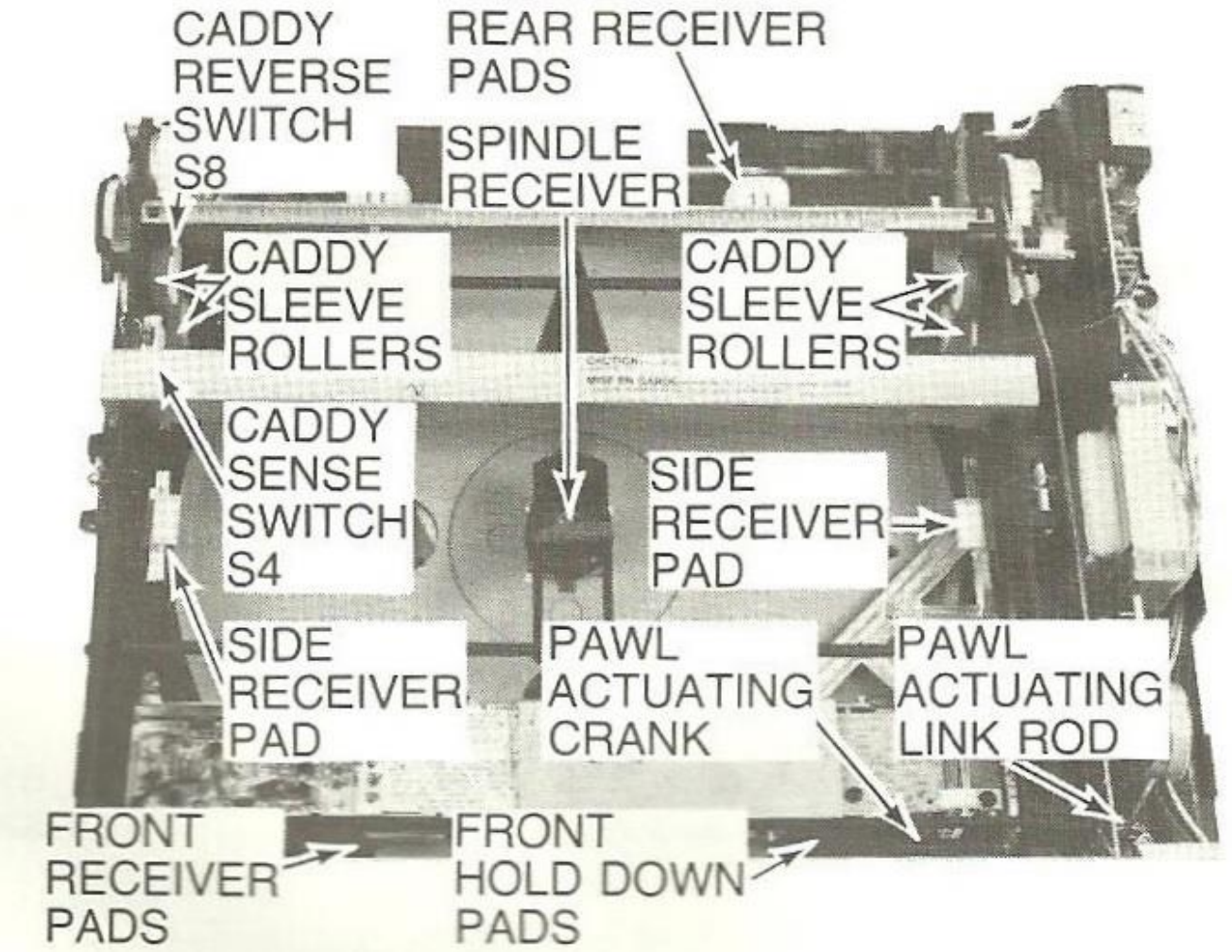


Fig. 5—Mechanism Identification

CED Player Operation & Parts #3

As the caddy (sleeve), now empty, begins its ejection travel from the player—the caddy (sleeve) lock defeat tabs (spring loaded) pop up above the spine to the position necessary for performing their function during the "unload" process. The rear receiver pads rotate up to their normal position to support the disc and spine. The caddy (sleeve) reverse switch, S8, is deactivated (opens), however the function motor continues to run. When the caddy (sleeve) is released by the caddy rollers it must then be manually removed from the player. As the caddy (sleeve) is being manually removed from the player—the caddy sense switch, S4, is deactivated (opens), the side receiver pads (spring loaded) raise up to support the spine, the front receiver pads (spring loaded) raise and the spine holddown pads (also spring loaded) lower to support the disc and spine. The last item to be released is the Pawl Actuating Crank, which is used to prevent the function gear actuating pawl from being tripped during the time a caddy (sleeve) is in the player (See Figs. 5 & 6).

NOTE: The function motor, now controlled by the mechanism μC, is still running in the forward mode.

Immediately upon release of the pawl activating crank the function gear actuating pawl is released, through mechanical linkage, and allowed to revert to its normal position. On the very next rotation of the pawl drive gear it strikes the function gear pawl placing the function gear

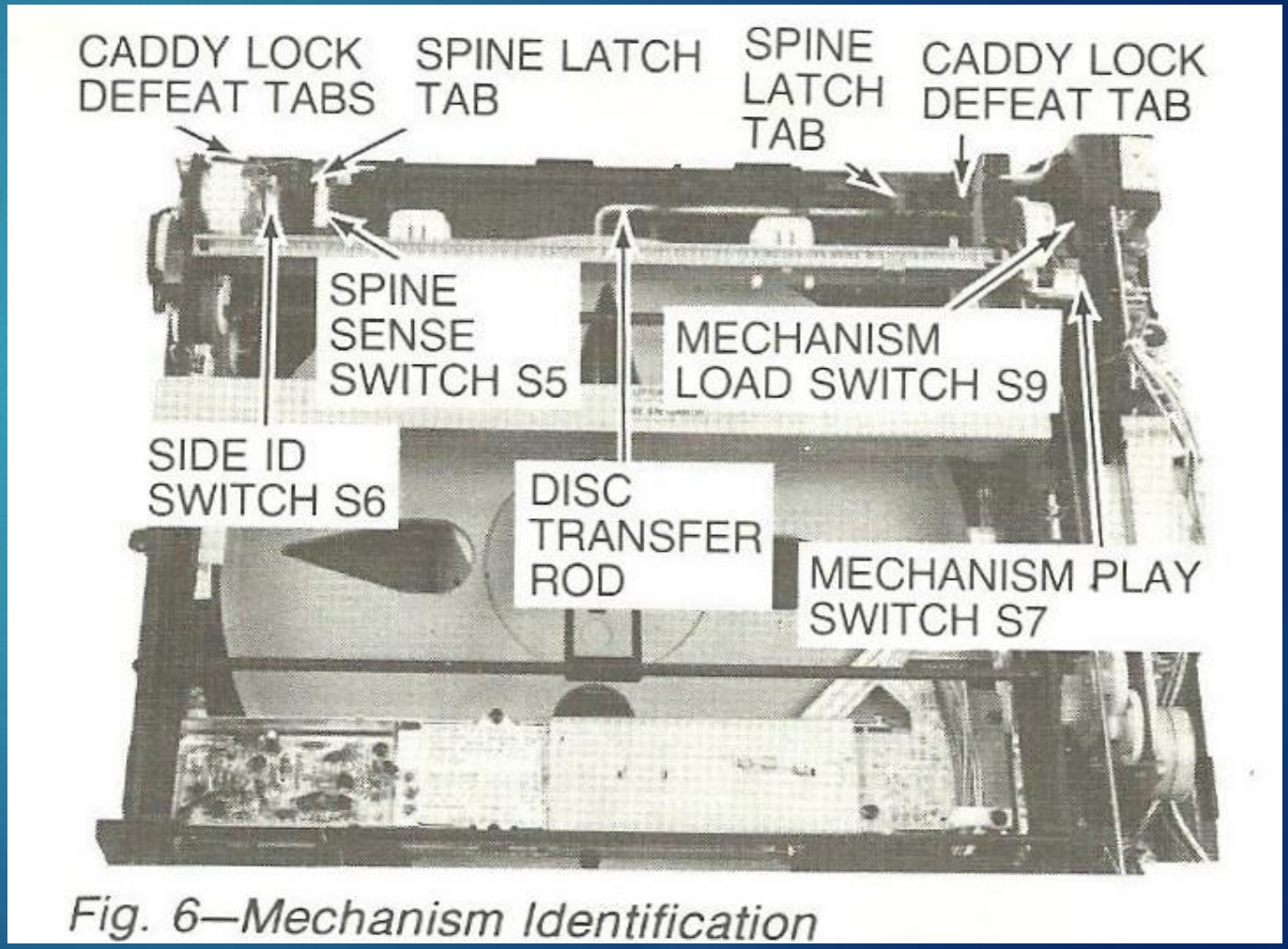


Fig. 6—Mechanism Identification

CED Player Flow Chart F Line

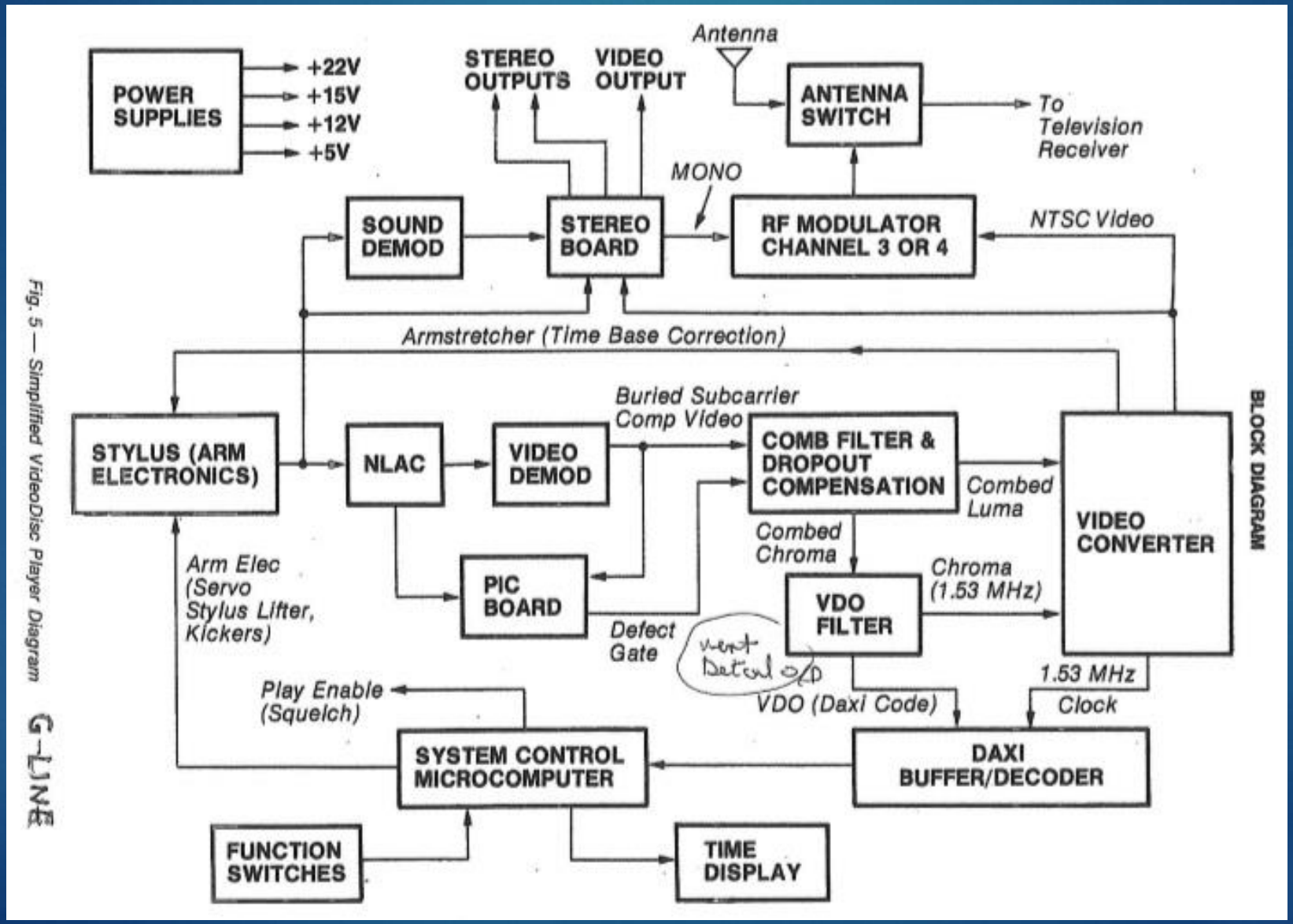
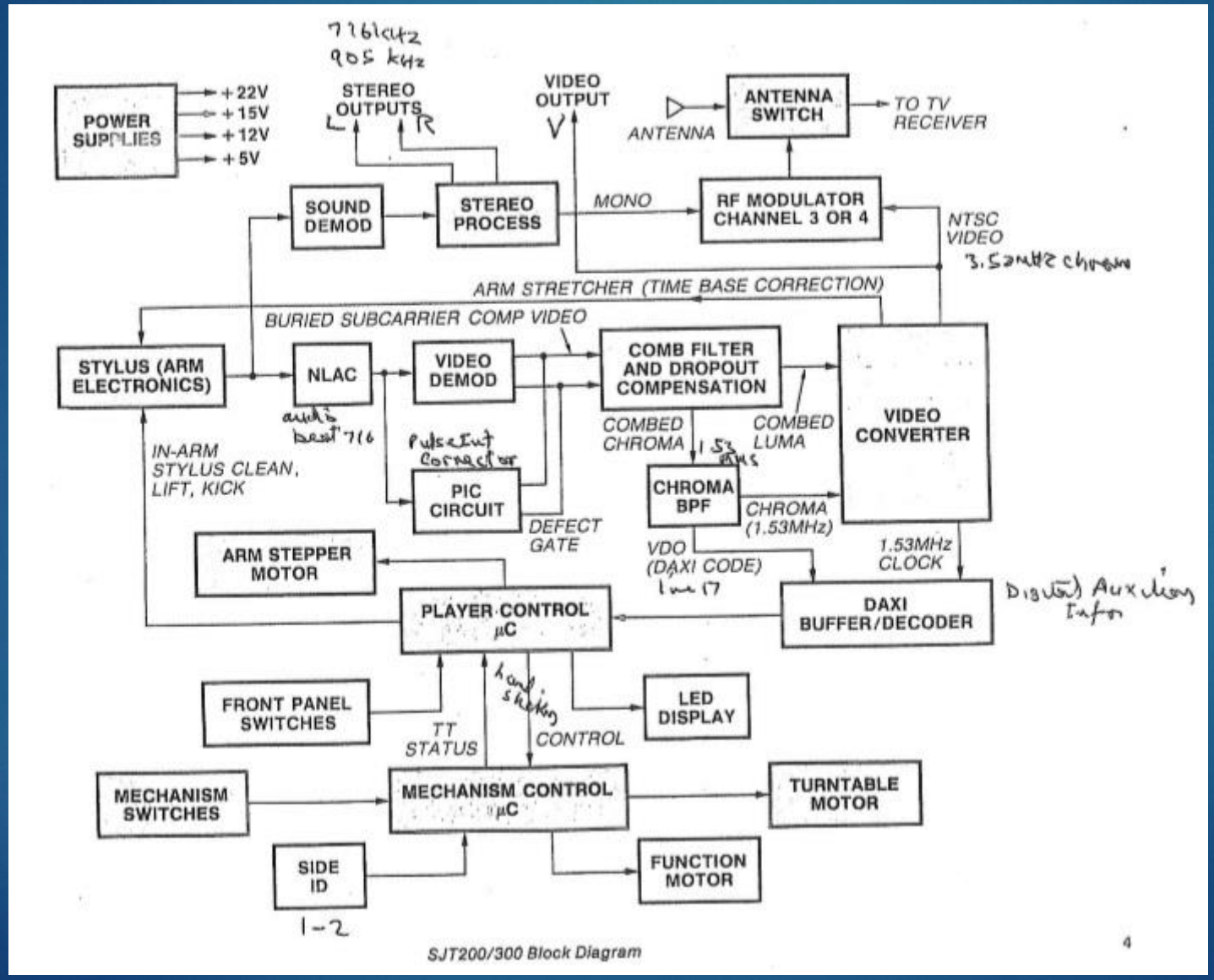


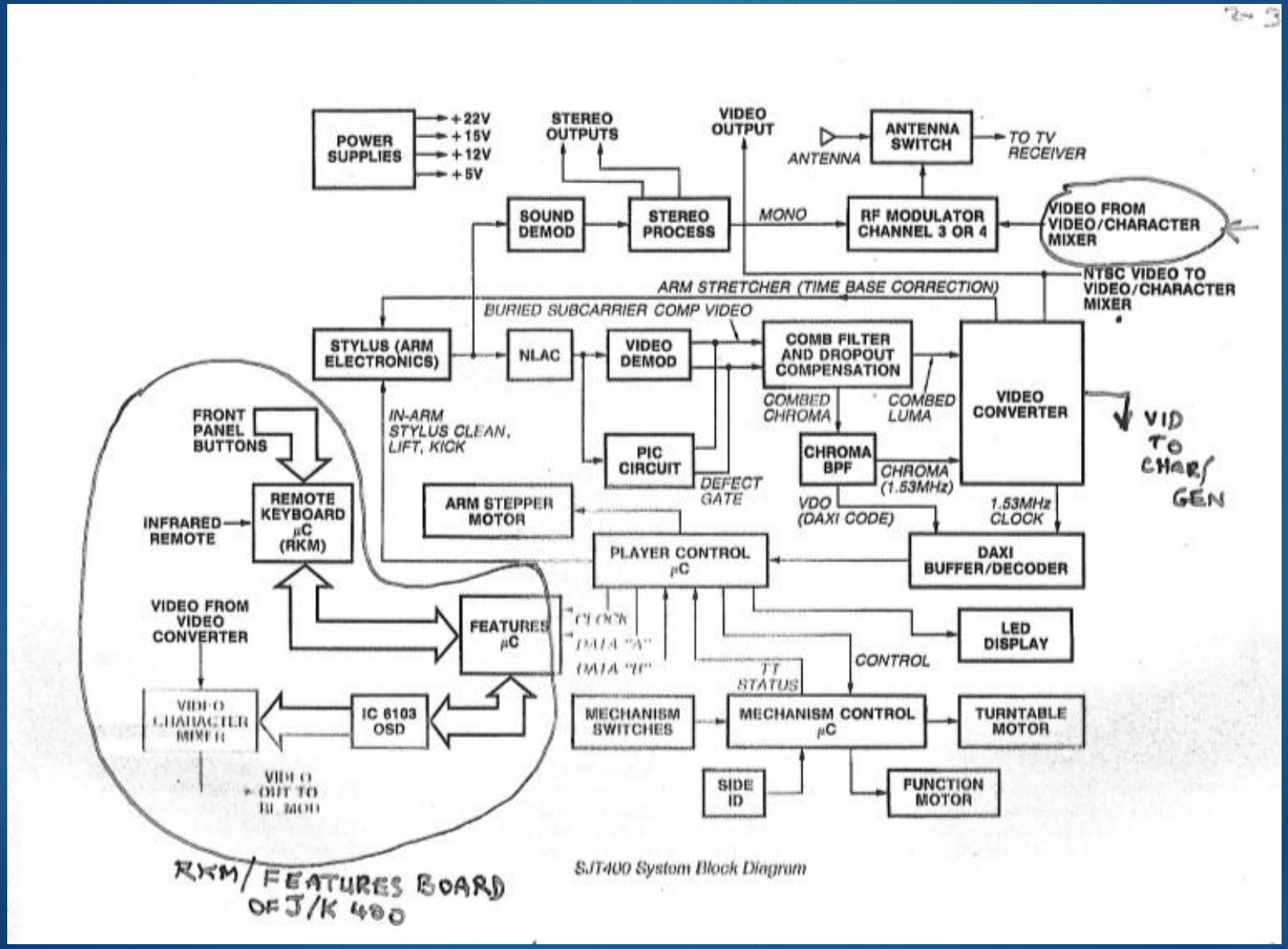
Fig. 5 — Simplified VideoDisc Player Diagram

G-LINE

CED Player Flow Chart J/K 200/300



CED Player Flow Chart J/K 400



CED Player Repair Tool Kit

- Phillips # 2 screwdriver
- Phillips # 1 screwdriver with a high quality tip
- 1/4" Hex Head screwdriver
- 1/2" Hex Nut driver. 1/4" with narrow head
- 1/2" Hex socket with driver
- Electric drill with removable tips
- Allen or Hex key. 1/16"
- Allen or Hex Key. 1/8" with long reach
- Needle nose pliers
- Soft paint brushes for cleaning. 3/4" and other sizes
- Stiff bristle brushes for cleaning.
- Digital multimeter with DC and AC and Resistance Ranges
- Silicone grease for plastic and metal (phonolube # 10-1223)
- Light synthetic machine oil (sewing machine oil)
- Syringe for use with machine oil (monojet for RC oil & gas)
- Omnilube 350 oil
- J/K belt remover solvent (glass cleaner with amnonia or household ammonia or 90% alcohol)
- Chemical resistant gloves
- Lint free wipes (handiwipes)
- Small flashlight
- Container for holding screws, etc.
- Spray contact cleaner
- Pocket ruler for 15/16 or 30/32 measurement on J/K players
- Dentist pick and flat probe
- Special magnet spacer gauge

CED Player Repair Tool Kit #2

Tool Kit Continued

What's wrong with my player?

John Stevens has made a wonderful Mechanical Service guide for both the F/G model players and J/K model players. I won't go over them in detail since we will be doing a hands on portion today that will cover most of this material but they are available for your viewing/printing pleasure here.

RCA F/G Basic Mechanical Service Guide
https://drive.google.com/open?id=1yA126Q5Thhw5bONS16rv-L2JlSoZGh3C

RCA J/K Basic Mechanical Service Guide Page 1
https://drive.google.com/open?id=1NU2b3ietNlRWFH3zeFJZ4kpNjpaloLam

RCA J/K Basic Mechanical Service Guide Page 2
https://drive.google.com/open?id=1PmtQHcOrtSYHY5gS1-BzvK_stVHWx5mA

Useful Servicing Tips and Time Savers
https://drive.google.com/open?id=1H1dVRiIP9nQmToT9VqmVMyjjZBlHe3iy

Thank you!

Links

Tom Howe's CED Magic Page
http://cedmagic.com/selectavision.html

CED Caddy & Label Variations List
http://www.cedmagic.com/forum/viewtopic.php?t=2152&highlight=variations

CED Player Manuals from LDDB
http://manuals.lddb.com/CED_Players/

Some neat information on the Bally NFL game, also a J400 service manual and Addendum under the Tech Center link.
http://www.dragons-lair-project.com/games/pages/nfl.asp

Video Links

How to remove and inspect a CED disc – By Josh Gibson
https://youtu.be/mpwuWQa6Ags

How to ship a CED disc – By Josh Gibson
https://youtu.be/6INFecHs6fI

Sync Plate Adjustment – By Tony Fleetwood
https://youtu.be/kj910yUZ6Xk

F/G Function Cam Adjustments – By Tony Fleetwood
https://youtu.be/tvzgetbdeWk

F/G Function Belt Replacement – By Tony Fleetwood
https://youtu.be/I71_IRN-n4E

J/K Belt Replacement/Service – By Tony Fleetwood
https://youtu.be/-jVh7xDa-EM

Common Q&A

I just picked up this player at a thrift store, how do I make it work and what's it worth?

How do I open a disc to clean it?

I have some discs I inherited, what are they worth and what's the best way to sell them?

I just got a player and some discs but it keeps skipping, what do I do?

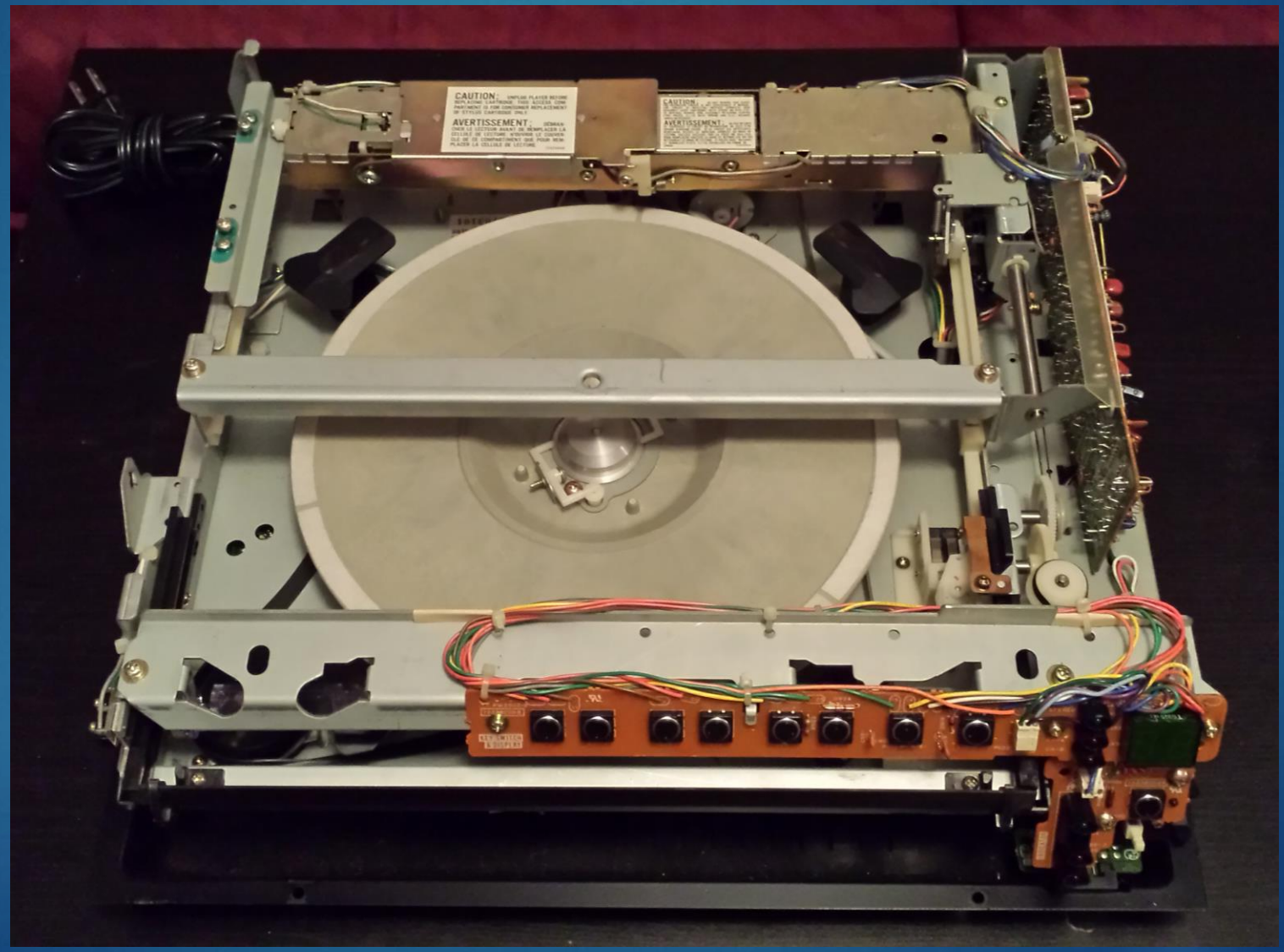
I just got into the format, where's the best place to buy discs?

I can't hook this up to my modern TV, what do I do?

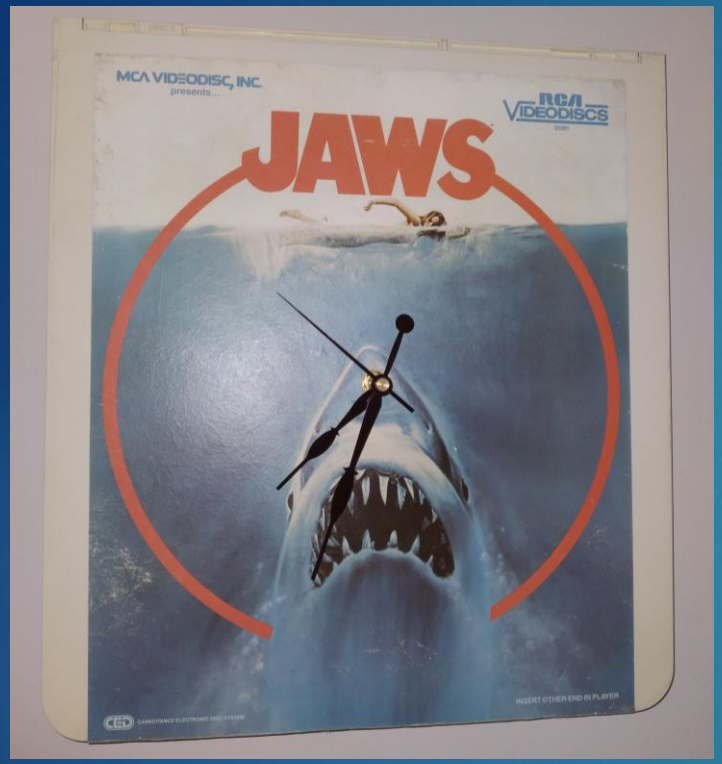
Where can I order new belts and a stylus?

Any more questions?

Hands on Time!



RCA Videodisc Clock



1. You will need to measure 17 Centimeters from the top of the disc and 16.3 Centimeters from the side of the disc.
2. Place a piece of tape over it and re-mark it.
3. Remove the spine and disc and reinsert the spine only.
4. Drill your hole with a 5/16th inch drill bit.
5. Remove the tape and clean the hole, then remove the spine to pull any excess shavings out of the caddy.
6. Reinsert the disc and spine.
7. Insert the clock movement through the back of the disc, don't forget to put the metal hanger on over the front of the clock movement.
8. Put the washer and nut on and hand tighten down.
9. Select your hands and attach.
10. Add battery and hang it.