



This new conception pre-amp has MC phono input and CD player input, without the signal passing through the switch.

The line amplifier has variable gain. In case of MC input, it is a non-inverting amplifier, whereas in case of CD input, the changing of input makes it an inverting amplifier by dropping the signal the side which is not used into the ground. Pentode tubes type 717A are used in the preamplifier in all stage. Wiring is done directly to the pins without sockets, trying to reproduce music without missing any bit of information.

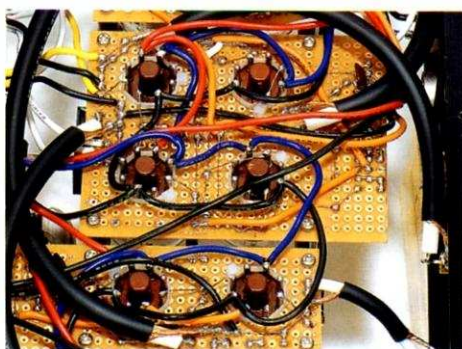
ラインアンプを反転増幅と非反転増幅に切り換えて入力信号を選択

## MC/CD兼用真空管プリアンプ

金田明彦 KANETA Akihiko



ケース両側板に渡したアルミ材に、5極電圧増幅管717Aを直付けした基板を吊り下げた構造。裏板側からの配線が容易



As for the GT tube, tube bases are included in mounting boards, with wires soldered to the pins.

The power section is in a separate chassis, power is supplied with 2 XLR connectors. Preamplifier itself has 2 input terminals MC and CD.



## DCアンプシリーズNo.194

ラインアンプを反転増幅と非反転増幅に切り換えて入力信号を選択

# MC/CD兼用真空管プリアンプ

〔前編〕

金田明彦 KANETA Akihiko

This preamplifier includes negative feedback equalization, connected to a mute selector to ground at output. Because of the low input impedance of the inverting amplifier, a bass equalization has been integrated. CD input is also included with a switch to switch the input signal. In this latest pre-amp, CD input is connected to a "reversal" input side of amplification stage, compared to the phono stage output. Musical signal then does not pass by the selector switch, thus freshness of sound has increased.



### The great idea

Although it has been said that it is difficult, by experience, to design a CD line amplifier which uses the reversal expansion amplification system, but it is probably a great idea.

The amplifier should expand the signal on one hand and on the other hand attenuate it, there are many possibilities to do so. Furthermore you must be able to squeeze the signal to zero.

CD signal level is high and signal level is very dependent of the source type, which often differ.

As for the reversal amplifier which is rare, direct connection to OP amp is very natural amplifier, application/response examples are wide, there is more opportunity to use reversal expansion amplifier than non reversal amplifier.

Expansion and attenuation is possible with setting gain. Furthermore it is possible to squeeze signal level down to zero.

The disadvantage of reverse amplifier is that input impedance is low. For CD playback, it is not a problem as the source signal from DAC accepts that, but for very good line preamplifiers, inverting line amplification has not been often used probably for this reason.

Meanwhile, non-inverting amplifiers are very often used in audio, in gain control amplifier, mostly with a non-gain of 1 (0dB).

This way, signal level of CD cannot correctly fit to my amplifier input level requirement; we should have a manual attenuation device. Because signal cannot be squeezed to zero, the muting circuit becomes necessary.

First of all, we should have a simple circuit constitution, with enough gain for the CD.

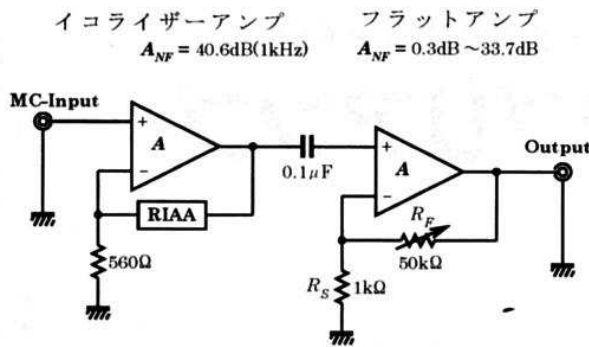
Output cable, power supply and output driver stage for channel filter are similar to the non reversal expansion amplifier. All required devices for CD playback are entirely included in the preamplifier.

But if we try to have both CD and LP input in one preamplifier, the signal must be switched on output side of the amplifier.

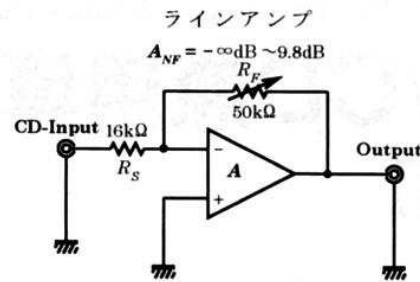
To achieve this with a single preamp, a buffer is added between the equalizer phono amplifier and the flat line amplifier, gain of the equalizer amplifier is then increased. This would lead to major and substantial modifications. Additional buffer amp is simple with semiconductor but with vacuum tube, it should have a constant current cathode follower, the chassis then becomes too small, which means a total new preamplifier design.

This one is the latest up-to-date pre-amp design.

Compared to the existing MC pre-amp, only the input switch and the input RCA jack are added, then you can have LP and CD. Preamp of course has a signal muting device for CD also.



【図1】 MCプリアンプのブロック図



【図2】 CDラインアンプのブロック図

There is no need to rework the equalizer amplifier. The signal line does not pass through the selector switch. So, no information is lost by the selector. Is it possible that such a magic happen with this simple trick? That is possible. This is the second great idea of the preamp.

This is not only about the sound quality, but also about the ease of use.

In DC vacuum tube amplifier, wiring is directly done at tube pins, which is possible by the replacement of most tube by US Octal base 717A pentode tube, wired in triode mode.

Of course, even with the former MC pre-amp and the CD line amplifier, you can remodel pre-amp to this CD combination layout. Music life would be spread even more with this machine.

### Gain control amplifier condition

In case of a differential amplifier, you can use inverting or non inverting input to amplify CD. But there is a condition to be cleared. The output stage of the amplifier must be in push pull operation.

Gain control of the amplifier is done by changing the value of feedback resistance,  $R_F$ , which control gain ANF of the NFB applied.

$R_F$  will load the amplifier. Lowering the ANF,  $R_F$  becomes small. The load effect for the amplifier becomes large.

It is the main defect of the power push pull output stage which low  $R_F$  largely to let flow electric current.

ANF then only changes the signal level. But there is a condition for that the sound quality is not different.

General attenuator, especially the poor quality pot has to be avoided absolutely.

The sound quality of the amplifier changes even at the NFB quantity. So if you change the ANF, before applying NFB, open loop gain  $A$  and ANF change the same quantity simultaneously, it is important that the NFB amount will always remains the same.

To be able to achieve this, the amplifier must be a current output type amplifier. A current output amplifier is proportional to the load resistance. Because, in a voltage output type amplifier, current is fixed regardless of to load resistance, when ANF is small, NFB is stable, and the sound quality changes.

Example 3: With any ANF, NFB is fixed. Most amplifiers with reduced ANF, with NFB for stabilization, it can even oscillate in worst cases.

When the pole (cutoff frequency of each amplifying stage) is designed so that the phase rotation is made extremely low, it can be avoided.

With excessive compensation, the sound quality is disappointing.

Amp fully symmetrical pole placement is appropriate, NFB is very stable.

This amplifier satisfies these conditions entirely, which is rare with a reversal expansion amplifier for CD.

### MC phono pre-amp and CD line amplifier

To study MC/CD combined pre-amp, first it will try to compare diagram of MC pre-amp and the CD line amplifier. Figure 1 is the MC pre-amp diagram, and Figure 2 it is the diagram of the CD line amplifier.

In MC pre-amp, which is a high gain amplifier,  $A_{nf}$  is 40.6dB at 1kHz, the small MC signal increase, with RIAA equalizer frequency characteristic of the signal to be designated as flat.

This equalizer operates in a condition to connect to high input impedance at the output (so that, flat amplifier non-inverting amplifier becomes high input impedance). ANF of the flat amplifier depends also on the value of resistance of feedback resistor  $R_F$ , but, with  $R_F$  pot of 50kOhms, it is from 0.3 to 33.7dB for example.

The opportunity to change the CD line amplifier to, for example with  $A_{nf}$  from  $\infty$  to 9.8dB, we instead use the opportunity to have more than 0dB gain.

Inverting input impedance is the resistance determined by the value of  $R_s$ , in Figure 2, it is 16kOhms.



Even with the same amp for CD and MC, changing value of ANF changes the impedance.

### MC / CD combined preamplifier

Figures 1 and 2 show the MC and CD preamplifier synoptic. It should be figured like on figure 3 for the combined preamp. As amplification loop is inverted, according to the music source, the switch changes the ANF range.

For a  $R_s$  of 5.1kOhms, ANF is set from  $-\infty$  to 24.5dB for MC. Adding a 33kOhms resistor to  $R_s$  at CD input, makes a ABNF gain from  $-\infty$  to 8.4dB. In order to balance the output level of MC and CD, ANF of the equalizer amplifier is raised in 47.9dB.

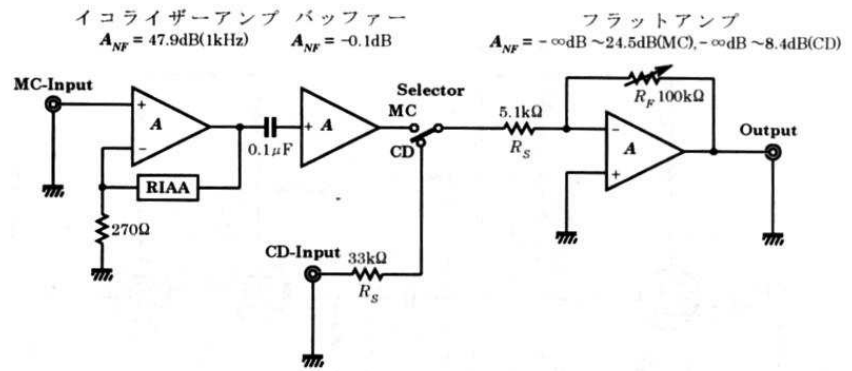
Furthermore between output of equalizer amplifier and input of line amplifier, a buffer is added to have a flat response. People often like and use Cathode follower, mu follower etc..

For the preamp use be easy, MC and CD have an appropriate equivalent signal level. This method of signal input and switch topology make the signal goes through the switch.

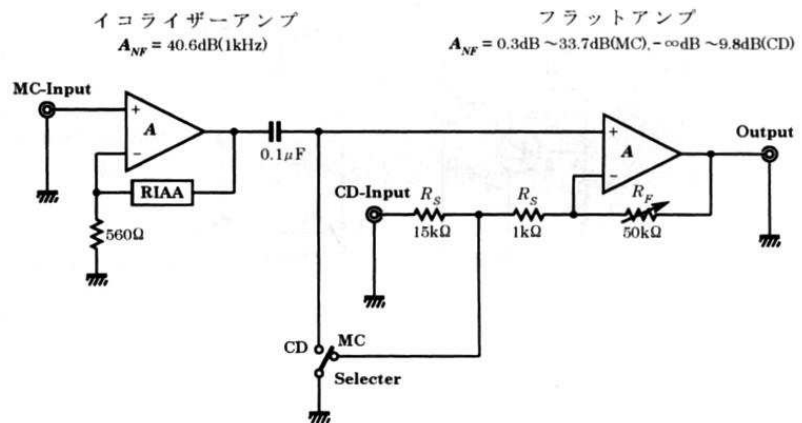
### Up to date MC / CD combined preamplifier

Figure 4 shows preamp, with the two "great ideas". There is no difference with the conventional equalizer amplifier.

Flat amp uses the two inputs simultaneously. Equalizer output is connected to the non-inverting high impedance input, whereas the CD input signal is connected to a low input-impedance, without crossing the switch directly.



〔図3〕 MC/CD兼用プリアンプ



〔図4〕 最新MC/CD兼用プリアンプ

The signal not used is shorted to ground: when playing MC, the CD signal line is shorted to ground.

Flat line amp in this topology becomes a non-inverting differential gain amplifier. With  $R_s$  at 1kOhms, MC ANF gain is the same as the flat preamp, with the same range of volume control.

When the CD is directly short circuited to ground at non-inverting input, the line amplifier in this situation is reversed. With  $R_s$  of 16kOhms, CD will have the appropriate gain range in ANF-line amplifier.

Originally, as line amplifier is a differential amplifier with two inputs, the signal which is not used at input, is short circuit to ground, the other signal is used as the desired signal.

This approach has many advantages. First, switch contact are not present in signal path.

The switch and the pin jack just added can be a simple improvement on previous MC preamp.

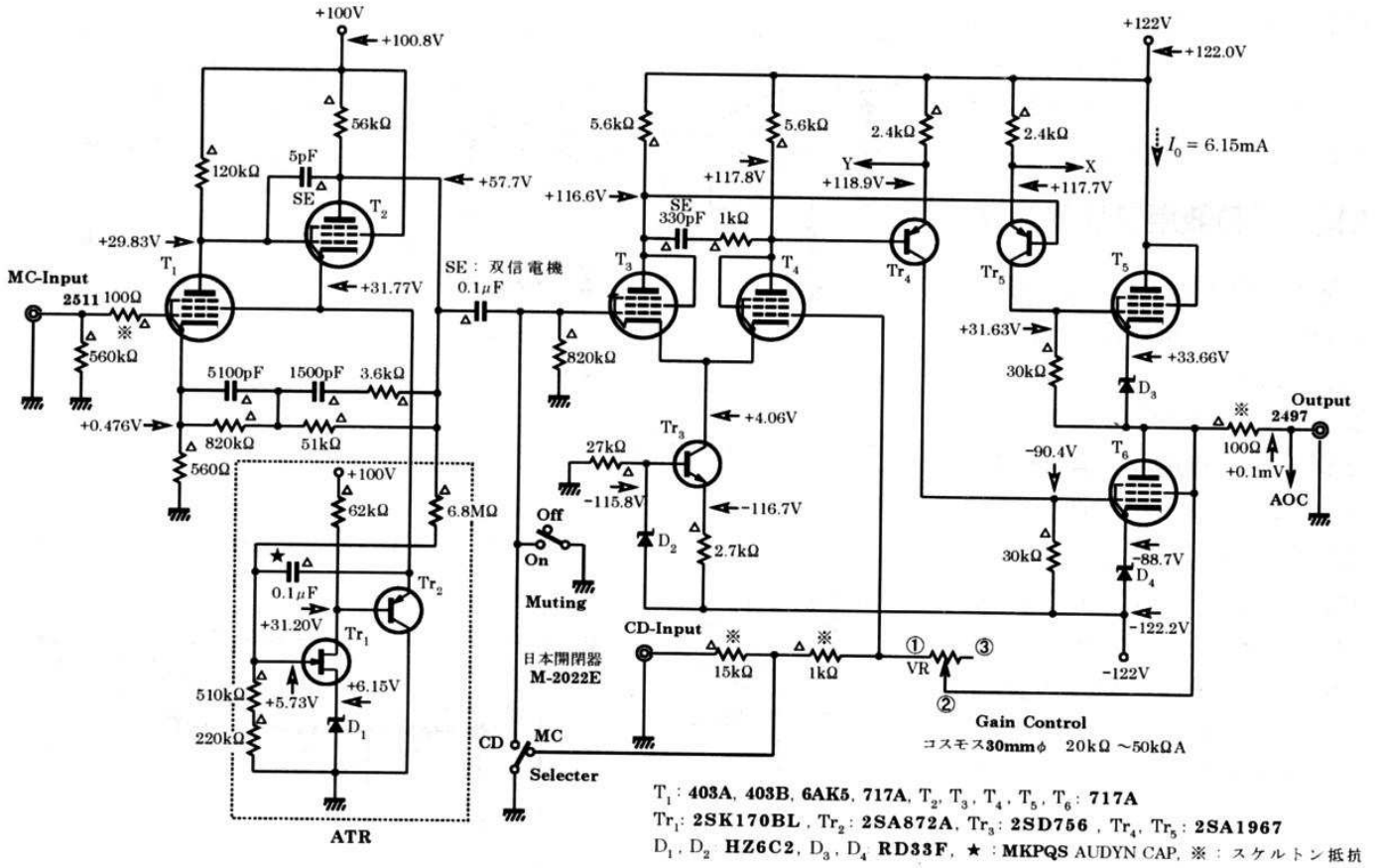
This is probably good news for the people who already use one the previous DC preamp. Benefits will be enormous.

### The MC / CD combined preamplifier

Figure 5 shows this MC / CD-type vacuum tube combined preamplifier.

This is mostly the same preamp, as previous preamp using 403A / B or 384/386 tubes, with the same circuit.

Extra input pin jack and a selector switch for signal selection, have been added.



〔図5〕 本機MC/CD兼用真空管プリアンプ

For MC playback, there is the need of a muting switch.

To tell the truth, the selector switch can substitute this muting switch. When you want zero signal for MC, you can change the selector to CD.

This is not twistable for the CD signal of course, thus this is the function of the muting switch. In order to make the preamp definite and for the use ease, an independent switch was provided for muting. You can combine switch, if you want to improve an existing pre-amp. When an existing pre-amp is improved, you can omit the front panel muting switch

## Condenser

DC amplifier system uses a coupling condenser. Capacitor is placed between equalizer amp and the flat amplifier. There is no superior capacitor for the sound quality than the Soshin SE capacitor.

But why a voltage of 60 to 100V often appear during operation.

During hearing, the fear is to get a sudden voltage at output. SE capacitor is to flatten voltage if it appears.

In all previous 403 preamplifier, coupling capacitor was 'Tone Factory', it was changed to Soshin SE mica capacitor.

This is no question: we return to SE capacitor. Probably, we get more musical information.

To prevent a blowout from occurring there, SE condenser is maintained here. Although probability of absence of offset is high, with power amplifier high sensitivity, and long hours of working, this is a security.

When arrangement of the amplifier and power source, or when you pile up cases, an unused amplifier should be put in

As for this amplifier, the semiconductor pre-amp which does not have the heat dissipation hole is good. If is not a standard unprocessed case should be used. Probability of a blowout decreases with this trick.

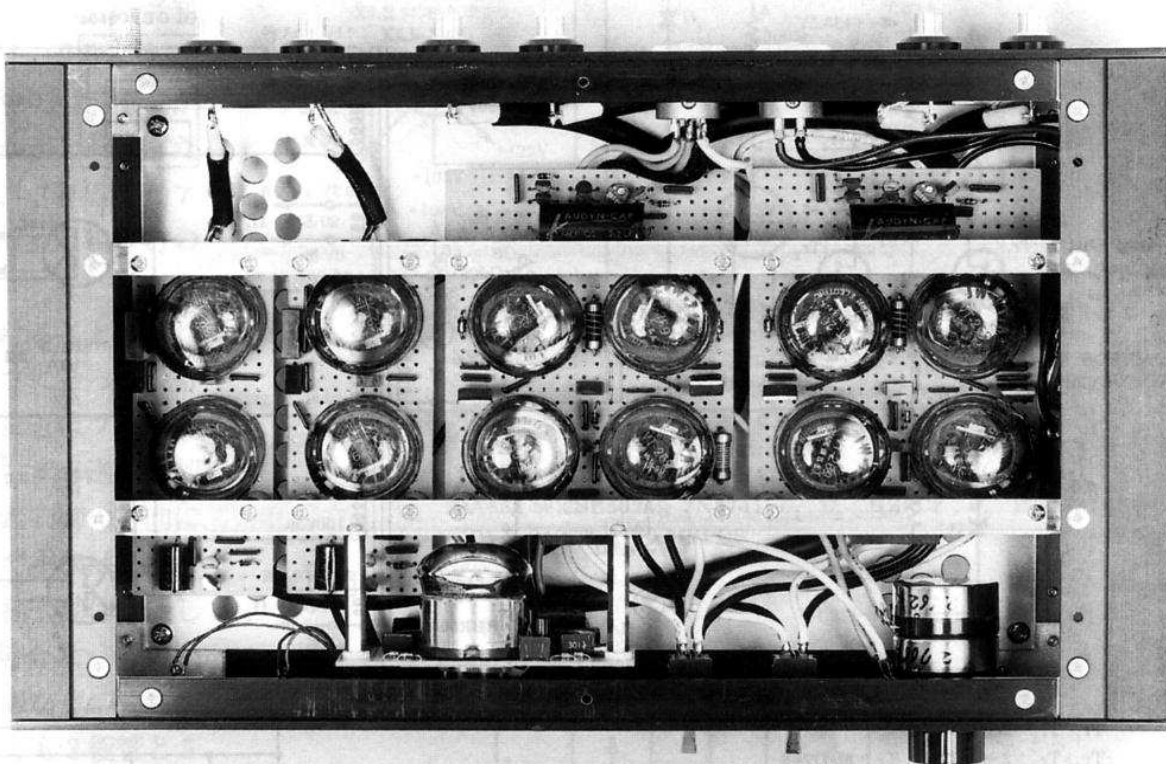
### First stage tube equalizer

Preamplifier was originally designed for 717A tubes.

When all vacuum tubes are standardized to the identical vacuum tube type, the next two merits appear.

The first one is that you can test the unique specific sound quality of each tube. Various kinds of vacuum tube would lead to a mixed sound.

The second is to increase the probability for finding the first stage low noise vacuum tube that the equalizer requires.



ケースの左右から渡したアルミアングルから4枚の基板を吊り下げた構造。真空管はUSオクタルベースの5極管717Aをすべての段に使用した

As the 384/386 which is a tube with direct lead wire pins, with the plate pulled out from the top, this 717A type, does not use a base, and the electrode are in vertical direction. When the 384/386 is used in the first equalizer stage, it has many 'microphonic effect', but you can use 717A.

However, you should know that due to resistance swing characteristic of 717A, it has dispersion. Out of 3 preamps built, only 1 unit sounds with very good sound. 2<sup>nd</sup> unit has a lot of 'microphonic noise'; at high level, "howl" start to happen.

For the 3<sup>rd</sup> unit, we were feeling the microphonic effect turns sound into electricity. It can operate as a microphone which converts sound into electricity, it can react to sound (aerial sound) which can be identified from the output ripple waveform.

Furthermore it seems that vacuum tube individual 'howling sound' always comes out. It changes with the pitch and operating temperature.

I have tried searching the vacuum tube whose resistance swing characteristic is suited for the first high gain stage but very good samples were not found. As for the frame grid 404A, the sound tends to vibrate, the cymbal hit continues with a "long howl". With the frame grid, the result was reversed. The 435A was fairly inoperable.

First stage equalizer plate voltage and screen grid voltage is 30V.

Running at that low voltage, tetrode tube such as 435A, 30V screen grid voltage is extremely low and the plate current is not pulling much current, thus the screen grid current increases. The behavior is not good.

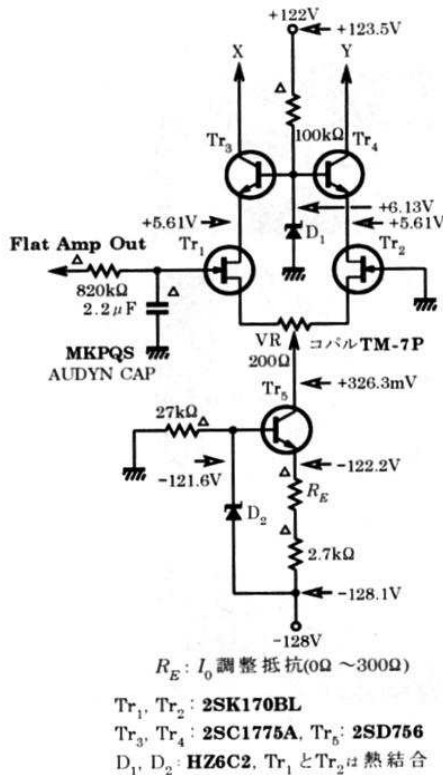
Type 403 tube is so much indifferent to vibration, it should be tried to use, this superior vibration resistance destiny it to the vacuum tube first stage equalizer. After all, vacuum tubes used in the first stage of the equalizer should be selected in terms of noise and vibration.

Extremely few tubes as the type of pentode EF86-403 were found.

The vacuum tube pre-amps which expand the small signal of MC cartridge directly are few, even in manufactured product; using tube in this first stage is a very severe condition that cannot be helped in any way.

#### **Amplifier power supply**

Tube preamplifier was almost finished whereas there are still unresolved problem of power supply for the line flat amplifier. First stage of the line amplifier has a high dynamic triode tube, which is susceptible to voltage fluctuations. If balance of two vacuum tubes is good, the differential amplifier power supply rejection effect is large. But because of subtle differences, difference occurs even in the rejection removal effect.



[図6] AOC

As a result, MC preamp output ripple will be observed at the flat gain amplifier output, when gain is at maximum.

Sometimes they almost cannot be observed. 10-20mV peak-peak may also be observed as triangle shape wave.

The differential amplifier has a better power supply rejection effect. But nevertheless we would like to improve this issue.

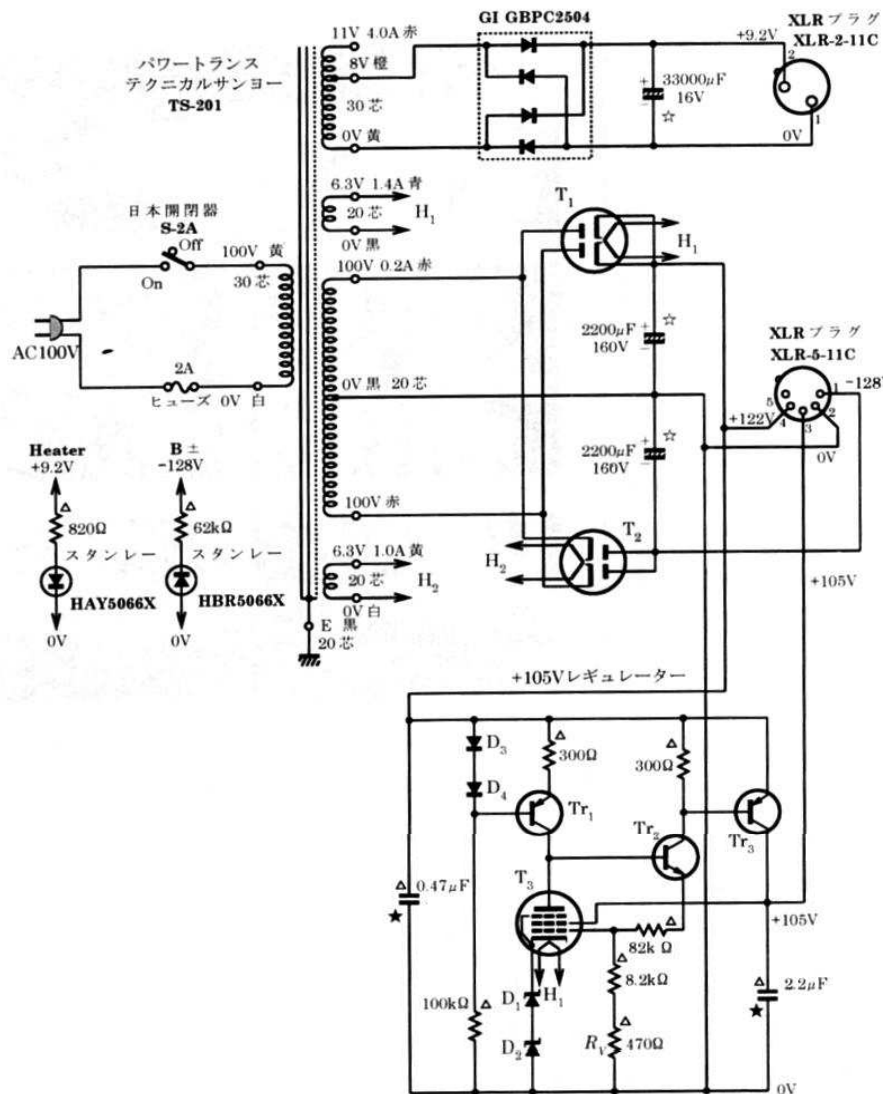
+105V is coming out from the voltage regulator of the equalizer amplifier.

I tried supplying current to the first stage of the line amplifier from this regulated power supply.

As a result, the ripple completely disappeared and the sound became clearer.

But influence appeared also in the equalizer amplifier. Because equalizer amplifier is a single ended 2 stage amplifier DC coupled, the power supply has a great influence.

With this topology with regulator, line amp has influence on the equalizer amp.



T<sub>1</sub>, T<sub>2</sub>: 412A or 6754, T<sub>3</sub>: 717A, Tr<sub>1</sub>: 2SA872A

Tr<sub>2</sub>: 2SC1775A, Tr<sub>3</sub>: 2SA653 or 2SB502 or 2N3741, D<sub>1</sub>, D<sub>2</sub>: HZ6C2, D<sub>3</sub>, D<sub>4</sub>: 1S1588

☆: 日本ケミコン KMH, ★: AUDYN CAP(RITEC) MKPQS

[図7] 電源部

A second solution has to be studied; it is studied at present time.

The solution of this article has to be considered only as one solution out of two possible.

One is the traditional approach: Add another +105 V single regulator, to power the first line amplifier stage. As a result, the sound is sharper and even more beautiful.

In the CD line triode connected amplifier, when a +105V regulator supplies power, the energy impression of sound decreases, which is quite strange.

Therefore the regulator was not used in the CD line amplifier.

On the second stage of line amplifier, there are strong fluctuations on the pentode tubes.

We have modified between 403A and 717A tubes in triode. In pentode tubes, screen grid current becomes the deciding factor, which should be powered from +105 V regulator.

In case of triode operation and AOC (output offset control) using, which also sink some current. Current is flowing other than the first level, but if, just the screen grid of pentode tubes, because it is an incommensurably little electric current.

Also the resounding/affecting for the equalizer amplifier probably will be smaller.

The sound of the pentode differential tube stage is very sharp, with high damping, also silent interval between musical instruments becomes clearer. However as gain become large, NFB quantity is larger, it becomes to give a kind of feeling as "retaining" a bit too much, and the sound is free from extravagant sounding like the triode amplifier. Being able to hear music pleasantly, this is the most important point for the audio amplifier. Recently on pre-amps and amplifiers, we tried to avoid excessive damping force, and progress toward optimum system. This machine has no regulator at power supply for line stages, and is back to triode connected operation. Pentode or triode operation, it will reduce the need to improve.

### AOC

Figure 6 is AOC. It is a simple circuit, and it is essential to this tube amplifier to stabilize the DC. Output offset is detected, in order to get output near 0V, output current of the mirror current stage is controlled. With audio signal, it is almost constant current.

### Power supply section

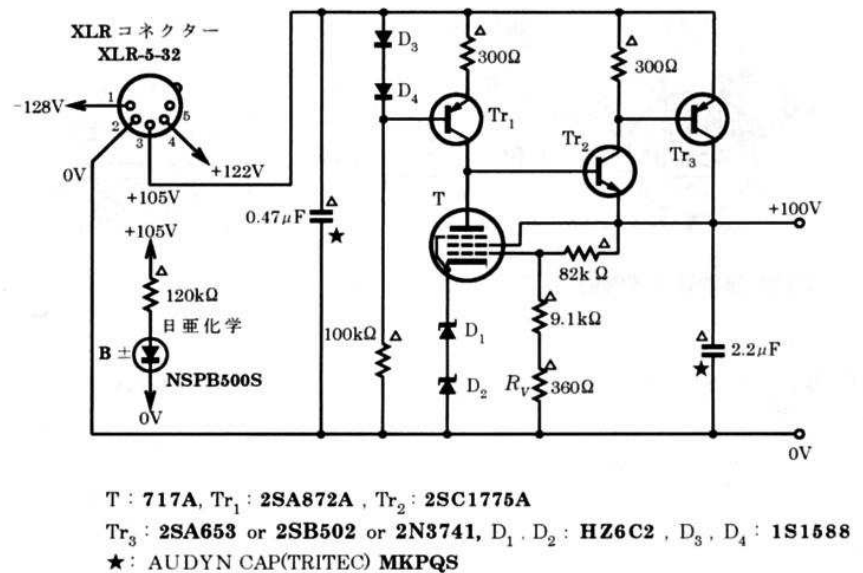
Figure 7 is the power supply section. The circuit is not different from the former preamplifier power supply. The tube of the '+105V regulator amplifier' changed to 717A, but, of course, you can use the same circuit even with a 403 tube.

### +100V Regulator

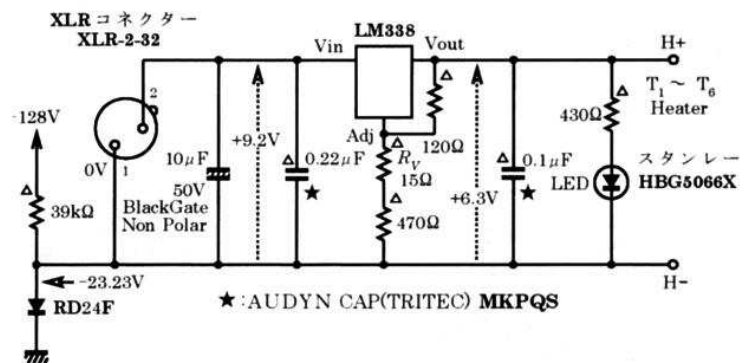
Figure 8 shows +100V regulator. The circuit is identical to the +105V regulator, just output setting resistor is different. You can also use a 403 tube in this error amplifier.

### +6.3V regulator

Figure 9 is +6.3V the regulator for the heater.  $R_v$  is the output voltage adjustment resistor.



〔図8〕 +100Vレギュレーター



〔図9〕 +6.3Vレギュレーター

### Construction

Vacuum tube and electrode connection. Figure 10 and 11 shows the electrode connection of the vacuum tubes and semiconductors.

For 717A, Cathode and Grid N<sup>3</sup> come out in the 3<sup>rd</sup> pin and the 5<sup>th</sup> pin, the shortest distance pin is use on the mounting plate.

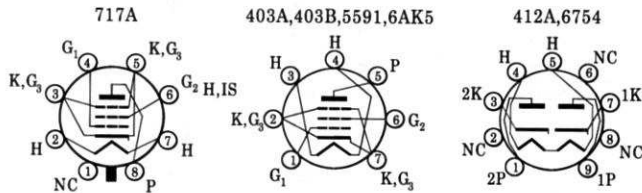
The 1<sup>st</sup> pin is not connected but the metal shielding of the center pole of the octal base is connected to it. The shielding effect is obtained with one wired to the ground pin, Nevertheless NC cannot be used instead of shield.

For 403, 2<sup>nd</sup> and 7<sup>th</sup> pins are connected to cathode and grid N<sup>3</sup>, but in the machine the 2<sup>nd</sup> pin is used.

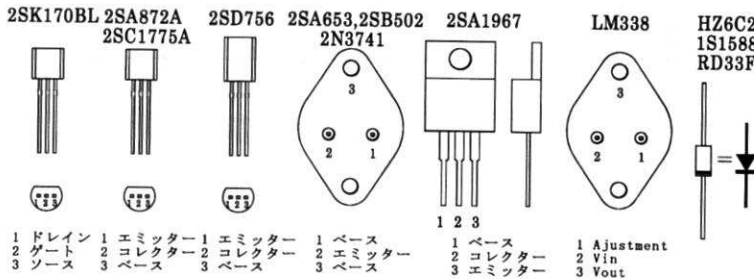
### Selection of vacuum tube

For DC preamplifier, selection of vacuum tubes is an important point to be successful. This is particularly important for the first stage equalizer tube. At the time when I used tube sockets, it was for changing tubes to search for the tube whose noise and howling was smallest. However, as it becomes a direct wiring, it makes some work to exchange tubes, it is necessary to choose the vacuum tubes before suit it to first stage. If the machine is a new construction, this is simple.

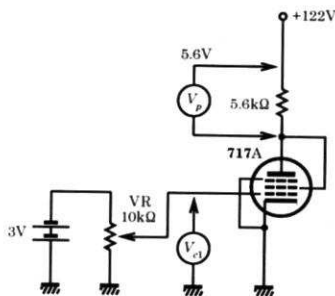




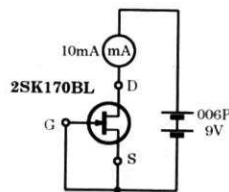
[図10] 真空管電極接続



[図11] 半導体電極接続



[図12] 717Aの $E_{c1}$ 測定



[図13] 2SK170の $I_{bss}$ 測定



[図14] 2SK170の熱結合

You have to remove the wire of the preamplifier first stage tube board. Lead wire may be stretched about 5cm.

The socket need not be fixed, to avoid shorting the metal case pins. And install a plastic sheet for absolute isolation during measurement.

Plug the tube to test into the socket, connect the power amplifier and speaker, the noise is thus amplified.

There is a various timbre even in noise. If some 'ssssccchhh' noise is no matter of concern, 'bass or rustling' noise is a matter of concern.

Furthermore when tapping the case lightly, you can check microphonic noise.

When a 403 tube is used in the first equalizer stage, the noise test of the 717A do not have to be done.

If you build a new vacuum tube DC preamplifier, the first stage tube has to be selected as in following procedure.

First: power section: The power supply section is built and the voltage check has to be done.

Build regulator circuit board and adjust output voltage. Then Equalizer circuit board is built. Wire a socket for T1 temporarily. When you insert a tube to test in socket, keep the input shorted to ground on the board.

Build the +6.3V regulator circuit board, install the +100V regulator circuit board and the equalizer board in the amplifier, wire the heater line and the DC line amplifier. The equalizer output line is wired to the output pin jack temporarily (20cm). The amplifier and line preamplifier may be any one line of preamplifier and power amplifier available.

Now you can hear the noise of equalizer amp. Successful applicants of 403 are about 20%-30% of the basic values, for the ratio of successful applicants of 717A, it is 30%.

But ratio of successful applicants goes down in the point of microphonic noise.

You use the vacuum tube noise disqualification for line and regulator.

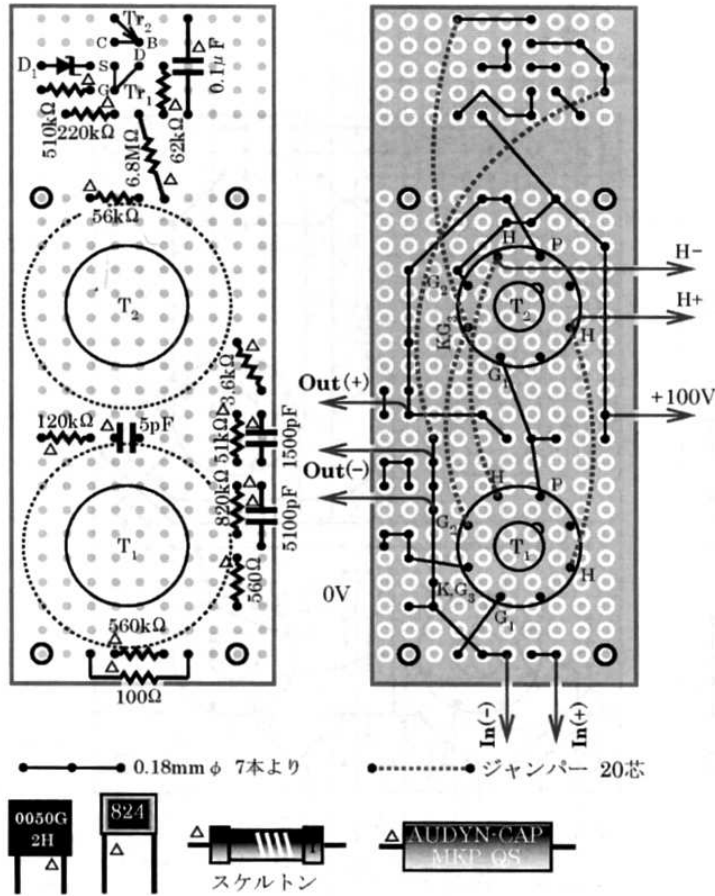
For the 110V regulator, the tube with little noise as possible is better to use.

As you rarely get the same noise levels out of Lch and Rch, if you get the same noise, it should probably come from regulator B+. In such case, try to replace with 717A.

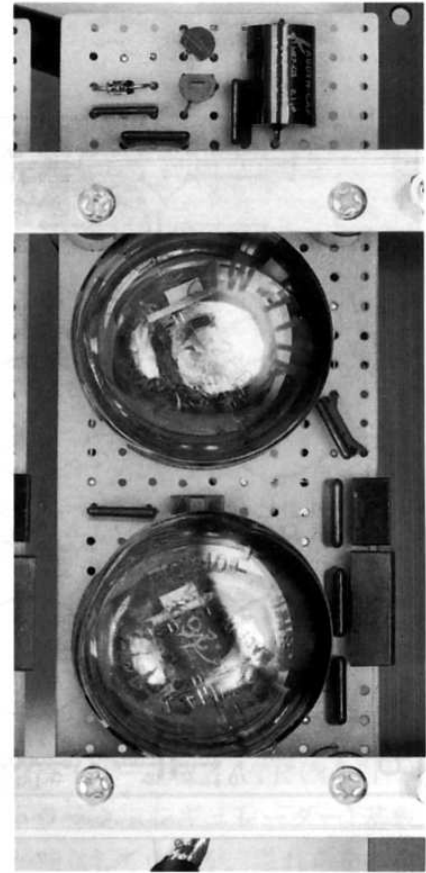
Next is measurement of differential amplifier first level tube T3 and T4. Measure 717A tubes under the conditions for being equal to the operating condition of the first level. Before the measuring, just turn on the heater in order to 'warm' tube.

Using the power section of preamplifier, measurement circuit for 717 is shown on figure 12. In order to set a voltage at plate load resistance of 5.6kOhms, at 56 V (thus  $I_b=10mA$ ), VR has to be adjusted and then measure the  $E_{c1}$  grid voltage.

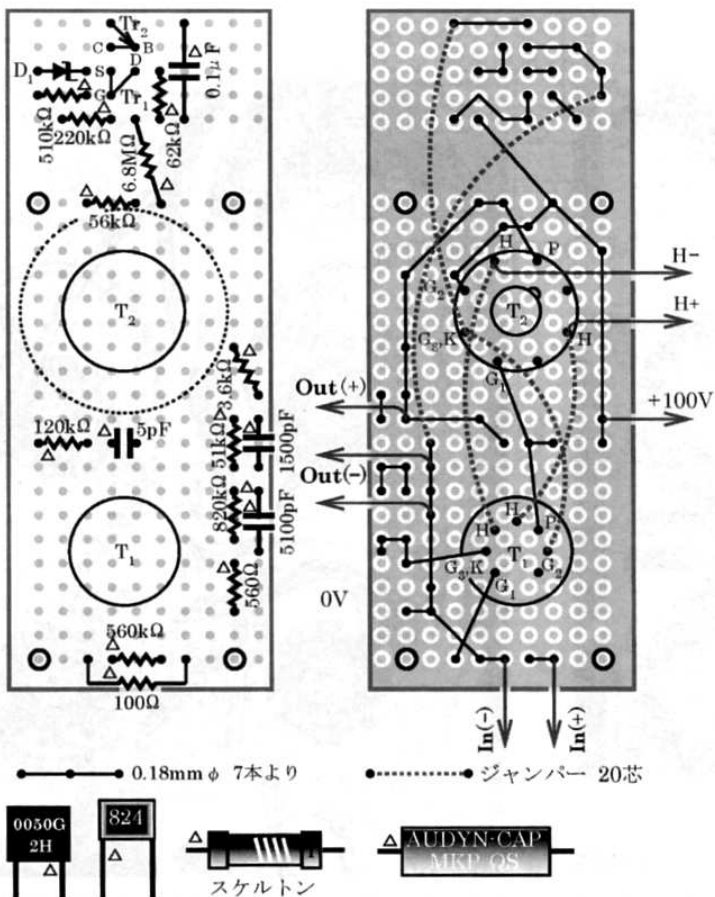
$E_{c1}$  of the pair for differential amplifier should be close. The vacuum tube whose  $E_{c1}$  is low relatively has to be used in first level tube T3 and T4, the vacuum tube whose  $E_{c1}$  is high has to be used in output stage T5 and T6.



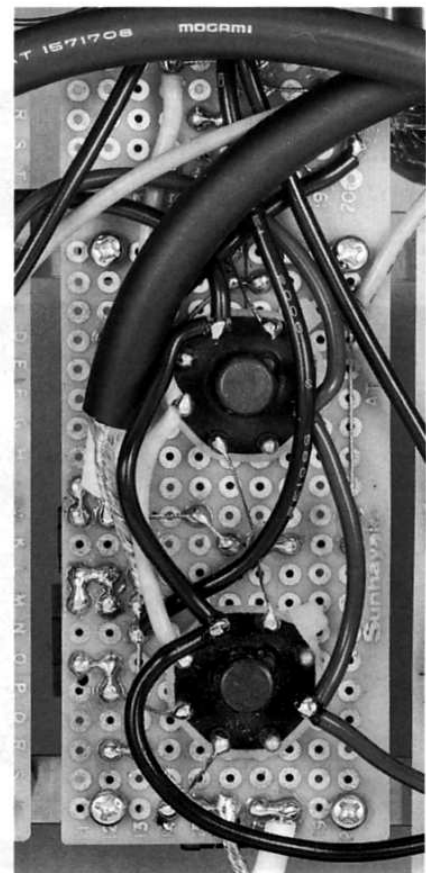
【図15】 イコライザーアンプ基板 (717A)



フォノEQ基板は717Aによる2段増幅。真空管にバラツキがあっても動作を安定させる電源部を基板上に配置



【図16】 イコライザーアンプ基板 (403)



フォノEQ基板裏側の配線。真空管のピンをインシュロックタイで縛ることで固定している

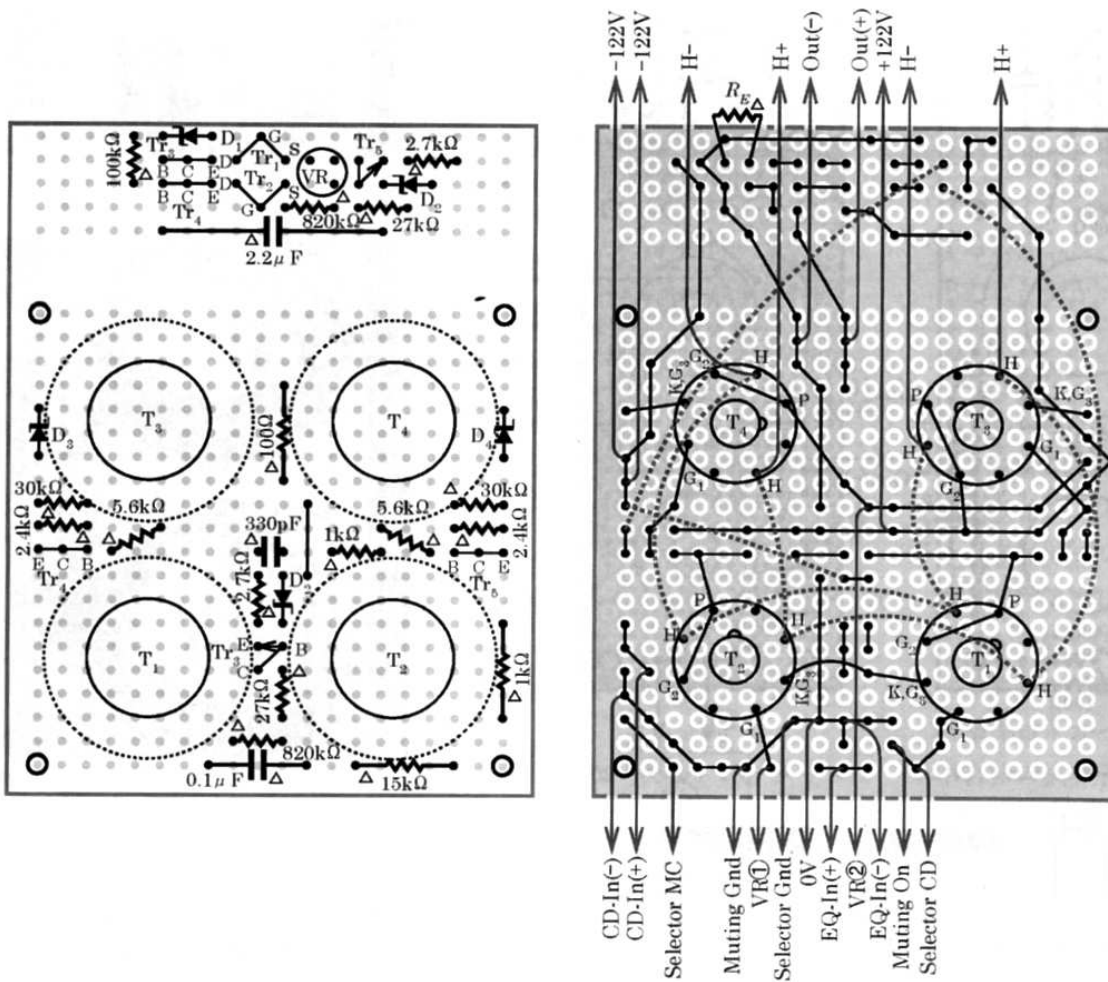
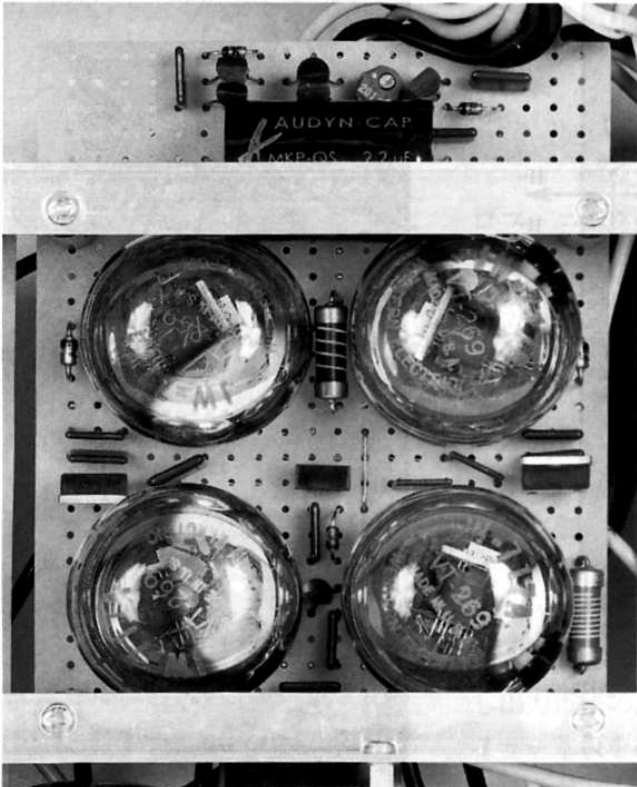
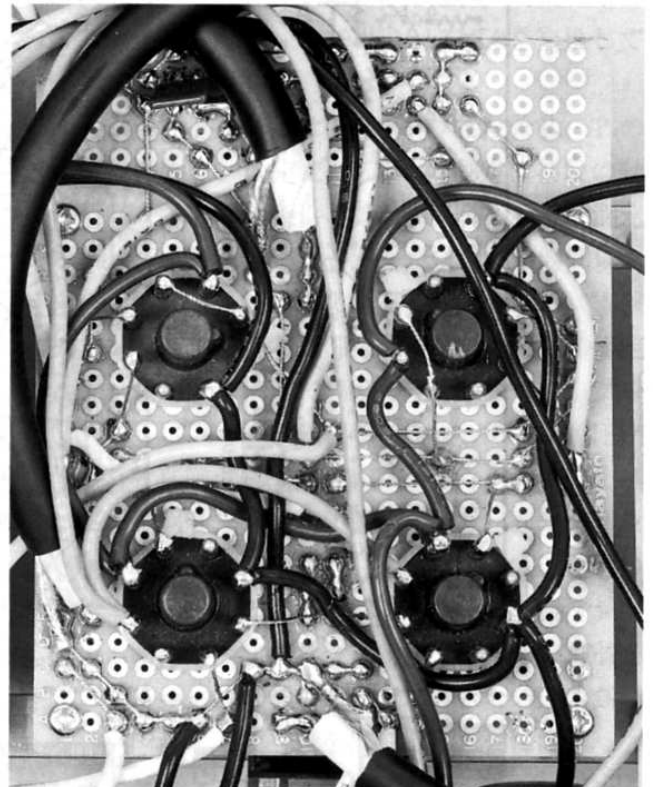


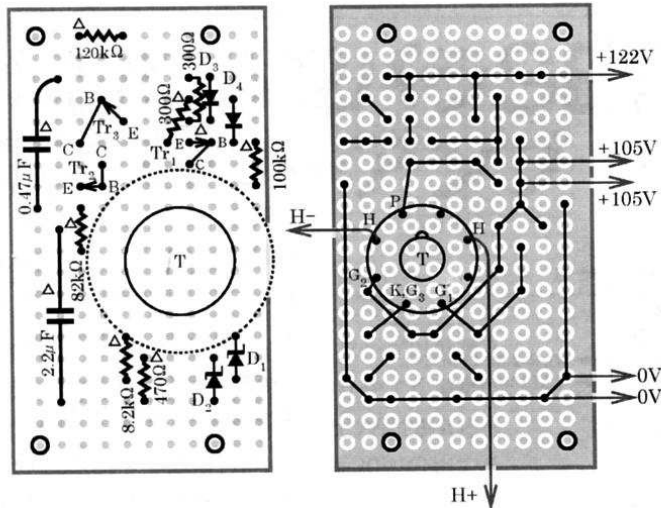
図17 フラットアンプ基板



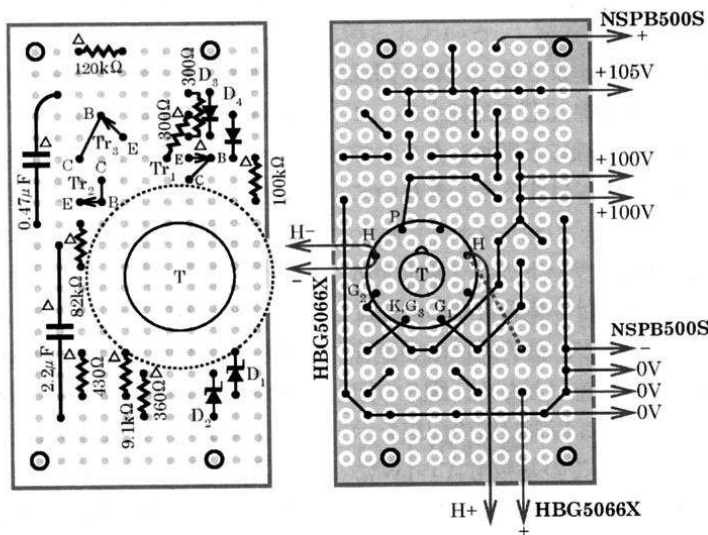
ラインアンプ部は差動アンプとプッシュプル出力段用に4本の717Aを使用。出力のオフセット電圧を抑える回路を基板上に配置



ラインアンプ部は差動入力側の非反転入力側にEQ出力を、反転入力側にCDを常時接続。一方をアースに落とすことで他方の入力を選択される



[図18] +105Vレギュレーター基板



[図19] +100Vレギュレーター基板

### Semi-conductors

Tr1 and Tr2 of AOC circuit (2SK 170) matching pair has a direct influence on the stability of offset voltage V0.

If possible, the method shown above in figure 13 definitely leads to a better matching. When you measure IDSS (voltage between the gate and source is 0v in the circuit in Figure 13, Id), the difference between transistor units to make pair for the differential amplifier should be within 0.1mA. Tr3, Tr4 and Tr5 do not have fixed gain necessity in this circuit.

### Thermal connection

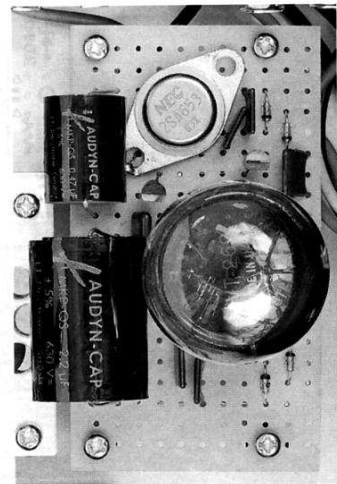
The only required thermal connection between transistors in this machine is for the first stage of AOC circuit (only for Tr1 and Tr2).

Figure 14 shows the thermal connection pattern. You use quick hardening araldite glue, to bond transistor Tr1 and Tr2 to each other.

### Circuit boards

The equalizer circuit board has to be chosen among the next 2 types, you build two of each.

Figure 15 shows the circuit board which use 717A for T1 and Figure 16 shows circuit board which use 403 for T1.



+105Vレギュレーターおよび+100Vレギュレーター基板の誤差増幅に5極管717Aを使用

In the 384/386 pre-amps, equalizer circuit board and ATR (the automatic track regulator) had independent boards. When all circuit is built on the same board, wiring becomes rationally, also the number of jumpers decreases and becomes easy to wire.

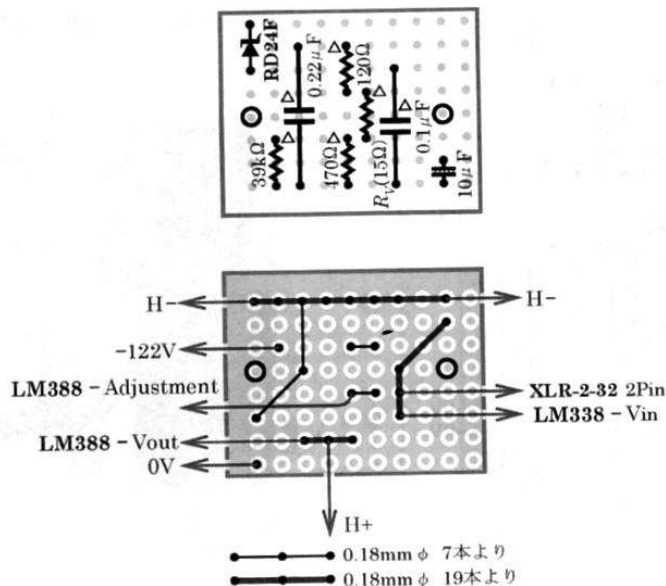
As cutting holes for tubes is easier in large boards, cut opening then separate boards for each circuit afterwards.

The hole for 717A has a diameter of 20mm; hole for 403 has a diameter of 18mm. Location of hole should be precisely marked with black sign pen.

You open the big hole if possible with the drill, expand with the reamer. This time, you should use a rather round one, whose round part is adapted to the round hole. When you get near to the line, work carefully with reamer.

Wire the other parts apart from the vacuum tube. The 5100pF cap should be placed according to the distance if the lead across to a 1,5mm diameter hole directly to the wire.

Next, reverse side wiring is completed as much as possible; 50mm metal support is locked in the support installation hole of board top side.



[図20] +6.3Vレギュレーター基板

When wiring reverse, keep the circuit board horizontally. To maintain the base of 717A against the board, pass pins through the circuit board and bind base pins with nylon collar. With such device, fixing and exchanging tube is simple. For installation of 403, vacuum tube passes through the circuit board hole, with nylon collars around tube on both sides. This maintains tube across board. Then you should put some glue at 4 dots at the circumference of tubes. The 403 tube is then locked on the board, removing will be very difficult.

Pin N<sup>o</sup>1 and circuit board will be wired with MOGAMI 2497 cable.

Pins are wired with 7 stranded wire cable, with 20 AWG core section.

After doing the estimate mounting in place, in the pin and the lead wire, then solder, it then can be wired cleanly.

Figure 17 is the line amplifier board. In the picture, pentode tubes are connected in pentode, but finally, it should be settled in triode mode, as Figure 5 shows the circuit with the triode connection wiring. This circuit board and AOC are also arranged from AT-1W Hayato board. Wiring is produced with 7stranded wire for circuit is clear and clean. Before installing 717A, you arrange other parts, and reverse side wiring is completed as much as possible.

Wiring between these six boards can be wired with 7 stranded wire, in order to keep it cleaner.

The 2.2 μF cap is installed after installing the 717A. Board is just a little narrow, but is the board is enlarged of 1 extra line, wiring the power supply XLR connectors becomes difficult to do.

Because with reverse side wiring of the boards, there is a place where the ground line crosses the power supply line,

The ground line is on the reverse of the board side.

After installing the port, lock 717A, and do remaining reverse side wiring.

The resistance of 100ohms is temporarily wired in RE of AOC.

The resistance of 10 ohms is inserted in one of the plate of Tube N<sup>o</sup>3 in order to measure idling electric current detection between G2 and +122V supply.

As on Figure 18 for the regulator board for +105 V, Figure 19 is a regulator board for +100V.

Hayato AT-1S Boards are separated after having done the round holes for 717A tubes. Also wiring method of these boards is similar to equalizer and the flat amplifier.

The resistance R<sub>v</sub> of 470 Ohms is temporarily wired on the board reverse side.

The dropping resistance for the +100V led light is also arranged on the circuit board.

Figure 20 is the board for the +6.3 V regulator. LM338 is at the right side, secured to case side panels.

22 Ohms R<sub>v</sub> resistance is wired at the board depending on the position of R<sub>v</sub>.

(To be continued in next MJ issue)



# MC/DC兼用真空管プリアンプ [後編]

金田明彦 KANETA Akihiko



Contact points on signal path have been reduced in order to get the maximum information possible from signal source. Components are soldered directly to tube pins. This time, signal does not pass through input selector as a new conception was done with line input stage with amplifier for both inverting and non-inverting differential input. Signal can also be connected to ground for muting. The line amplifier has a variable gain, it is inverting if you select CD input and non-inverting when you select phono input.

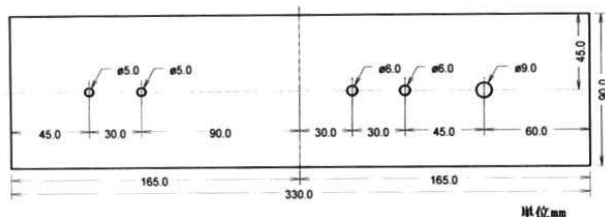
## Case working:

The case of the preamplifier is a case from TAKACHI electronics industry reference OS88-20-33BX. Figure 21 to 32 (10 sequential reissued from former model) for figures and dimensions of metal work. A selector has been added in front panel and a socket for CD input at rear panel.

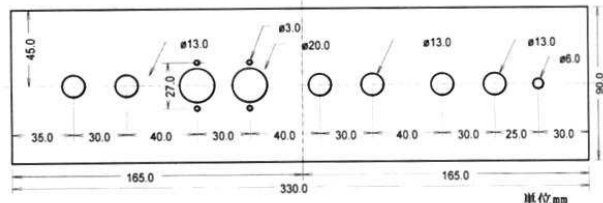
The power pin jack was added. The other things are not different to from the previous preamps. When you would like to improve the previous amplifier, just add one 6 mm hole in front panel, but rebuild a new rear panel would probably be better. TAKACHI electronics sells separate parts of the case.

However as the panels are not higher, please pay attention to the position of circuit boards.

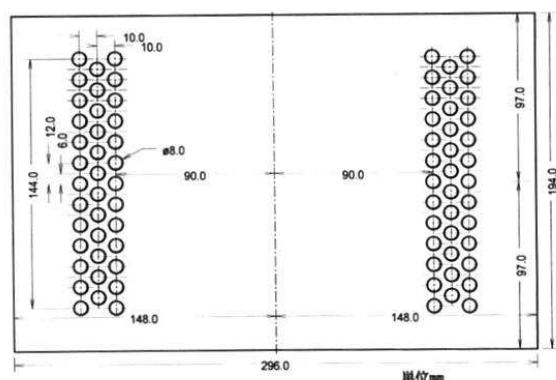
The 2 L angle profile of 10\*10mm as in Figure 27, were fixed in the case frame with 30mm supports + 5mm spacers hanging down, so that the circuit boards are lowered. Because in the preamplifier the back of 717A is high, the L angle is fixed at 20mm from the metal support.



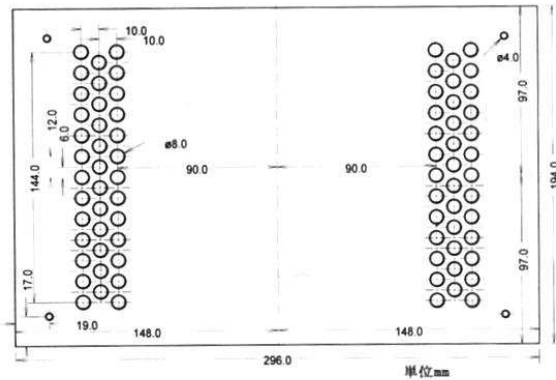
〔図21〕 プリアンプフロントパネル



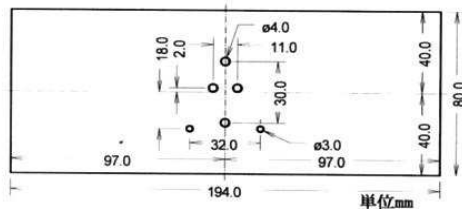
〔図22〕 プリアンプリアパネル



〔図23〕 プリアンプ天板



〔図24〕 プリアンプ底板



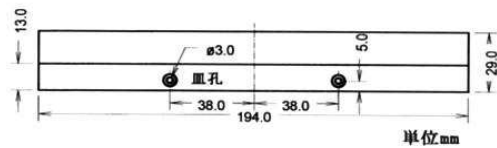
【図25】 プリアンプ右サイドパネル

Figure 33 is the 412A mounting panel. It is made of aluminum sheet of thickness 1.2mm and 55\* 10mm size and L type angle. For this, board has to be cut at the correct length, after holes are made. Holes are punched in a horizontal hold position, in order to keep the plate flat, as thin aluminum panels often bent when punched.

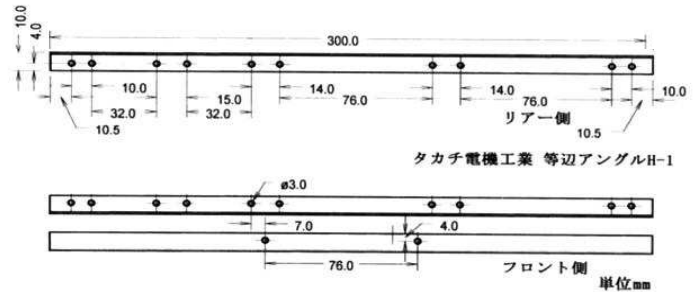
#### Wiring of the power supply

The power source section is wired at the same time as the assembly of case.

First you install the parts in front and rear panel, which is completed with the lettering.



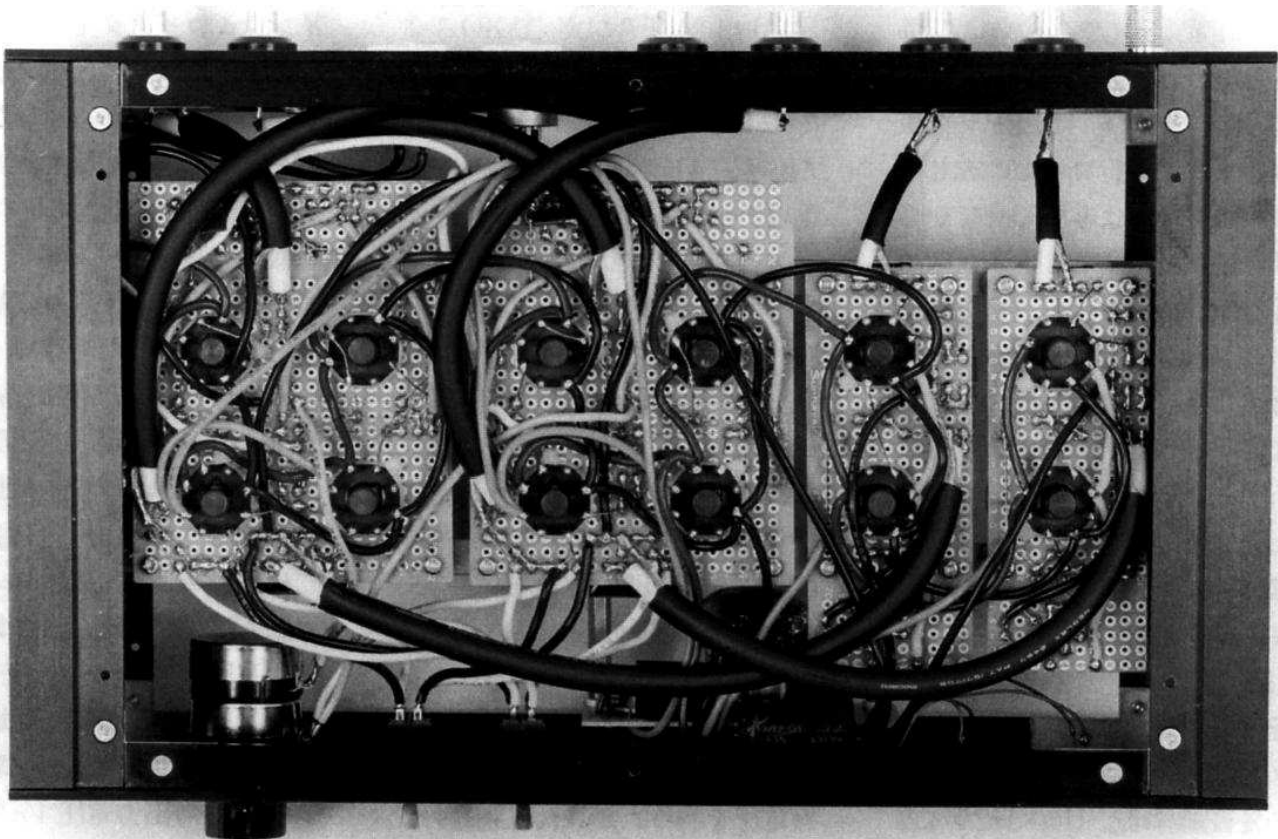
【図26】 プリアンプフレーム



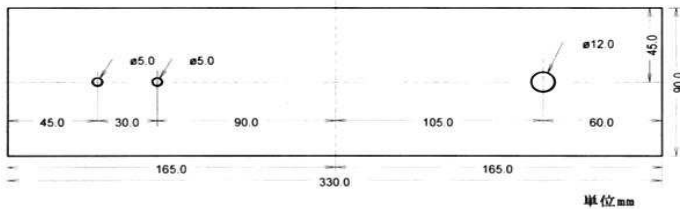
【図27】 プリアンプアングル

Prepare the parts and the base plate from case, then check the transformer windings, each winding should be fit connections. Use AC 8V for filament line, and wire the diode GBPC 2504. 11v leads are not used, bring wires together. Wire GBPC 2504 diodes to the DC output 33000μF capacitor.

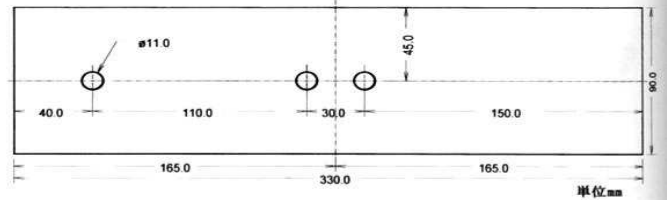
After installing the transformer base plate on case, wire primary side of transformer. It is wired parallel with 30 AWG core wire directly soldered to the dark red AC 100V plug. In "DAIEI", D is the phase side of primary.



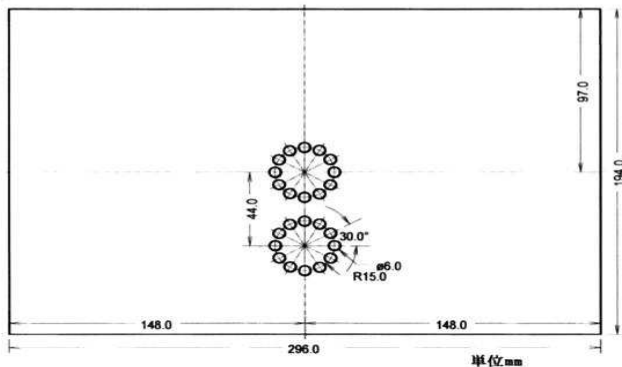
アルミアングルで4枚の基板を吊り下げた構造のため、基板裏側をささぎるものは何もない。製作時の配線、将来の改造などが非常に容易になっている



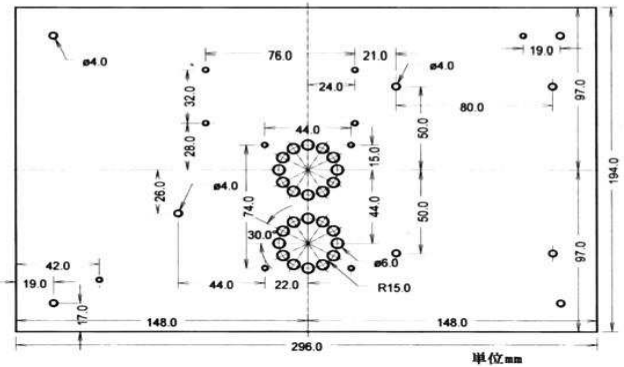
[図28] 電源フロントパネル



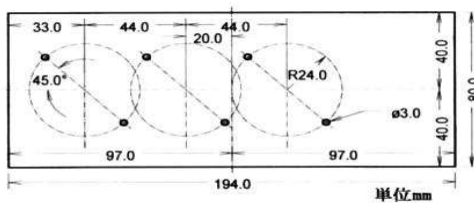
[図29] 電源リアパネル



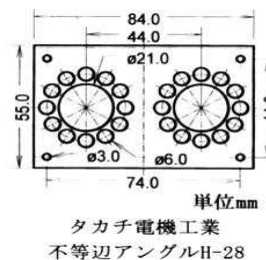
[図30] 電源天板



[図31] 電源底板



[図32] 電源左サイドパネル



タカチ電機工業  
不等辺アングルH-28

Cold side of the AC100V primary coil (white) is soldered parallel to the black wire, use "1L2P" lug to secure to the plate. Wire the switch from the red and yellow code parallel wires. Shield between the transformer primary and secondary, gets out with the two (black) wires, connect it to the ground plate. Then wire the two primary wires of transformer.

412A tubes are installed in the panel in Figure 33. Method is similar to the installation of 403 (the August edition). The +122V line is pulled out from 1<sup>st</sup> and 2<sup>nd</sup> cathode of T1 with the reverse side of the installation panel as on, -122 V line is pulled out from 1<sup>st</sup> and 2<sup>nd</sup> plates of T2. The secondary AC100V lines are wired it between cathode and plates of T1 and T2. Wire H1 and H2 heater lines. The heater wiring to T3 is pulled out from the heater of T1.

The 412A installation panel is locked in proper position. Install Chemical Condenser caps on the left side panel, fixed from the outside of panels. Connect the +122V line, the 0V line, and -122V line to the 2200  $\mu$ F caps. Be sure to correctly hold caps and hold nuts and screw of terminals.

Wire the DC9.2V line from 33000 $\mu$ F cap and LED line. Dropping resistance is secured to the plate with 1L5P lug.

Check the rectifier circuit at this point. Turn on to measure the DC output voltage. Because with no-load, voltage of Figure 7 will be rather higher. After checking, capacitor will keep charge, so use a discharge resistor.

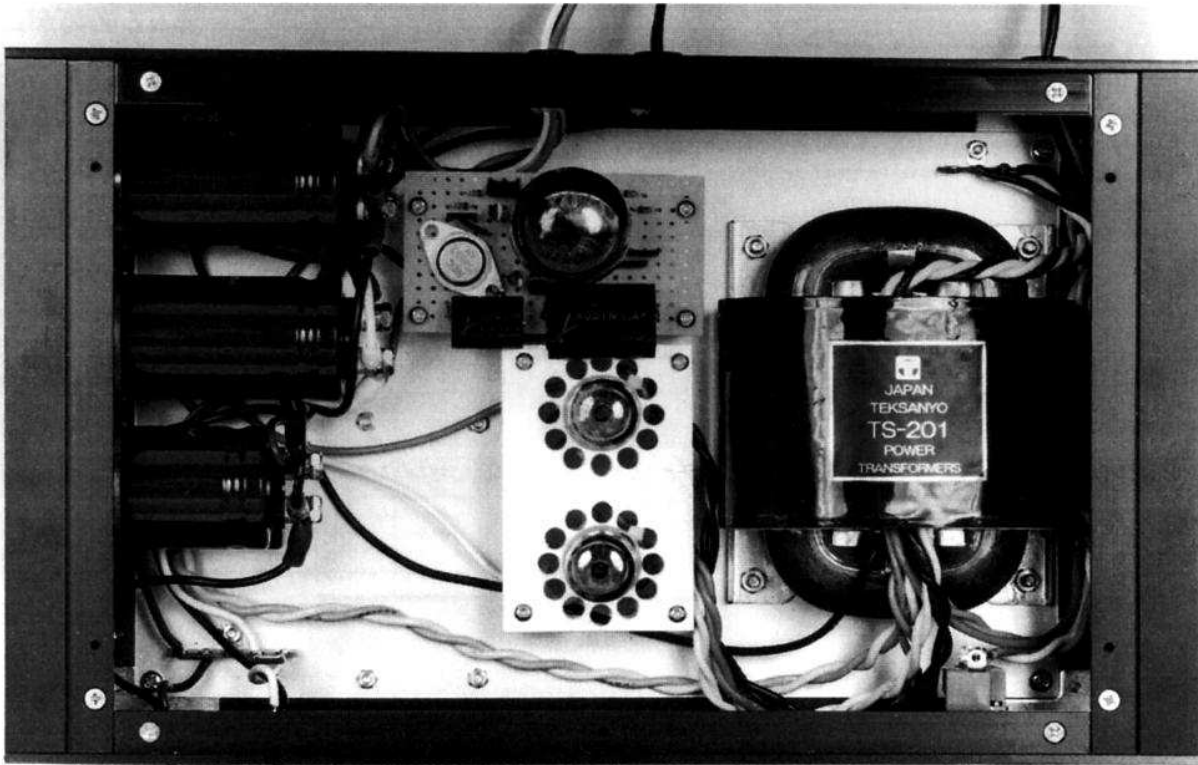
Wire the XLR plug. The length of wire should allow arranging the pre-amp and power supply side by side, with some free length.

Bundle the wire and add the length of internal wiring of power supply as needed. The wire passes through the plastic rear panel outlet, install wire and wire it at the Chemical Condenser.

### Heater adjustment board

As for the circuit board (other than the flat amplifier), the better method is to complete adjustment of circuit before installing board in the case. The first thing to do is to adjust the +6.3V output voltage of the regulator.

LM338 regulator is wired between the +6.3 V regulator board, the amplifier case and the XLR connectors on the power supply. +6.3V should be measured at the XLR connector, based on the V0 offset voltage to tune to 6.3V at output.



電源部は別筐体で、Rコア型トランスを内蔵。B電源には整流管を使用し定電圧電源を搭載。定電圧電源の誤差増幅部には5極管717Aを使用した

When  $R_v$  is enlarged,  $V_o$  becomes high, when  $R_v$  is reduced,  $V_o$  becomes low. When the value of  $R_v$  is tuned, wire it in proper position.

Next, you adjust the +105V regulator. From the +122V power source and the H1 filament wiring, then turn on the filament. The  $R_v$  resistor adjusts output voltage as in the +6.3V regulator. When the value of  $R_v$  has been chosen, wire it in proper position. Then, wire the +105V from regulator to the XLR connector and mount board in case.

To adjust the output voltage of the +100V regulator, you need the +105V output voltage of the regulator and +6.3V output voltage of the filament regulator. Wire temporarily the XLR connector and the regulator board of the amplifier, turn on the +105V regulator, and adjust  $V_o$  value.  $R_v$  should be wired around the center position. Check that the +100V regulator voltage and the +6.3V filament voltage arrive to the equalizer board.

These lead wires should be connected to the circuit board, with preamplifier input shorted to the ground.

Turn on the power supply and wait until DC voltage is constant. If the +60V is checked OK, then check the output voltage of the ATR. This voltage can vary widely according to the specification of tube T1. If voltage is between +22V/+35V, there is no problem.

#### Preamplifier Wiring

Assemble, wire and adjust the line amplifier section in parallel. Equalizer amplifier and regulator check being completed.

In the panel where the lettering has been completed, assemble and install led lights. Install top and bottom board after adjusting. Before installing angles, wire power supply to the XLR connector.

There is 2 wires connected to the -122V line, 3 wires connected to the 0V line, 1 wire to the +105V and 2 wires to the +122V line. AWG 20 core cables are tied securely together at 12mm from end.

A 6mm length cut for soldering is prepared.

Solder wires to the connector pins you have pre-soldered previously. Be careful not to make some shots between pins with solder.

Next, you install 20mm spacers on the upper part frame of case, 35mm length support are locked to the angle studs, abut if you only have 30mm support, add 5mm spacer. Line preamplifier circuit board is hold in place.

The heater is wired first to the board. Then wire the +122V power line, and don't forget the 0V line. Then wire switches and front VR gain control. CD input wire, to the VR gain control and switch, is using Mogami 2497 cable.



フロントパネルはこれまでの真空管プリアンプとほとんど同じで、セレクタースイッチを追加しただけ。天板には放熱孔が規則正しく並んでいる



電源部はインジケーターと電源スイッチのみ備わる。天板の放熱孔デザインは、整流管に合わせて円環状にしている

There is 2 wires connected to the -100V line, 2 wires connected to the 0V line, and heating lines.

The led wire is pulled out. +105V and 0V lines are pulled from the XLR connector to the regulator board, mounted in the case with 300mm columns and 5mm spacers at angle, vertically. The led wire is pulled out from +100V and 0V wires.

Wire equalizer to the input connector. Cable is Mogami 2511. Cable has influence on the sound, length is limited to 5-6cm. Do not use 2497 cable but rather the smaller 2511.

MOGAMI cable should be oriented with the 'M' at the source side, i.e. input connector.

This is soon the end. Equalizer output capacitor is wired with 2497 cable. 'M' is at the equalizer side. Preamplifier is then completed. Play some music, it will help aging amplifier. The age time for tubes is about 1 week.

### Quality of preamplifier

Figure 34 is the gain frequency characteristic of the equalizer amplifier. The RIAA response accuracy is right. The fact that gain is attenuated below 20Hz is the influence of ATR. The is almost flat until 100kHz, as the influence of the 3.6kOhms equalizer resistor providing attenuation at -6dB/oct. Each pole frequency is apart from RIAA requirement.

At 1kHz gain is 40.6dB. This the necessary gain to get the output of the MC cartridge to the direct CD input. Figure 35 is the output voltage and distortion factor of the equalizer amplifier.

Maximum output voltage with low 3rd order distortion is 10VRMS at 1kHz and 5VRMS at 10kHz. This output voltage is sufficient as the equalizer is only intended to amplify small signal.

MOGAMI cable should be oriented with the 'M' at the source side, i.e. at the connector side.

Avoid wiring on top of the circuit board, and make some soft curve with the cable.

When using thick cable connected to a circuit board, wire first the connector side, this is easier to do, because any voltage check or component changing afterwards becomes difficult when cable is connected.

Output connectors are wired with 2497 cable from the circuit board. 'M' should be oriented to the amplifier output (connector).

### Adjustment of line amplifier

Wire the other boards and mount them to have the preamplifier completed.

Select 'phono source' at the switch and turn muting on. Set VR at maximum gain.

Pieces of AWG20 core wire of 5cm length are prepared to connect output to the output connector, and check offset output voltage  $V_0$ , where  $V_0$  should be set at 0V.

Adjust VR of the AOC board. V0 is OK when it is within 10mV.

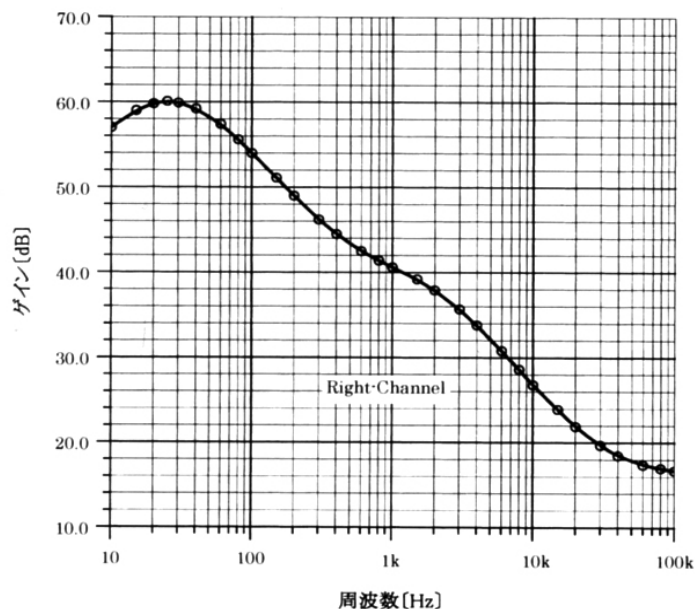
Between plate/G2, and +122 V of T3 tube, connect a resistor of about 10 Ohms. Plate current  $I_0$  is then checked at the resistor pins. When voltage is around 10mV,  $I_0$  is then around 1mA. As normal current is around 5 to 6mA, voltage at the resistor pins should be around 50-60mV, adjust RE of AOC circuit.

When RE is increasing,  $I_0$  becomes larger, when and when RE is decreasing,  $I_0$  also decreases.

$I_0$  increases after the power supply is switch on and it get stable around 5 minutes later. Adjust and remove the 10 Ohms resistor, wire plate/G2 to the + 122V power supply.

Mount Equalizer boards to the angle with column, wire the heater line. +100V regulator is mounted vertically at the angle studs. Connect wires before mounting.





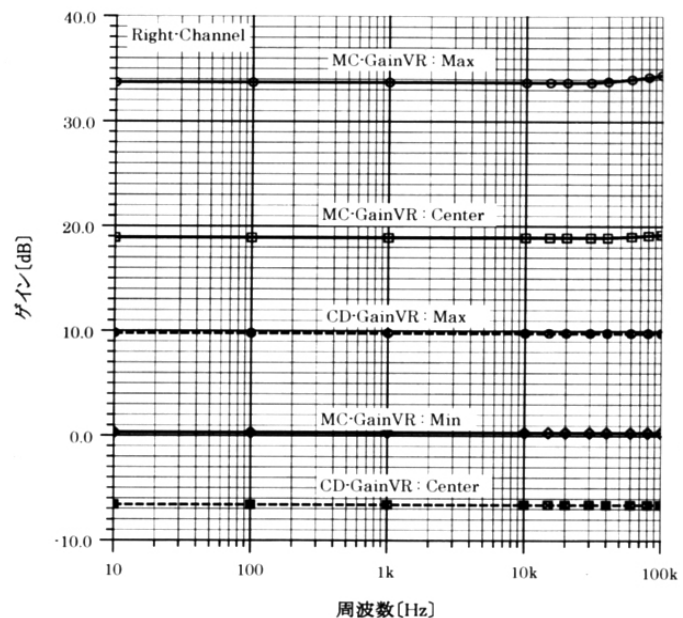
[図34] イコライザーアンプゲイン周波数特性

Figure 36 shows the line amplifier frequency response. Gain is significantly different in MC and CD input.

With MC input, gain with control VR at max is 33,7dB, at center it is 18,9dB, and at minimum, it is 0,3dB.

For CD input, gain with control VR at max is 9,8dB, at center it is 6,6dB, and at minimum, as it is -∞dB, it is not shown on graph. Frequency response is flat for each gain level.

Special distortion at the output will differ from MC or CD input, and different level of NFB which means different gain ANF. Two graphs are necessary for those measures.

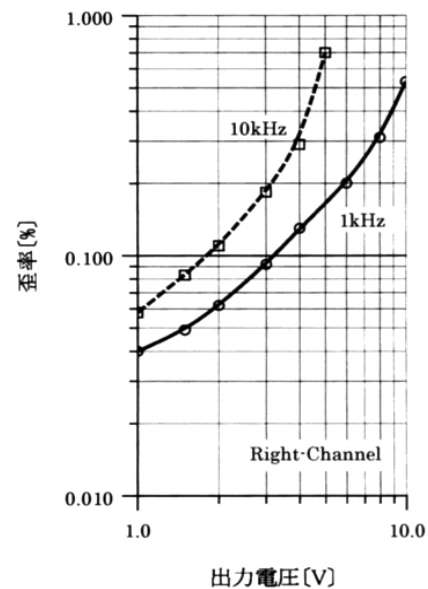


[図36] フラットアンプゲイン周波数特性

Figure 37 shows the output voltage distortion characteristic when using the MC input. As output voltage decreases (on left), distortion increases as measurement actually measures noise distortion only, not harmonic distortion. Noise is constant regardless of the output voltage, so the higher the output voltage, the smaller the noise part is. Amplifier distortion of the amplifier is increasing above output of 10V, but this is a very low distortion overall. Maximum output voltage is 40VRMS. The input voltage for

the maximum output power of power amplifier is 4 VRMS. The power amplifier's maximum input voltage in the high-power amplifiers is 4Vrms. An extra voltage capacity ratio of 10 insures a relaxed sound.

Figure 38 shows the distortion with respect to the output voltage when using the CD input. Distortion graph shows typical distortion and noise characteristic. At 20V output voltage distortion is close to the previous graph. Control VR at max and at center, characteristic shows total overlapping. Gain with control VR at center, the output voltage is 4V, but as shown in



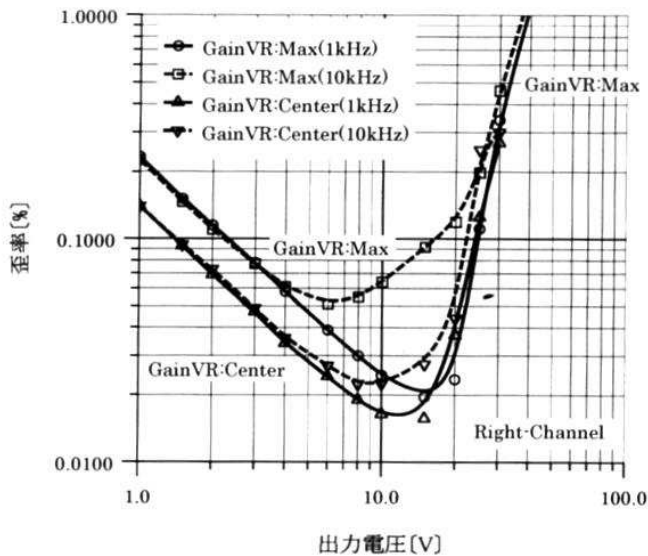
[図35] イコライザーアンプ出力電圧対歪率特性

figure 36, gain is -6,6dB, output voltage is at the limit of capacity of the input amplifier.

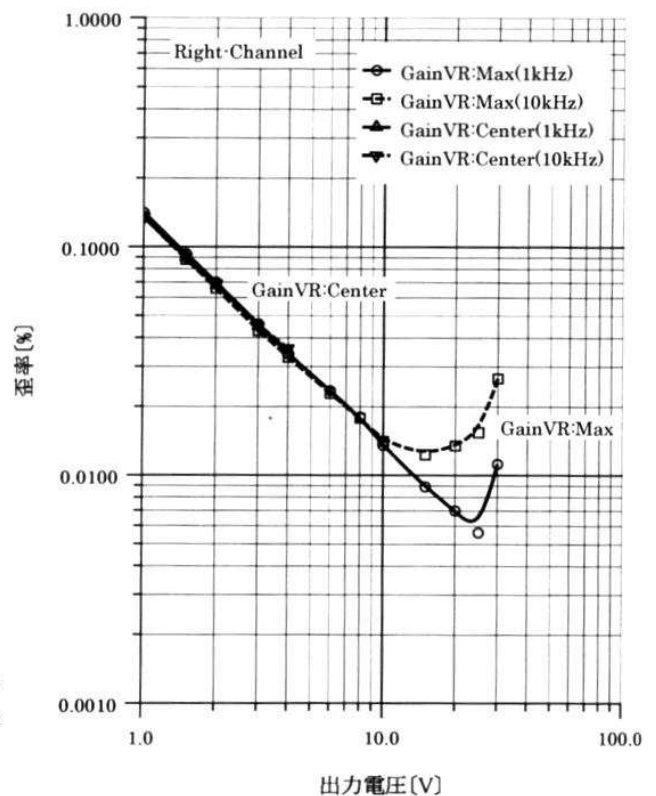
Given the CD maximum output voltage, this is correct.

Electrical characteristics of the power amplifier are a positive proof that it works correctly but it is not a proof of a good sound.

For example board and holding column position, which is just a small modification itself, has changed our impression of the sound, as it was different. But, you cannot get any difference in data for that.



[図37] フラットアンプ出力電圧対歪率特性 (MC入力)



[図38] フラットアンプ出力電圧対歪率特性 (CD入力)

### Preamplifier sound

The sound of the preamplifier features a respect of fundamental tone, with dense harmonic overtone power and a wide range tone impression. It sounds comfortably. The energy gives the impression of being totally surrounded by the sound, wider than speakers.

For example double bass, tuba and bass drum sound nice and have their own individual sound, expressed very real.

The only thing is that some very low bass cannot be heard, but this is below the current low musical instrument, around one

Also, sound of pizzicato strings was nicely mixed with the elastic and weighted bass instrument and reverberation.

On small string orchestra, we listen deeply and precisely to the wood instruments tone. Bass is brilliant and tears the air. High resolution is overwhelming. Complex musical signal gives a thrilling impression.

Also CD plays a very delicate way, with a rich expression, energy playing. By comparison of the 717A line preamplifier of last year, sound is identical.



リアパネルにはフォノとCDの入力端子, 2個のXLR端子を使用した電源供給, 出力端子が備わる。ピンジャックはスーパー・トロン研究所製

But previous 717A line preamp was using Tung-Sol tubes, this one uses Western Electric 717A tubes.

As difference is small, the preamplifier is set up in the living room for a long time.

Music is an art and if you ask what reproduction of art is, this preamplifier is made by human hand to reproduce music. The last power amplifier and this combined MC/CD preamplifier, both of them completed, gives you music that makes life richer.

Among music sources used to test preamplifier, one of each source CD/LP is presented below.

[LP Record]:  
Wagner's musical drama  
'Iraitsuhairaishi'

Georg Solti Vienna Philharmonic Orchestra.  
LONDON SLH3025

[CD]  
Chostakovitch Symphony No. 11 (1905)  
V. Ashkenazy Philharmonic Orchestra  
of Saint Petersburg.  
LONDON POCL-165