CONCORD
VIDEO TAPE RECORDER
TECHNICAL GUIDE

SERVICE COPY
NOT FOR SALE

MODEL VTR-600-1

CONCORD ELECTRONICS CORPORATION

1935 ARMACOST AVENUE LOS ANGELES, CALIFORNIA 90025

I N D E X

PREFACE

Industrial and educational television has grown rapidly since the development of reliable, low-cost, high performance television cameras.

Closed circuit television has become a valuable tool in industry and education.

Many applications require a method of recording and playing back television pictures.

Special motion picture cameras and projectors will perform this function, however, time is required to develop film and film can be recorded only one time. Obviously an electronic system similar to audio magnetic recording would be far superior.

CONCORD engineers have developed a simple, portable, low-cost, reliable VIDEO TAPE RECORDER MODEL VTR-600.

This service manual is written to familiarize service technicians with the VTR-600.

INTRODUCTION

Video recording is very similar to audio recording. It has different requirements due to the wide frequency response necessary for television pictures.

The frequency response of magnetic recording can be expanded by increased tape speed and smaller head gap. To record video (near DC to over two megacycles) a tape speed of hundreds of inches per second is required. High speed tape travel results in short recording time or large tape reels. High speed tape travel also makes speed control difficult to obtain.

CONCORD has developed a system of obtaining high writing speed (tape to head) with nominal tape speed. This system permits recording with wide frequency response but has none of the disadvantages of high speed tape travel. This is accomplished by moving the head as well as the tape. This rotary head system is called Helical Scan and requires a servo controlled motor to drive the video heads.

Magnetic recording of video by direct recording would require a broad compensating network to produce a flat response. Frequency modulation of a carrier with the video signal and recording this modulated carrier eliminates the need for complicated compensation.

This FM signal can be applied directly to the recording head. Bias is not required as in standard audio recording. Noise can be eliminated by limiting similar to FM audio broadcasting.

To record audio we must have :

1. Tape transport mechanism.
2. Magnetic heads to record and erase.
3. Bias and erase signal.
4. Electronic circuits to record and play.

To record video we must have :

1. Rotary head machanism.
2. Rotary head control system (Servo).
3. FM modulator, limiter, demodulator.
4. Television monitor to view the recording.
5. Television receiver or camera for a source of signal to record.

MAGNETIC HEAD

The relative tape speed against the head of the CONCORD MODEL VTR-600 VIDEO TAPE RECORDER is 484 inches per second and to obtain this high speed, a rotating magnetic head assembly, in which a pair of magnetic heads located at opposite sides of the circumference, is provided. The head assembly is rotating at a speed of 1,800 rpm and along the half of the circumference of the head rotation, the magnetic recording tape is in contact. (Refer Fig. 1)

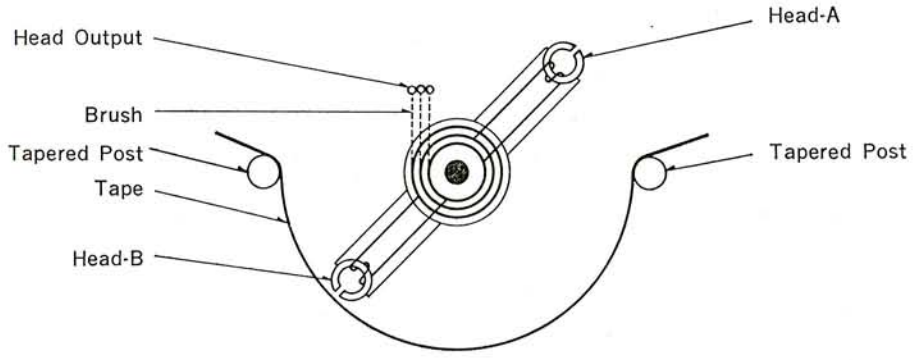


Fig. 1

Immediately before head-A is in contact with the tape, head-B is disengaged from the tape. The recordings are made helically on the tape as shown in Fig. 2. The tape itself is moving at a speed of 12 ips. The audio signals are recorded with AC bias current, at the top edge of the tape. At the bottom edge of the tape, a control signal, which synchronizes the rotating speed of the head against the vertical sync. signal in the video signal, is recorded.

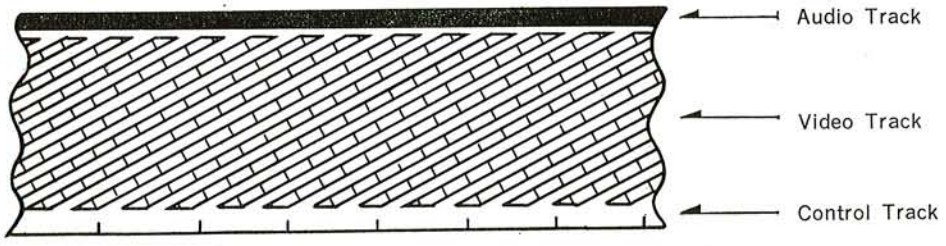


Fig. 2

When reproducing, the video, audio and control heads pick up the previously recorded signals on the tape. To do this precisely the servo mechanism is necessary.

The operating principle of the VTR and the regular Audio Tape Recorder is identical. The operating theory of the audio and video head is identical.

The construction of the head is as shown in Fig. 3. It is composed of a core made of a material which has high permeability, the coils and the gap. When a current is fed into the coil, a magnetic field is formed which magnetizes the magnetic oxide coated on the recording tape. When reproducing, the magnetic fields on the tape induces voltage in the coil and the recorded signals are reproduced.

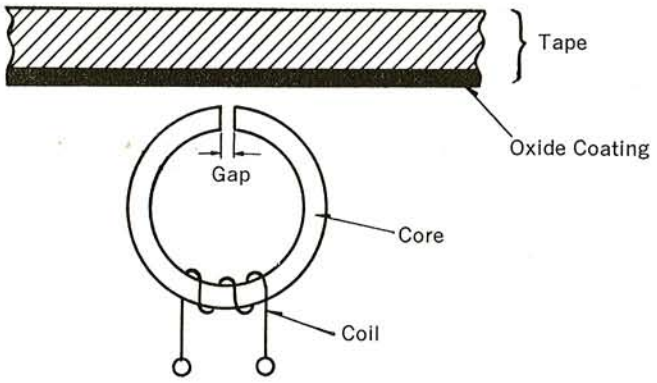


Fig. 3

When the tape speed is constant, it is logically possible to record up to the high-end frequency by narrowing the gap of the head. However, if the gap is made too narrow, it tends to decrease the reproduction efficiency, because of the existence of small space between the tape and the head. Generally, the gap of an audio tape recorder is approximately 5 microns which enables it to record frequencies up to 20,000 cps. However, in video recording, the high-end frequency is at least 2 Mc which is 100 times of that of the regular audio tape recorder. It requires a head gap as narrow as 1 micron and at the same time requires the high relative tape speed against the rotating head.

The reproducted power output is reduced when the frequency to be recorded becomes higher and the loss in the output is in direct proportion to the frequency wave length (λ). One of the most essential factors for creating the loss of output is friction space (d) between the tape and the head. The relation among the Space Loss (λ) and (d) is expressed in the function as shown below;

$$\text{Space Loss} = K \frac{d}{\lambda} (\text{dB})$$

As obvious from the function above, when the frequency is higher the wave length is shortened and the output loss increases.

As expressed in the another function below showing the relation of tape velocity (V), wave length (λ) and frequency (f), the tape speed has a cue to the S/N ratio of the picture quality.

$$f = \frac{V}{\lambda} \qquad \therefore \quad V = f\lambda$$

As minimum level of video signal to be recorded marks 3MC and its wave length is 3μ sec., the necessary speed of tape has to be 9m/sec. which assures the minimum standard of picture quality.

To record the audio signals on the tape, in the early days, recording with DC bias or no bias current was adopted but now most audio tape recorders use AC bias for recording. With the AC bias recording system, noiseless, distortion-free and linear recording is obtained.

When recording the FM waves of the video signals, the recording is not made by the amplitude of the waves but it uses the non-bias recording system and records the frequency change.

The video head is subject to the accumulation of the residue of the tape oxide and dust during usage which, of course, degrades the record and reproduction quality. To remove these a brush, or gauze, etc, are to be used.

The life of the head is subject to the material of the head, construction of the head, kind of the tape as well as the operating conditions. The tape holdback tension, surface roughness of all tape guides and dust when using, are factors controlling video head life.

The biggest merit of the magnetic video recording is the fact that the recording can be erased for another recording. In order to erase the recording, two methods are available (DC and AC erasures). Generally, the noise and distortions are greater in case of the DC erasure.

The AC erasure is (as shown in Fig. 5) made with the ring-type head which is supplied with a large current of high frequency and brings the recording tape to the saturation point "A". The erasure is made immediately before the recording is made. The erasing magnetic field gradually decreases as the tape moves away from the head so that the magnetic field cycles many times. As shown in Fig. 6, the magnetization will be decreased from A-B-C... and approaches to the neutral point "O" and finally becomes zero.

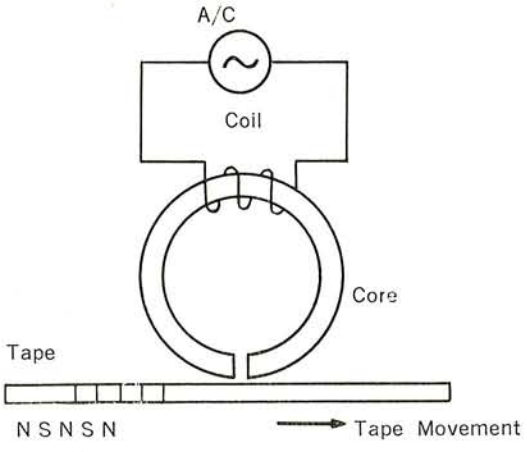


Fig. 5

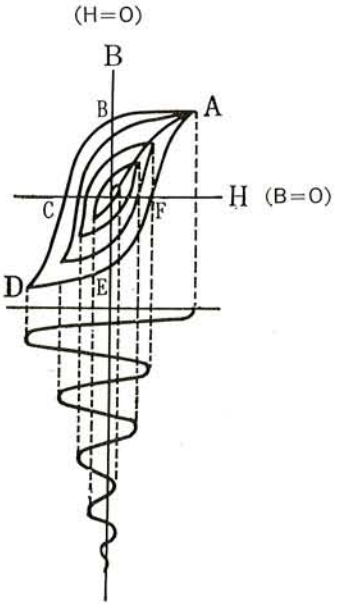


Fig. 6

VIDEO CIRCUIT

The block diagram is shown in Fig. 7. The input of the video signal is obtained either from a monitor/receiver or the television camera and will be reproduced at the monitor/receiver screen. The input of audio signals is obtained either from the monitor/receiver or a microphone or the line output terminals provided on the sound

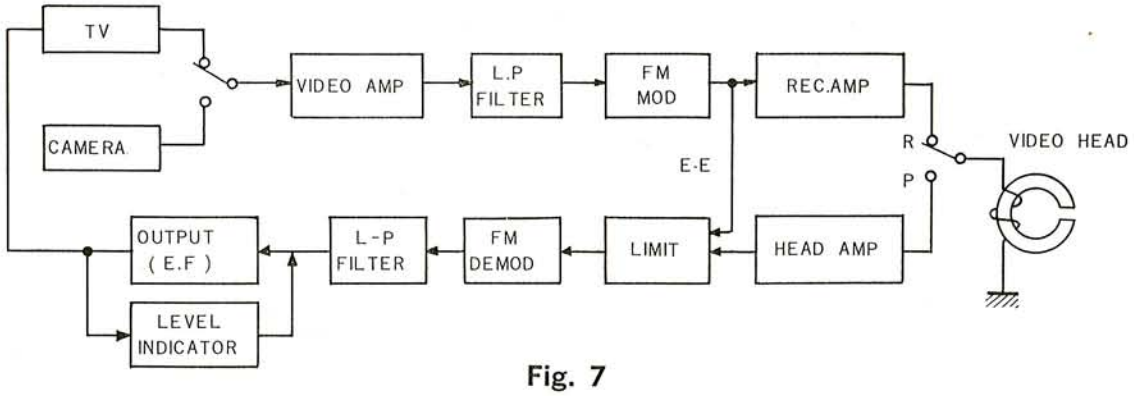


Fig. 7

source equipment and can be reproduced either through the monitor/receiver or an external amplifier connected to the line output jack on the recorder.

The image passing only through the video modulation and demodulation circuits (not through the head and the tape) is called "E-E" system image while the actual reproduced image, which passes through the video modulation and demodulation circuits as well as the head and the tape, is called "V-V" system image.

The video modulation circuit is composed of the Common Base Amplifier, Low-Pass Filter and the FM Modulator. The video polarity of the Common Base Amplifier is the same both for the input and the output signals. A multi-vibrator is used as the FM modulator. The video signal changes the base current thus generating Frequency Modulation.

The frequency of the FM modulator changes according to the modulating wave and the maximum frequency range is called "Deviation". Although the S/N ratio of the reproduced image improves as the Deviation becomes wider, the range of the deviation is limited by the band-width of the head and tape systems. If the modulation is excessive the white level of the input video signal will appear as black on the reproduced image. The wave form of the modulator output without the modulating wave must be a nearly perfect square wave. This is called "modulation balance". If it is unbalanced, a beat oscillation will be created in the E-E mode.

The modulator output is fed to the video recording amplifier through the driver transformer.

The video demodulation circuit is composed of a limiter, FM demodulator, Low-Pass Filter, Emitter-Follower amplifier and the Level indicator circuits. The Limiter (as shown in Fig. 8), holds the amplitude of output from the head pre-amplifier (i.e. input signal to the limiter) constant by clipping it at the center of the wave form and eliminates the noise contained in the output.

The characteristics of the diode (as shown in Fig. 9) is; to increase resistance at low voltage and permit an avalanche current with higher voltage. If two diodes are connected with opposite polarity, the internal resistance at about zero-volt is large, but it tends to decrease over certain positive or negative voltages. These diodes are connected between the collector and the base of the amplifier. The amplifier has a negative feedback above a

certain voltage and forms the input/output characteristics as shown in Fig. 10. The output from the head pre-amplifier with constant amplitude and without noise will be fed to the FM demodulator by connecting these amplifiers in multi-stage.

The FM demodulation in this equipment is obtained by differentiating and multiplying the output from the limiter. (Refer to Fig. 11)

The demodulated signals are amplified and the demodulated wave is filtered by the Low-Pass filter. Then the video portion of the modulation wave is fed to the monitor receiver, after impedance matching at the emitter-follower.

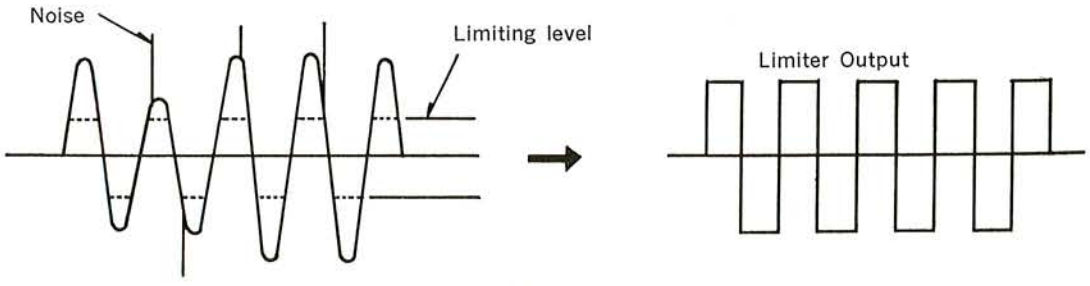


Fig. 8

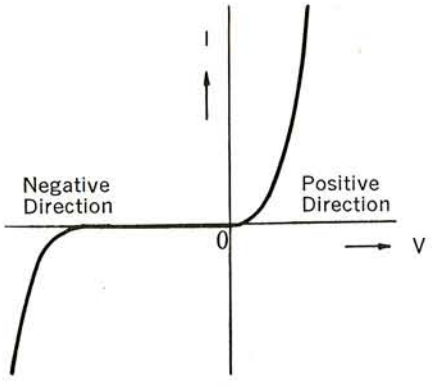


Fig. 9

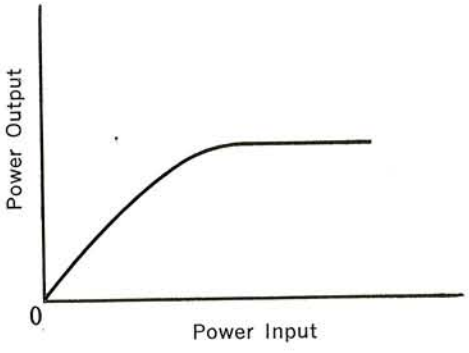


Fig. 10

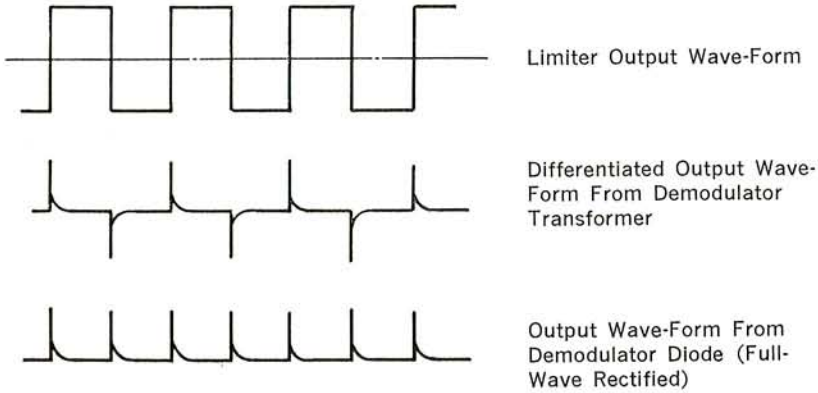


Fig. 11

The indication of the modulation is made at the final stage of the demodulation circuit. This is accomplished by amplifying the white peaks of the video signal above a certain level and letting the signal feedback to the previous stage thus creating some oscillation. When this happens, the picture quality on the video monitor will be deteriorated, however, this deterioration does not affect the recording amplifier so that the recorded signal on the tape is not over-modulated.

Recording amplifier is to record the signal onto the tape by giving the modulated current to the video recording head and a pair of heads are provided with the respective amplifier. The recording current has an optimum level and the reproducing output voltage from the head decreases if the level is higher or lower.

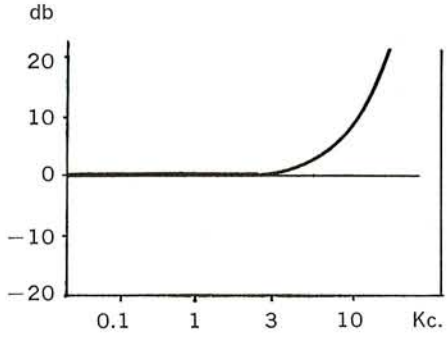
The pre-amplifier is a critical factor which determines the S/N ratio and the quality of the image. The noise level of the reproduced image will be determined by the level of the noise generated in this amplifier and the reproduced output voltage from the head.

AUDIO CIRCUIT

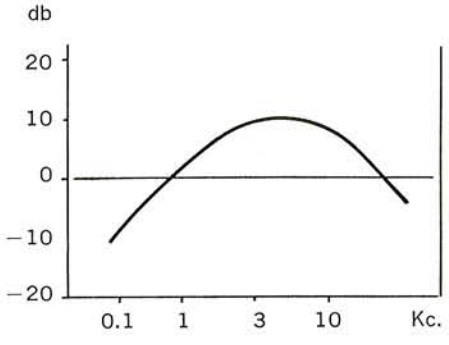
When recording video signals, the audio signals are recorded at the top edge of the recording tape (approximately 1 millimeter width) and one head is used for both recording and reproduction. In order to obtain good quality sound recordings, an AC bias system is used.

EQUALIZATION

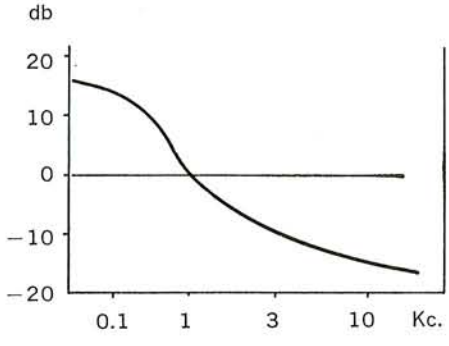
When recording, series resistors having a resistance value relatively high in comparison to the reactance of the recording head are used to provide a constant current regardless of frequencies making the magnetization in direct proportion to the level of the signal. This is called constant current recording. In reproduction the reproduced output increases in proportion to the frequency when it is relatively low in comparison to the magnetic pole gap of the head, but it decreases abruptly when the frequency becomes high because of the self demagnetizing effect and the gap loss. To maintain an even frequency response, it is necessary to boost the high frequencies in recording and boost low frequencies in reproduction. (Refer to Fig. 12)



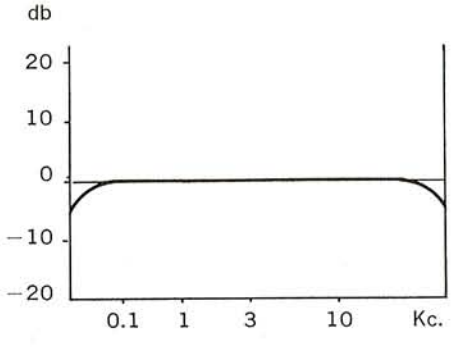
(A) Frequency Response of Rec. Amp



(B) Frequency Response of Head



(C) Frequency Response of Playback Amp.



(D) Overall Frequency Response

Fig. 12

LEVEL INDICATOR

If the amplitude of the recording signal is excessively large, the distortion tends to increase. On the other hand, if the signal level is too small, it decreases the S/N ratio. In order to control the recording signal level, an audio level indicator is provided on the unit.

ERASURE OF SIGNAL

When the recorder is set in the Record mode, the signal previously recorded on the tape (audio, control and video signals) are erased (AC erasure) automatically before reaching the video, audio and control recording heads.

CONTROL CIRCUIT

A rotating two head system is adopted in this equipment. In order to record the video tracks on the recording tape with a constant slant, pre-determined inclination is given to the video head tracking on the tape, and the locus of the video head on the recording tape is obtained as shown in Fig. 13.

On the tape, as shown in Fig. 13, the three different locuses are found, the video track to record the video signals, the audio track to record audio signals and the control track to record the control signal to control the locus of the video head.

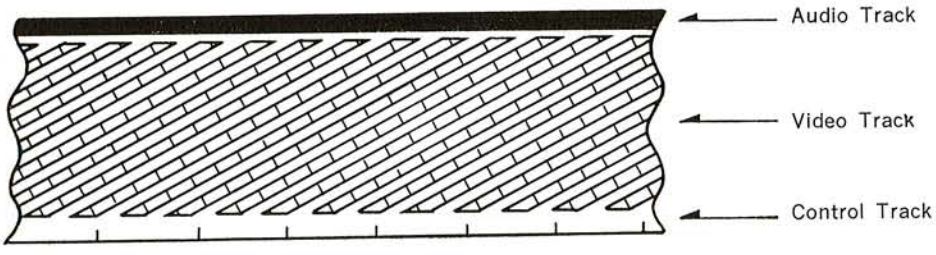


Fig. 13

A pair of video heads are mounted 180 degrees apart on a motor called "head disc. motor". Controlling of the video head means controlling the head disc. motor. There are two ways to control the head disc motor. One is called a "servo system" which controls the head disc. motor rotating phase of the motor and the driving signal of the motor. The other is called "direct driving system" and is used in this unit. A synchronous motor which synchronizes its rotation to the driving signal is used.

Fig. 14 is the comparison of these two systems. The direct driving system is much simpler than the servo system. The head disc. motor is rotated at a speed of 1,800 rpm, and it synchronizes with the vertical sync in the television signal and the contacting period of a head against the tape becomes 1/60 sec. In recording it is necessary to drive the head disc motor by this vertical sync signal. Noise is unavoidably created at the moment of head switching. If this noise appears in the image, it is distorted, so to eliminate this problem it is necessary to adjust the timing of the switching period within the vicinity of the vertical sync signal.

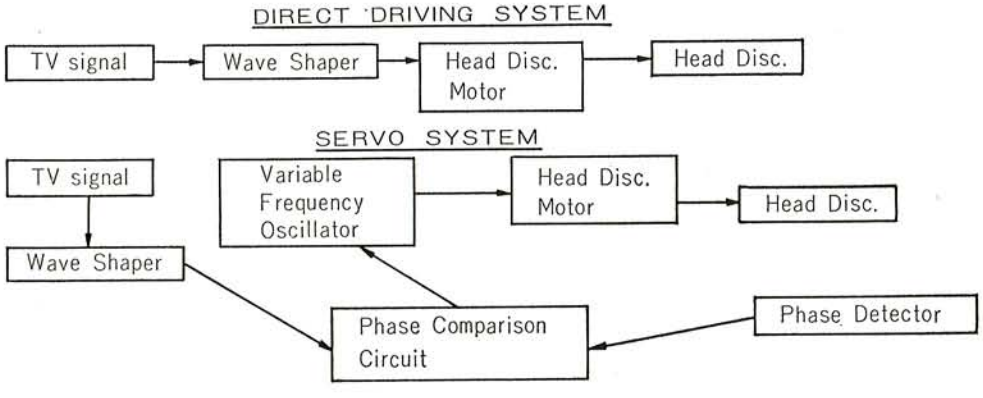


Fig. 14

In reproduction the operation is identical to recording. The locus recorded by the head-A must be traced by head-A in reproduction. This operation is called "head sensing". To perfectly match the locus and the head during reproduction the phase adjustment of the reproduced signal becomes necessary. If the heads are tracing outside of the locus made at recording, it degrades the S/N ratio and the picture quality.

Another important factor in the VTR is the stability of the tape speed. If the tape speed is not well stabilized, not only unpleasing sound will be reproduced, but the control signal in reproduction will be distorted and in the extreme condition the image cannot be distinguished on the monitor screen at all.

The wow and flutter (same as in regular audio tape recorders) are mainly created by the uneven rotation of the reel and the eccentricity of the capstan. When the holdback tension on the supply reel is uneven, this uneven back tension coincides with the rotation of the supply reel and will develop an uneven tape movement.

VTR tolerance in tape movement is more critical than the regular audio tape recorder.

VTR-600 CONTROL SYSTEM

The composition of the control circuit is shown in Fig. 15.

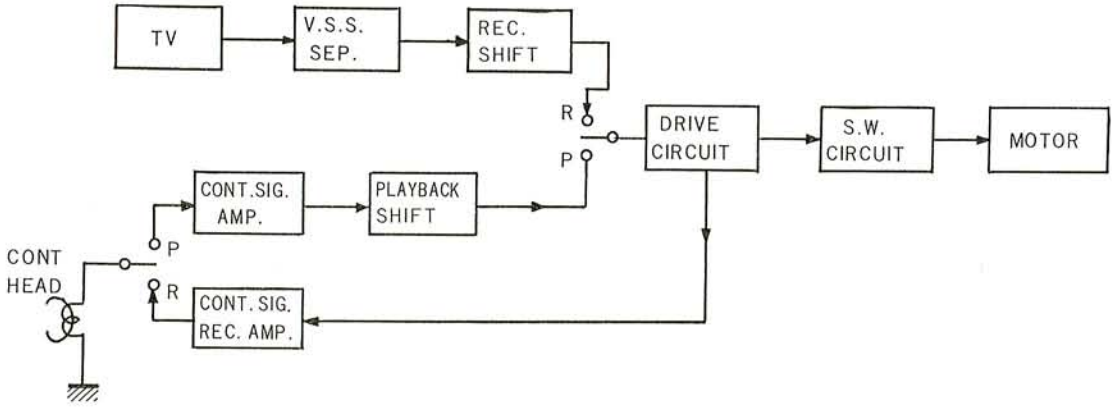


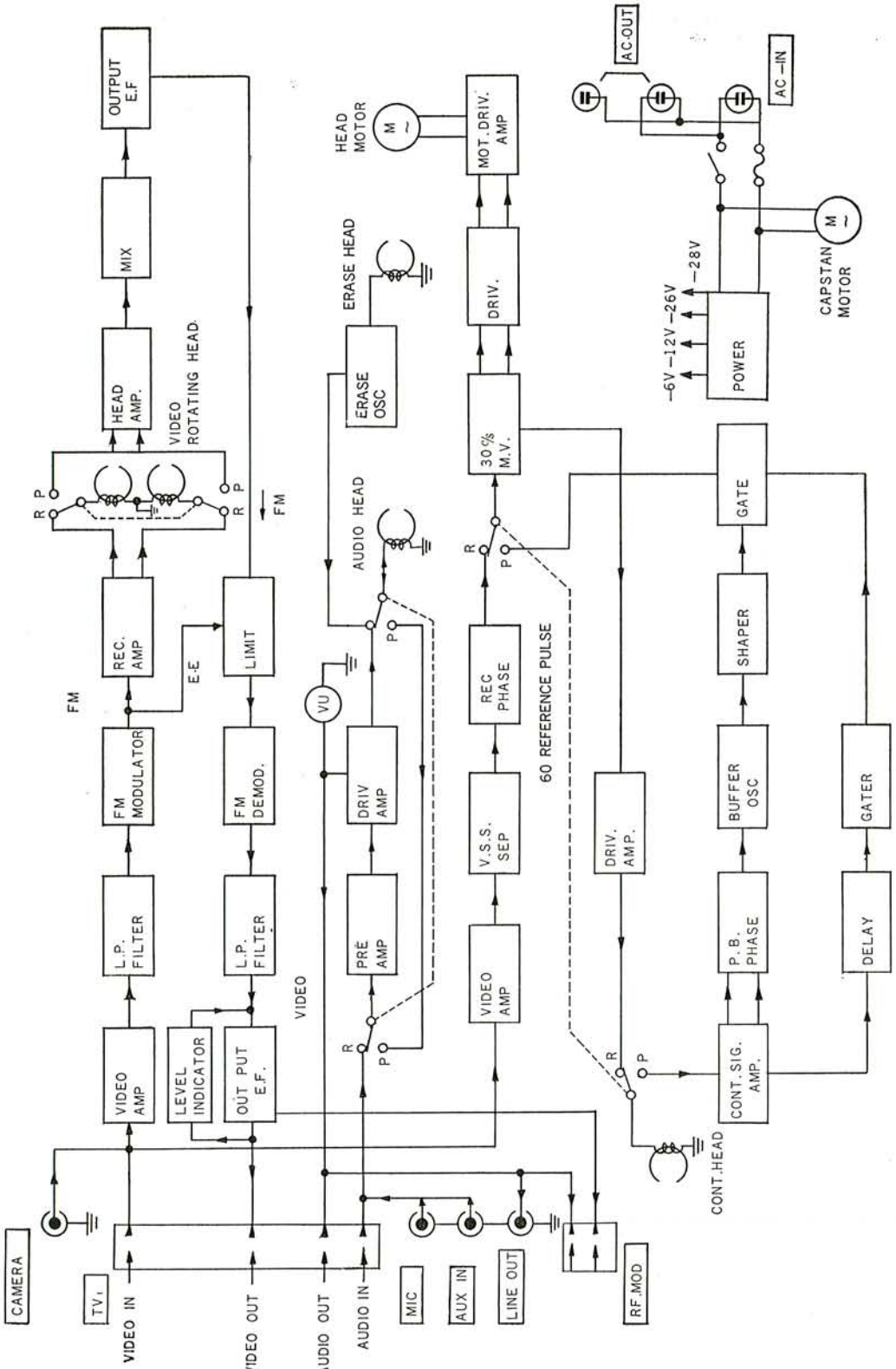
Fig. 15

The circuit that strips the vertical sync. pulse from the composite television signals is called "Vertical Sync. Signal Separating Circuit" (V.S.S. Sep.) and the head disc. motor is controlled by this vertical sync. pulse. It is necessary to adjust the phase of the switching time of the video heads within the vicinity of the vertical sync signal. Although the adjustment of the position of the motor (position of the stator relative to the movement of the recording tape) is possible, it does not permit fine adjustments, therefore the Recording Shifter, which delays the position of the vertital sync. pulse of the television signal, is used in the unit.

The drive circuit supplies the necessary power to the motor in the form of a square wave. When recording, the head disc motor is rotated with a fixed phase relationship synchronous to the television signal. Simultaneously, this signal is fed to the Control Signal Recording Amplifier and is recorded on the tape. This records the differential wave of the motor driving wave on the control track of the tape to control the rotation of the motor in reproduction.

During reproduction, the head disc. motor is controlled by the pulse signal recorded on the control track of the tape which is picked up by the control head. The most important thing in reproduction is to adjust the rotation of the head so that the heads trace exactly the same locus recorded on the tape. In order to obtain the proper tracking, and the best S/N ratio, the Playback Shifter is used to adjust the phase relationship between the head disc. motor which determines the locus of the video head and the control signal deriven from the control track of the tape.

BLOCK DIAGRAM



Now, the followings are the "hows" to control the head disc. motor in the CONCORD MODEL VTR-600 VIDEO TAPE RECORDER.

As mentioned above, the direct driving system is adopted in this equipment and the composition of the control circuit is shown in the Fig. 16.

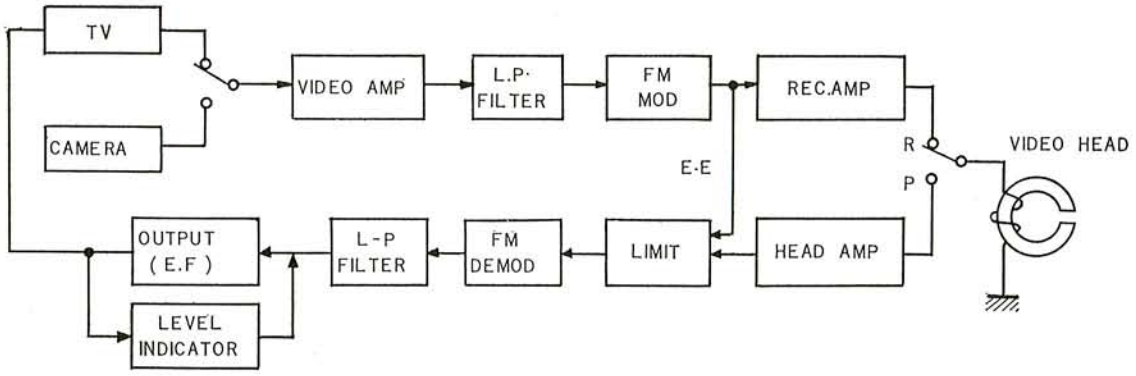


Fig. 16

TO SUMMERIZE THE CRITICAL POINTS REQUIRED IN THE VIDEO HEAD CONTROL SYSTEM:

1. IN RECORDING:

A. The video head assembly must be rotated synchronous to the vertical sync. signal of the video signal.

B. The timing of the head switching must be adjustable within the vicinity of the vertical blanking portion of the television signals.

C. The duty cycles of the motor driving wave must be 50 : 50.

2. IN REPRODUCTION:

A. The video head assembly must be rotated synchronous to the Control Signal recorded on the tape.

B. The head sensing must be possible.

C. The tracking error must be adjustable.

D. The wow and the flutter must be removed in the tape driving mechanism.

E. The duty cycle of the motor driving wave must be 50 : 50.

DETAILED EXPLANATIONS OF THE CIRCUIT ADOPTED IN THE UNIT:

It is required in the V.S.S.Sep. circuit that the vertical sync. signal must be stripped from the television signal even when the noise is contained in it and the amplitude of the input signal varies. Therefore, a special consideration is given to the integrated circuit which consists of four stages of amplifiers having dynamic range of more than 0.3V of input video signal.

Rec. Shifter delays the vertical sync. signal by a certain amount of constant phase and triggers the monostable multivibrator by a positive trigger pulse (60 cps). The timing of the variance is from 2 to 10 milliseconds (or 22 to 165 degrees mechanically) and is adjustable per the relationship with the mounting position of the motor. However, large changes of this setting must be avoided. This adjustment, however, is only possible when the unit is in the Record mode.

The drive circuit is composed of the Astable Multivibrator, 2 sets of the Direct-coupling Amplifiers and a Push-Pull Switching Circuit.

The self-excited Oscillation Frequency of the Astable Multivibrator is adjusted for 28.5 to 29 c/s and because the head disc. motor is driven by the wave from the Astable Multivibrator, wave shaping circuit is added, thus a sharply defined square wave is obtained.

When recording, both collectors of the Astable Multivibrators are triggered by the vertical sync. signal of 60 cps with a certain amount of delayed phase by means of the Rec. Shifter. It works like a Flip-Flop Circuit thus it synchronizes with the vertical sync. signal and its frequency becomes 30 cps. Furthermore, in order to set the duty cycle at 50 : 50 in recording and reproduction, the triggering in recording is obtained from 60 cps as explained above, and the trigger pulse in reproduction is developed with the proper polarity recorded on the tape, by means of a Gate circuit specially added.

The power which operates the switching circuit for the head disc. motor is given from this circuit through two pairs of directly connected power amplifiers, thus the switching circuit acts as a push-pull circuit and feeds square wave currents to the head disc. motor which is connected to the collectors of both transistors and forms a Rotating Magnetic Field. Therefore the two pole synchronous motor is rotating at a speed of 1,800 rpm, and with the heads placed 180 degrees apart from each other, the contacting cycle of a head against the tape becomes 60 cycles per second, and the time when each head contacts the tape is 1/60 sec. Further, the peripheral angle of these two heads against the tape in contact is only 180 degrees of the full rotation of 360 degrees, or in other words, when head-A comes in contact with the tape head-B is instantaneously disconnected from the tape. This switching, however, creates slight noise on the reproduced image, which is unavoidable. Therefore, the timing of this switching is adjusted within the vicinity of the blanking period in the vertical sync. signal by adjusting the phase of the trigger signal of the Astable Multivibrator by means of the Rec. Shifter.

The Twin-Tee Oscillator is used in this equipment. The sine wave oscillation is generated by this oscillator and its frequency is adjusted for 60 cps. It synchronizes to the outer trigger pulse with some time variable if the trigger pulse is different from the oscillating frequency. Although the trigger pulse is set for 60 cps. it varies slightly because of the mechanical variance as explained above. The Twin-Tee Oscillator synchronizes with the average frequency of 60 cps. and its output signal does not respond to the trigger pulses having rather fast variance, therefore, is working as a damper for the wow.

Since the output wave form from the Twin-Tee Oscillator is sine wave, it is necessary to shape the wave form by means of Schmitt Circuit. In this instance, the trigger pulse and the output wave from the Schmitt Circuit has a delay of approximately 6ms.

The output from the Astable Multivibrator is considered as the motor driving signal itself, therefore this signal (square wave of 30 cps) is fed to the control head through the Cont. Sig. Rec. Amp. The duty cycle is 50:50, square wave of 7Vpp and the recording on the tape is only made of positive and negative pulses of the rising and falling periods.

The following explanations are for the reproduction modes.

CONT. SIG. AMP. :

As explained above, when recording, as shown in Fig. 17, the square wave signal voltage is fed to the control head, therefore, its differential wave forms are recorded on the control track. Because of this, when reproducing, the pulses having negative and positive polarities are reproduced.

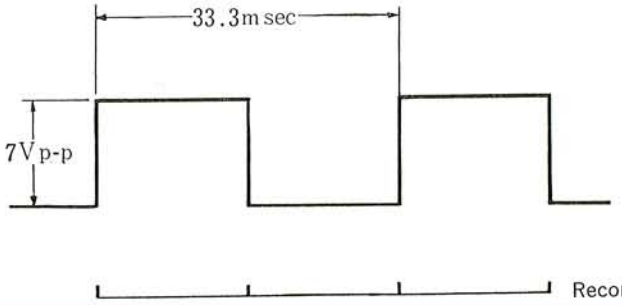


Fig. 17

The Cont. Sig. Amp. consists of a P-N-P transistor and 3 N-P-N transistors. At the first two stages (Class-A) both polarized pulses are amplified and by Class-B at the 3rd stage having P-N-P and N-P-N transistors, in which, the P-N-P transistor changes the negative pulses to positive ones and N-P-N transistor changes the positive pulses to negative ones, as the duration of the negative and positive pulses is 33.3ms (30 cps) and they are having 180 degrees of phase difference (16.66ms of timing difference) from each other.

PLAYBACK SHIFTER. :

As explained above, it is necessary to sense the pair of video heads during reproduction. In order to keep the duty cycle of the motor driving wave form (Astable Multivibrator) 50:50 it is convenient to use 60 cps. The Playback Phase Shifter keeps the tracking error minimum during reproduction, therefore, the variable range of which must be 180 degrees mechanically or 16.66ms electrically. Because of the above reason, the trigger signal of the Playback Shifter is set for 60 cps. and the variable range has to be 0 to 16.66ms. Two sets of the Monostable Multivibrators are connected in series and the variable range of each set of Multivibrator is about 1～9ms thus providing a total variable range of 2 to 18ms which satisfies the minimum variable range of 16.66ms. In order to obtain the above characteristics, in a first Monostable Multivibrator, the triggering of the collector is made by negative pulses and the triggering of the base is made by positive pulses (as the phase relationship of positive and negative pulses are 180 degrees apart) thus obtaining operation as if the triggering were made by a control signal of 60 cps.

BUFFER OSCILLATOR :

The control and audio signals reproduced from the tape generally changes according to the wow and flutter of the mechanism and it is quite difficult to completely eliminate wow and flutter mechanically. To decrease these mechanical variance electrically, a Buffer Oscillator is adopted to dampen these variances. It is required in the Buffer Oscillator that; the "Q" of the Oscillator must be sufficiently high and the oscillating frequency must be stable against the change of outer conditions.

DELAY, GATOR AND GATE CIRCUIT :

If the triggering of the Astable Multivibrator is made with the output pulse from the Schmitt Circuit, it operates the same as in the case of recording. However, it is impossible to sense both video heads perfectly. When head-B is tracing the locus on the tape recorded with head-A, mechanically, these two heads must be in perfect matching therefore, in order to trace the locus of a head with the same head during reproduction, the Delay Gator Gate becomes necessary.

The head sensing is done by triggering the collectors of the Astable Multivibrator after gating the positive pulse of the 3rd Stage of the Cont. Sig. Amp. as well as the output pulse of the Schmitt Circuit by means of two sets of the Gate Circuits. The Gator determines the timing of the gating and it is set for 16.66ms. Also, because of triggering the Twin-Tee Oscillator, the control pulse and the output wave forms from the Schmitt Circuit have phase differences of approximately 8ms, so that the pulse which determines the gating time, or in other words, the positive pulse of the 3rd Stage of the Cont. Sig. Amp. must also have same phase difference (8ms.).

After passing through the above circuits, the Playback Shifter adjusts the position of the heads to the locus exactly as recorded on the tape.

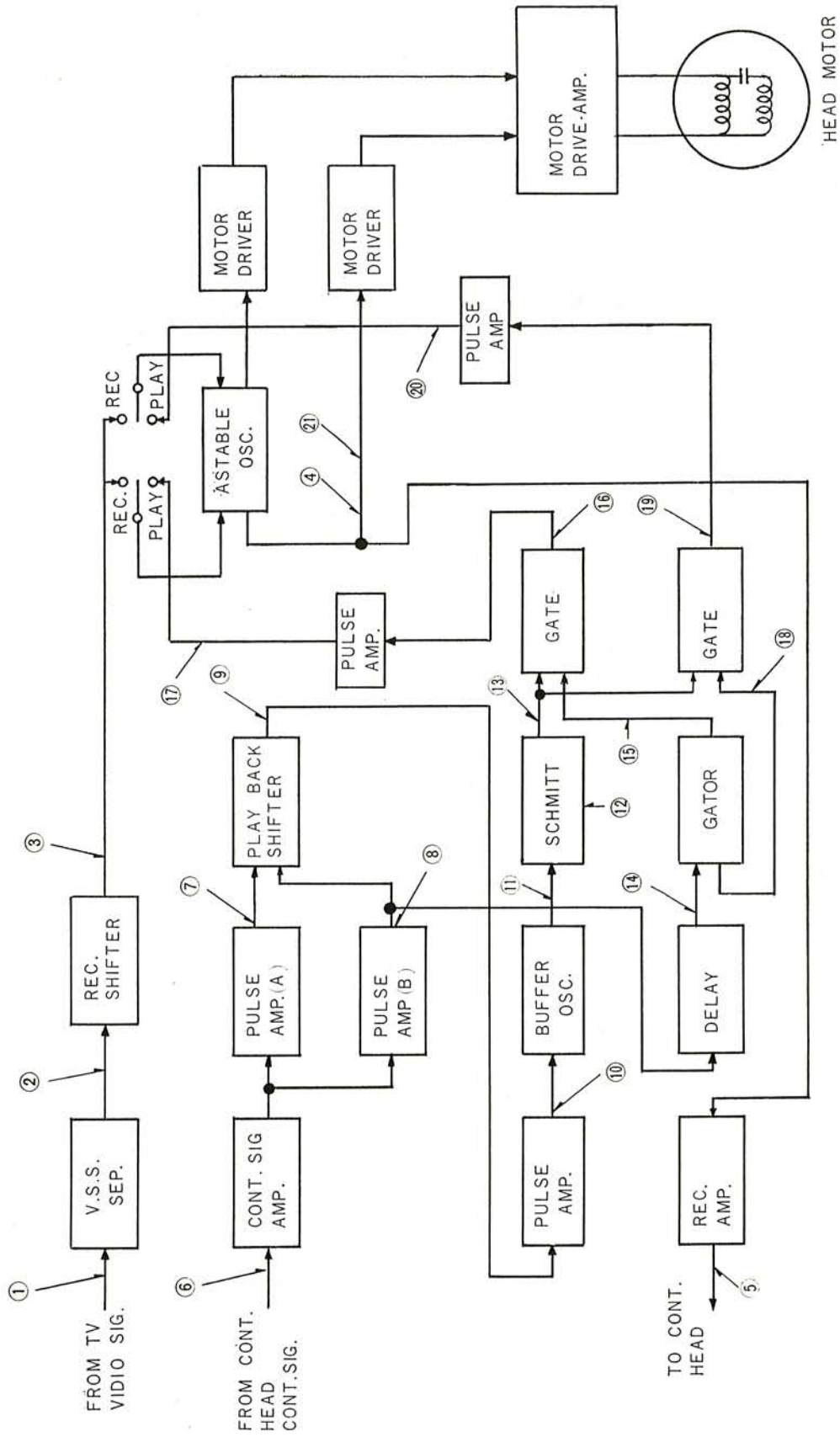
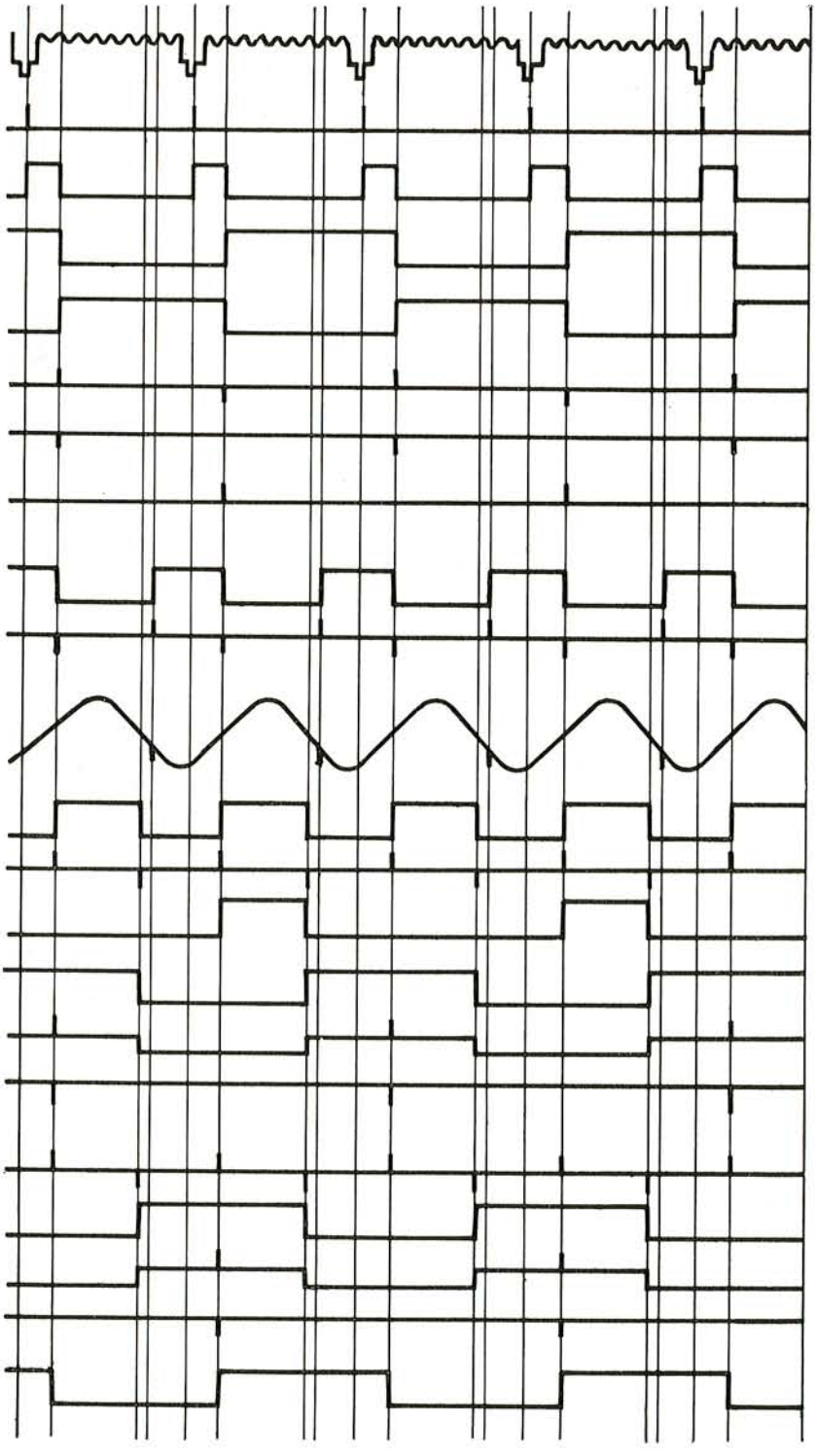


Fig. 18 BLOCK DIAGRAM - CONTROL CIRCUIT

1. Video Signal
2. Vert. Sync. Signal
3. Rec. Shifter
4. Astable at Recording
5. Rec. Amp.
6. CONT. Head Output
7. Pulse Amp. A
8. Pulse Amp. B Output
9. Play Shifter
10. Twin-Tee Osc. Trigger Pulse Amp.
11. Twin-Tee Osc. (Buffer Osc.)
12. Schmitt
13. Differenciated Wave-form of (12) (Delayed Wave of (8))
14. Delay by (8)
15. Gator-1
16. Gated (13) (15)
17. Amplified (16)
13. Differenciated Wave-form of (12)
18. Gator-2
19. Gated (13) (18)
20. Amplified (19)
21. Play Motor Drive



(10ms/cm)

Fig. 19 CONTROL SYSTEM

DETAILED EXPLANATIONS ON THE MECHANISM

The following are detailed explanations of the mechanism which will dominate the characteristics of the video tape recorder.

As it is well known, recording or reproduction of audio and video signals is unobtainable merely with the heads, tape and the other electrical elements. For tape feeding and for keeping the rotation of the rotating head in perfect relation, the mechanism becomes very critical and the aforementioned magnetic and electrical characteristics are only obtainable with the proper mechanism.

Other than the rotating head assembly, all mechanism are similar to those of the regular audio tape recorders. However, the component parts are made with much more preciseness, severer than those for fine watches and cameras.

The followings are the nomenclatures of the component parts used in the CONCORD MODEL VTR-600 VIDEO TAPE RECORDER.

MECHANICAL FUNCTION :

Record, Playback, Rewind and Stop are the most essential mechanical functions of every tape recorder. Besides them, there is a Fast Forward function. In operating these functions, the model VTR-600 is provided with a pushbutton system which is easy to operate and of less trouble. Generally speaking, a recorder requires constant tape transportation speed because of which every recorder has a capstan drive system. This system is to rotate a capstan by means of a belt between the flywheel and the motor pulley. The capstan is to transport the tape at constant speed, and requires an accurate mechanism.

PRINCIPLE OF MECHANICAL MOVEMENT :

When AC power is applied, the capstan and head motors begin to rotate. The capstan motor is attached with motor pulley. Capstan flywheel, takeup reel hub and rewind idler are connected to each other by means of a belt. Therefore, when the capstan motor begins rotation, these satelite mechanical parts start rotation simultaneously. (If the tape tension arm is not engaged, the capstan motor does not rotate.)

1) PLAY :

When Play Button is depressed, the pinch roller engages the capstan and tape transportation begins simultaneously. The transported tape is wound by the takeup reel. The takeup reel hub is driven by a belt connected to the motor pulley. The reel pulley pushes the reel hub slightly upward by means of a clutch. The reel hub starts rotation by means of friction between felt placed on the surface of the reel pulley and reel hub. The takeup reel hub is provided with adequate torque so that tape tension is constant.

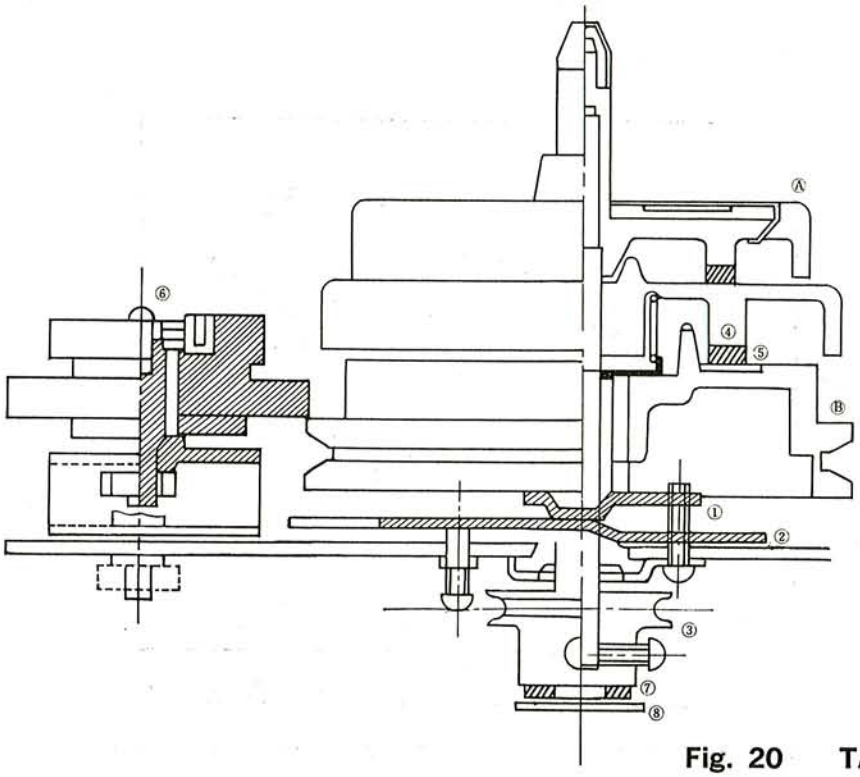


Fig. 20 TAKEUP REEL HUB

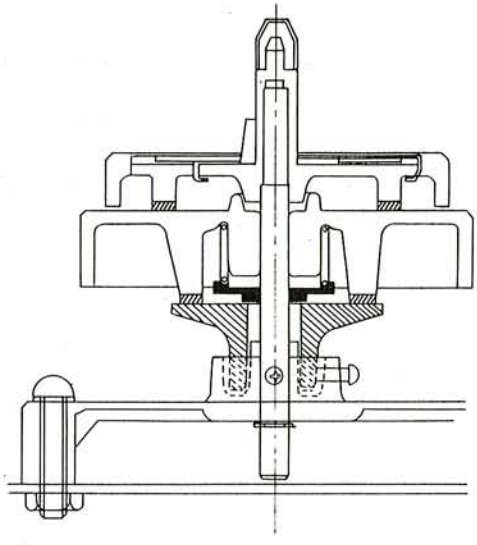


Fig. 21

SUPPLY REEL HUB

Record/Play mode :	When (2) is pulled toward right side, (1) is pushed upward then (4) and (5) are coupled and rotation is transported to (A).
Fast Forward :	(6) is moved to right, and both (A) and (B) begin rotation.
Stop/Rewind :	(2) moves to left and (1) falls. Then, (4) and (5) are instantly disconnected and (A) stops while (7) and (8) contact each other which create back-tension.

1) **PLAY :**

2) **RECORD :**

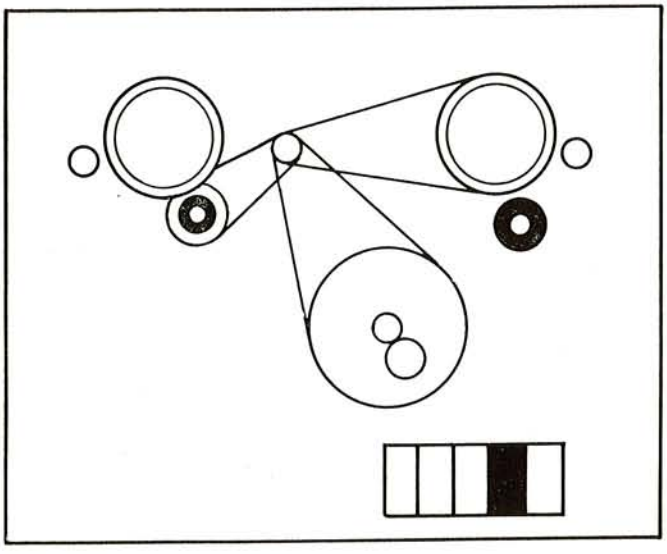


Fig. 22 "RECORD" AND "PLAYBACK"

When Record button is depressed, the amplifier circuit only is switched. The tape is driven only when Record and Play buttons are depressed simultaneously. Therefore, Record and Play employ with the same mechanical motion, as it is essential to keep constant tape speed in recording and playing modes. Speed variations produce distorted picture and sound.

3) **REWIND :**

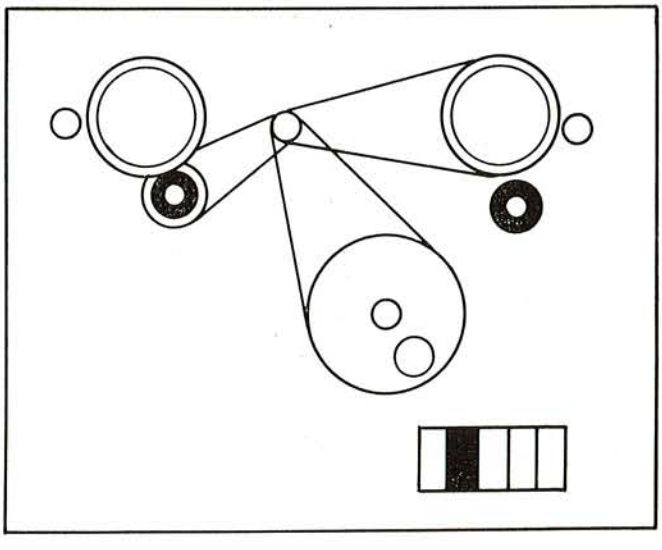


Fig. 23 "REWIND"

When Rewind button is depressed, rewind idler contacts supply reel hub and the movement of a belt connected to the idler is relayed to supply reel hub. Back tension is applied to the rewind reel hub so that balanced speed between rewinding action and rewind reel is obtained. Pinch roller is disengaged from the capstan while Rewind button is depressed.

4) STOP :

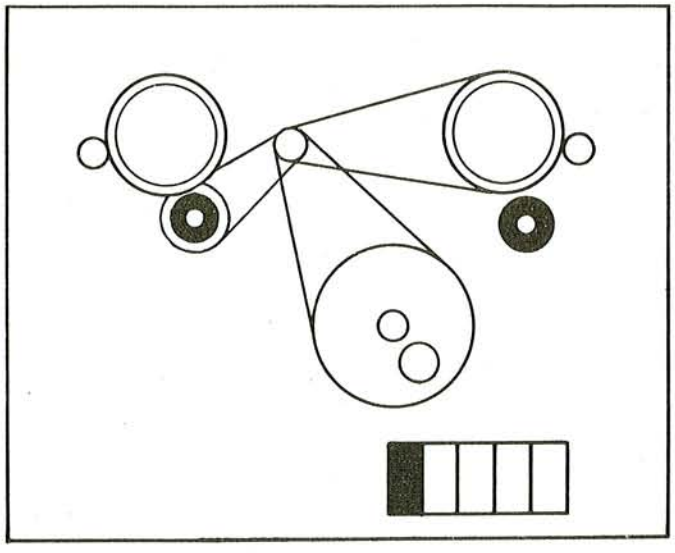


Fig. 24 "STOP"

When the tape is stopped by pressing Stop button, the pinch rollor is disengaged from capstan, and supply and rewind reel hubs are braked.

5) FAST FORWARD :

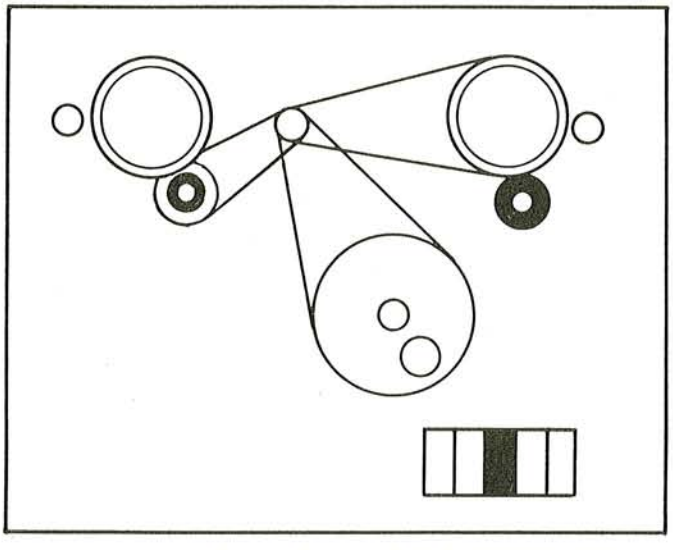


Fig. 25 "FAST FORWARD"

When Fast Forward button is depressed, the high-speed rotation of reel pulley driven by a belt of motor pulley is directly relayed to the Fast Forward roller. Supply reel hub has slight back-tension as in record or play mode. Pinch roller is disengaged.

When Power Switch is "ON" position, both capstan motor and head motor rotate simultaneously. The video head bar is installed at the top of the shaft of the head motor. The head bar rotates inside of tape guide at approximate speed of 1,800 rpm, clockwise. While rotating, the video heads protrude slightly through the gap located at the center of tape guide, and contacts the tape. Therefore, the tape guide must not be touched while the head motor is in operation. The output power of the 2 video heads is fed to the video amplifier by means of contact brushes and slip rings located at the center of the head bar. Tape is driven diagonally on the circumference of the tape guide from supply reel to takeup reel. On the tape guide, a tape supporter is attached so that the tape is transported correctly. The tapered posts located at both sides of the tape guide change the direction of tape, and require professional adjustment.

SPECIFICATIONS

System	:	Rotary 2-head system.
Tape Speed	:	12 ips.
Tape Used	:	1/2 inch Video Tape. A type winding
Tape Length	:	2,400ft., 1,200ft., 600ft.
Recording Time	:	40 minutes with 7″ (2,400ft.) Tape (standard).
Recording System	:	USA Standard System.
Video Modulation System	:	Double Side-band FM.
Video Input	:	1.0V p-p, 75Ω Unbalanced.
Video Output	:	1.0V p-p, 75Ω Unbalanced.
Resolution	:	Approximately 250 lines.
Video S/N	:	Better than 40db.
Audio Input	:	Microphone-20KΩ, -60db Unbalanced.
		AUX. -1MΩ, 0db Unbalanced.
Audio Frequency Range	:	80 ~ 10,000 cps.
Audio S/N	:	Better than 40db.
Source Voltage	:	AC 117V.
Source Frequency	:	50/60 cps. (Capstan sleeve change)
Power Consumption	:	160W
Dimensions	:	16-1/2″ (l)×16-1/2″ (w)×10″ (d)
Weight	:	Approximately 52.9 lbs.

GALLERY PRESS 67

OPERATING INSTRUCTIONS

1. INSTALLATION

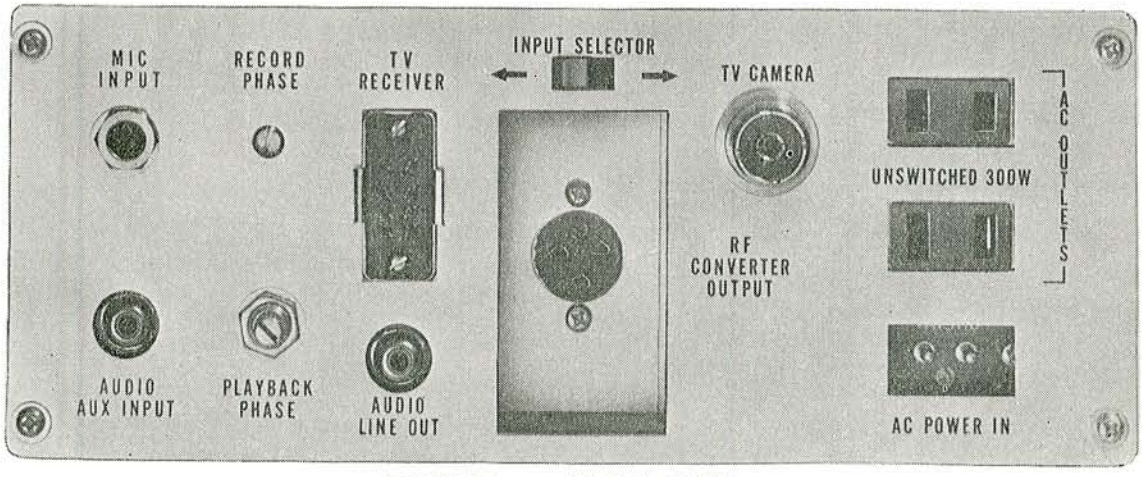


PHOTO-1 JACK PANEL

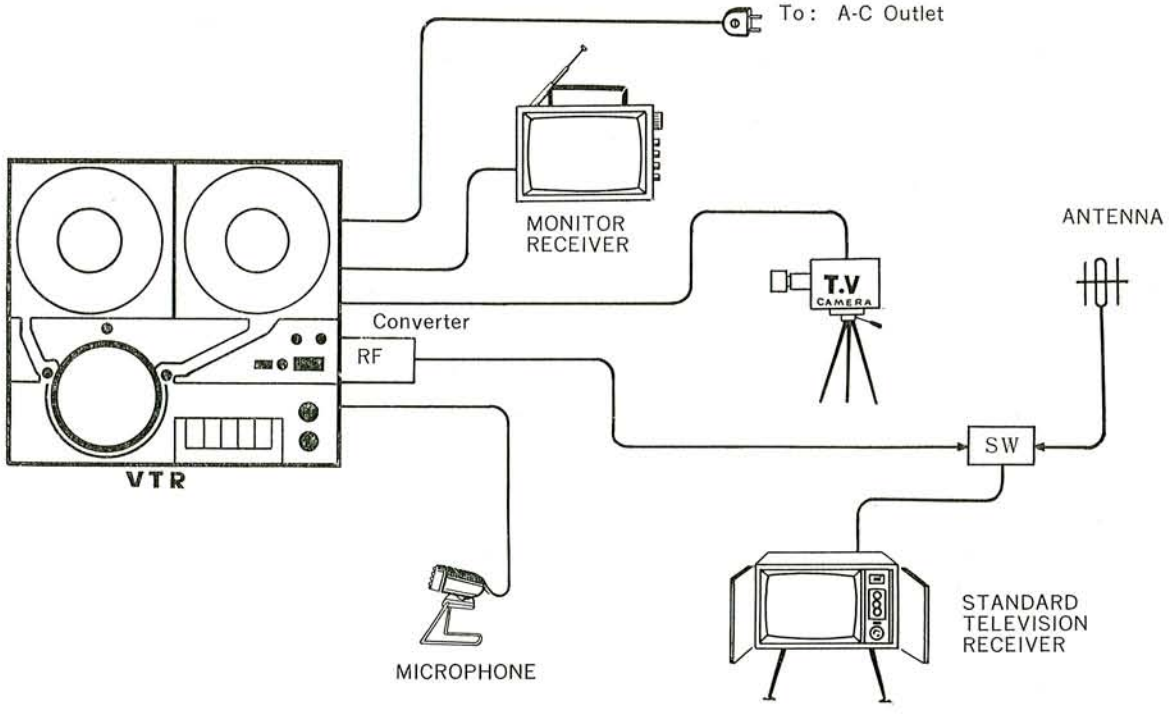


Fig. 26 BASIC CONNECTIONS

2. CONCORD MR-600 MONITOR/RECEIVER

When the Concord MR-600 is used, connect it to the V.T.R. by means of the cable provided, then turn the selection switch on the left side of the T.V. set to "VTR". When the switch is moved to "TV", the MR-600 becomes a conventional TV receiver.

3. TV CAMERA

See operating instructions included with TV Camera.

4. VTR

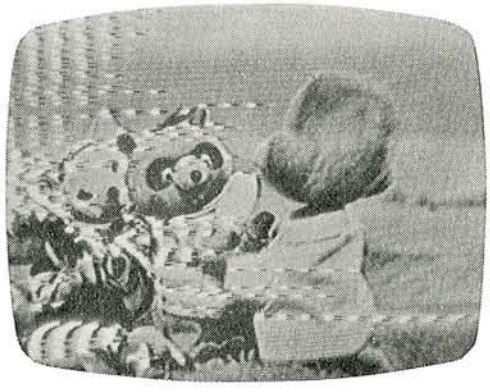
A. ON THE FRONT PANEL, LEVEL CONTROLS FOR RECORDING BOTH PICTURE AND SOUND, A TAPE COUNTER, A HEAD-CLEANING BUTTON AND VARIOUS FUNCTION PUSHBUTTONS ARE PROVIDED.

B. SOUND RECORDING ADJUSTMENT AND POWER SOURCE :

Turn the AUDIO level control knob to the right to turn power "on". Then depress the "RECORD BUTTON" and the point of the level meter begins to swing. Try to set the level so that the needle deflects within the black zone during peak volume of the source material.

C. RECORDING PICTURE ADJUSTMENT :

Turn the VIDEO level control knob to the right while observing the monitor in order to increase modulation level. An excessive modulation will produce stripes on the screen as shown in Photo-2. The most desirable recording level is the point just before the stripes appear on the screen.



Excessive Record Level
(Overmodulation)

PHOTO-2

D. TAPE COUNTER :

The tape counter consists of 3 digits and shows relative recording time. By depressing the white button located at right side of the tape counter, the figures return to zero. Make sure not to re-set the counter while recording.

E. RECORDING AND PLAYING BUTTONS :

When Record Button (Black) is depressed, the tape does not start, but the picture to be recorded appears on the screen of the Monitor. By observing the picture, adjust for the proper recording level. When the adjustment is made, depress Record and Play Buttons simultaneously. After rewinding, press the play button to reproduce the recorded picture and sound on either Concord MR-600 Monitor/Receiver or on conventional TV set.

F. FAST FORWARD/REWIND BUTTON :

For fast forwarding or rewinding tape.

G. STOP BUTTON :

To stop tape transportation mechanism.

H. HEAD-CLEANER BUTTON :

Depress the head-cleaner button once for 2-3 seconds when recording or playing cannot be made properly because of head clogging. This is to be done when the video heads are rotating.

I. 50 CPS SOURCE :

When using the recorder where 50 cps A-C power is standard, place the 50 cps adaptor sleeve on the capstan.

J. R-PHASE AND P-PHASE :

Two controls for R-Phase and P-Phase are provided on the jack panel at right side of the recorder. R-Phase is to change the head switching position. The head switching line is only observed on the reproduced picture. Turn the vertical hold knob on the TV set to make a blanking signal locate at the center of the screen, then, adjust R-Phase to keep the head switching line within 3 to 5H (about 5mm on 9″ TV set) above the blanking signal by repeating recording and playing in the above-mentioned state. P-Phase is to be set at the position when the reproduced picture quality becomes the best.

Note : These two controls are carefully adjusted at the factory so it is not recommended for the user to re-adjust these except for the following occasions :

a. R-Phase :

When the recorder is repaired (the adjustment of R/P Phase should be refered to the nearest serviceman.)

b. P-Phase :

i) When playing the tape recorded by other VTR,
ii) When playing old tape,
iii) When the power source voltage is suddenly altered, or
iv) When the S/N of the recorded picture is excessively poor.

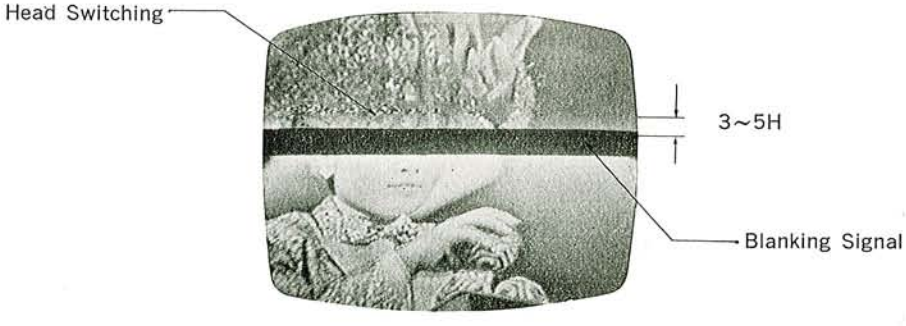


PHOTO-3 Head Switching Position Adjustment

MAINTENANCE

To obtain the best performance from the VTR, it is important that the oxide residue from the tape must be cleaned from the heads periodically.

Make sure not to magnetize the heads and tape so as to avoid malfunction in recording and playing.

1. Before using the recorder, clean the tape and path in the following manner :

A. Cut the power "off" and unload the tape.

B. Remove the head cover (not video head cover) and clean the tapered tape guides, capstan and pinch roller by using a cotton swab slightly moistened with a commercial cleaner.

C. The cleaning of video heads can be done after the curved metal guard is removed. Benzol or Trichloro-Trifluoroethane ($C_2Cl_3F_3$) is suitable as a cleaning fluid. However, the utmost care must be taken to avoid any excessive pressure on the heads.

2. Demagnetization of Heads :

Avoid bringing a magnet close to the video heads or to test the heads by means of a tester to avoid undesirable magnetization.

If erroneously the video heads are magnetized, demagnetize as follows :

Using a demagnetizer, after stopping heads completely, connect the A-C cord of demagnetizer to the A-C outlet and then bring the demagnetizer close to the surface of the head for 2 or 3 seconds. After that, take it slowly away from the head to about one foot and disconnect the A-C plug.

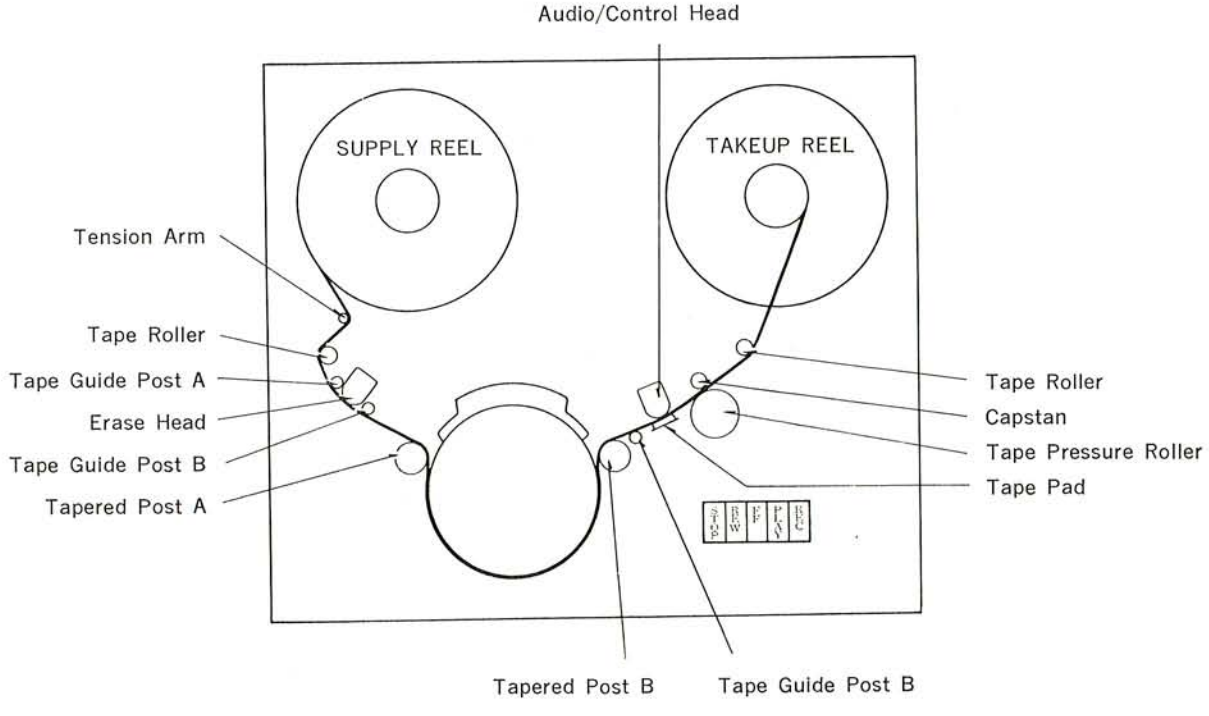
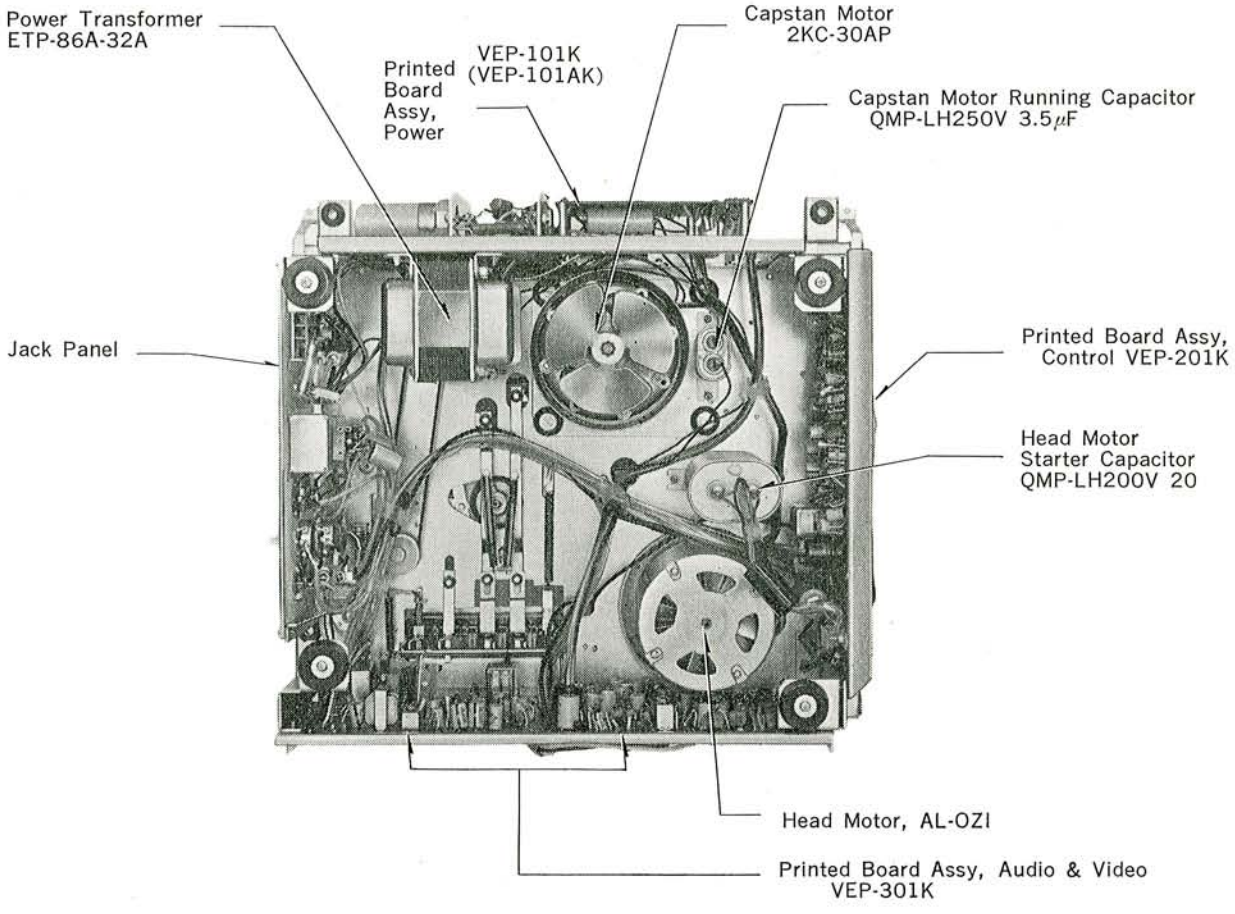


Fig. 27 TAPE THREADING

ELECTRICAL CIRCUIT ADJUSTMENT

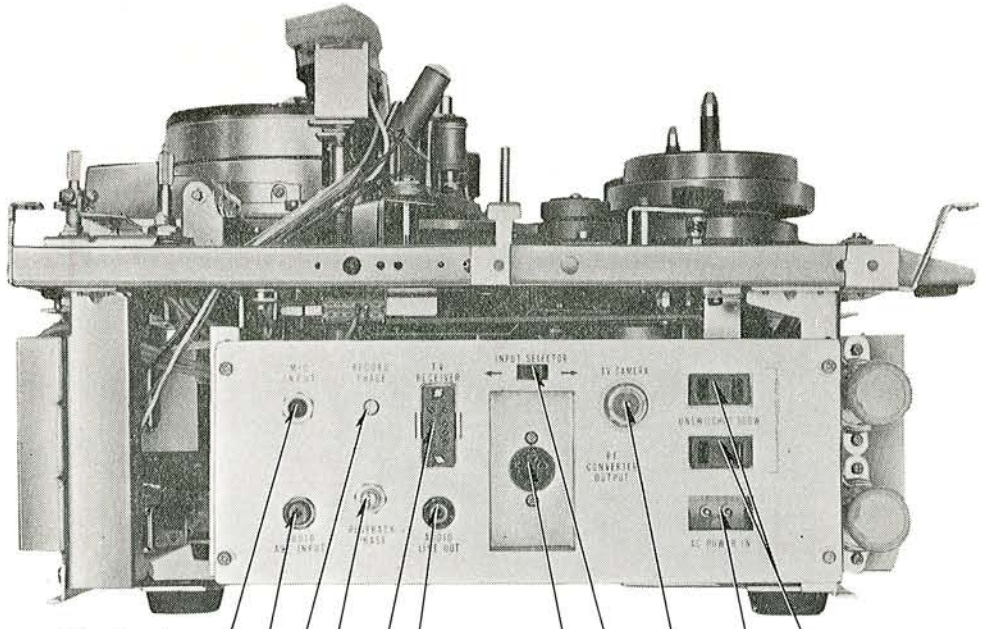
MAIN PARTS LOCATION



Remarks :

Parts No. indicated in the parenthesis is for VTR-600-1, the model with Audio Dubbing function.

JACK PANEL



Mic. Input
VJJ-1

Audio AUX. Input
VJJ-2

Record Phase Control, R-220

Play Phase Control, R-271

Monitor Receiver Connector
VJS-1

Audio Line Output
VJJ-2

Convenient A-C Outlets
VJS-9U

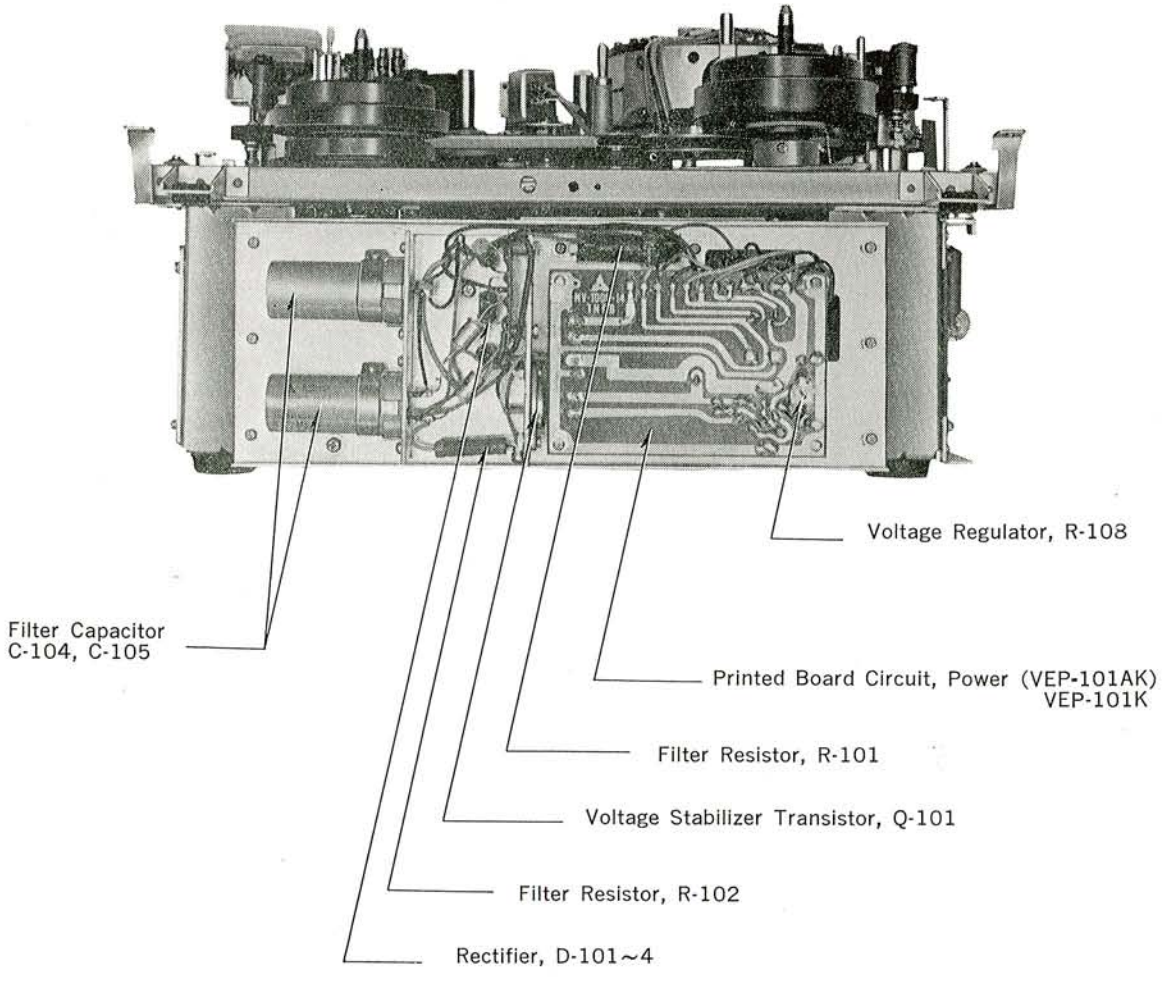
A-C Power Input
VJP-4

ITV Camera Connector

Input Selector Switch
VSS-1

RF Converter/Video
Adaptor Connector
VJS-4

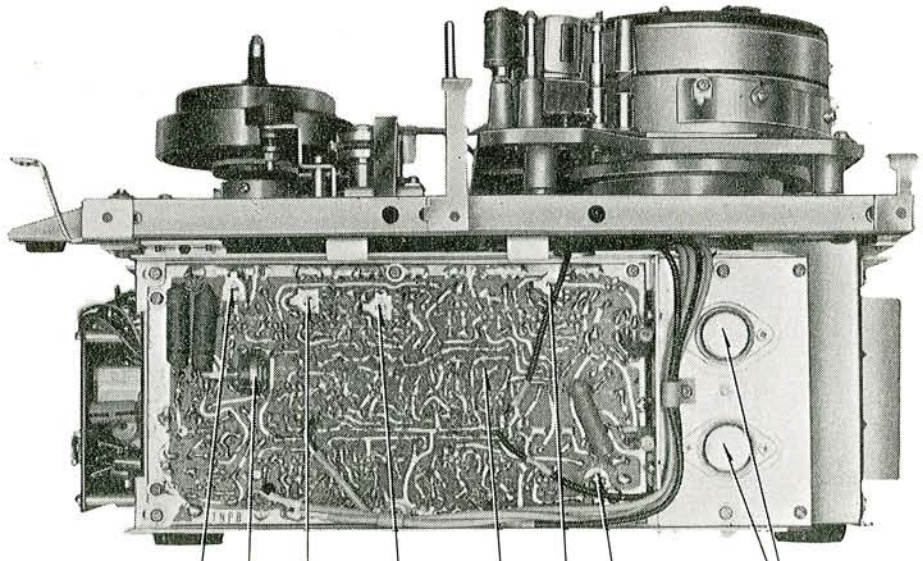
POWER SUPPLY CIRCUIT



Remarks :

Parts No. indicated in the parenthesis is for VTR-600-1, the model with Audio Dubbing function.

CONTROL CIRCUIT



Motor Driving Amplifier
Transistor, Q-213, Q-214

Phase Control, R-298

Power Supply Jack, J-201

Buffer Oscillator Frequency
(60 cps) Regulator, R-297

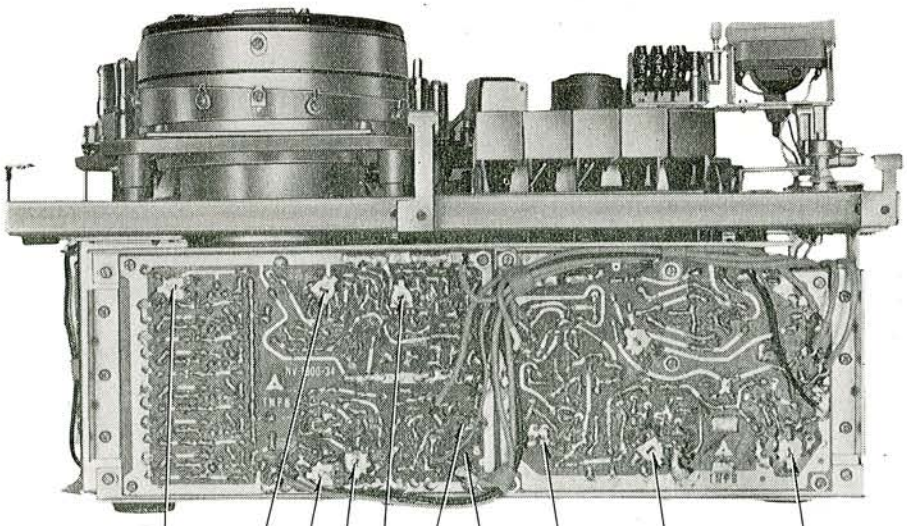
Multiple Vibrator Frequency
(30 cps) Regulator, R-227

Time Delay Regulator, R-2112

Printed Board, Control/VEP-201K

Gator Timing Regulator, R-2120

VIDEO AND AUDIO CIRCUITS



VU Meter Sensitivity Regulator, R-431

Limiter Balance Regulator R-348

Demodulation Balance Regulator, R-355

Modulation Frequency Regulator, R-314

Modulation Frequency Balance Regulator, R-313

Video Gain Control, R-419

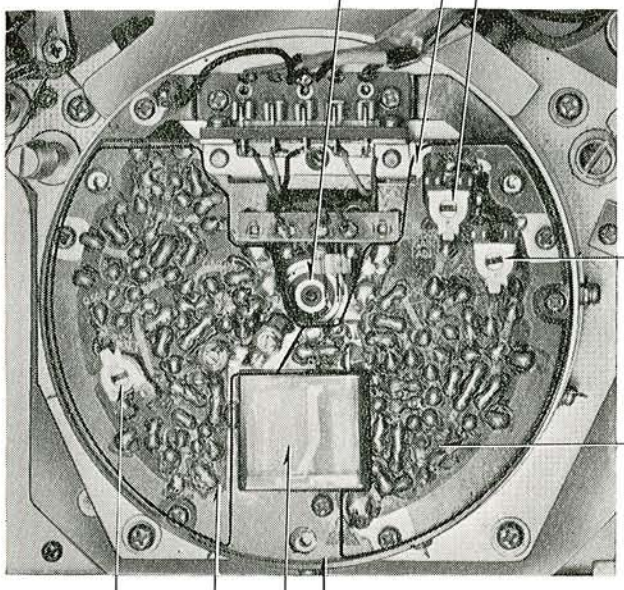
Printed Board Assy, Audio VEP-401K

Printed Board Assy, Video VEP-301K

Power Supply Jack, J-304

Indicator Level Regulator, R-369

RECORD AND PLAYBACK AMPLIFIER CIRCUITS



Remarks :

Parts No. indicated in the parenthesis is for VTR-600-1, the model with Audio Dubbing function.

AMPLIFIER ADJUSTMENTS

When service is performed on the printed circuit board or a component part is replaced, conduct the following adjustments :

POWER SUPPLY CIRCUIT

ADJUSTMENT OF POWER SOURCE VOLTAGE

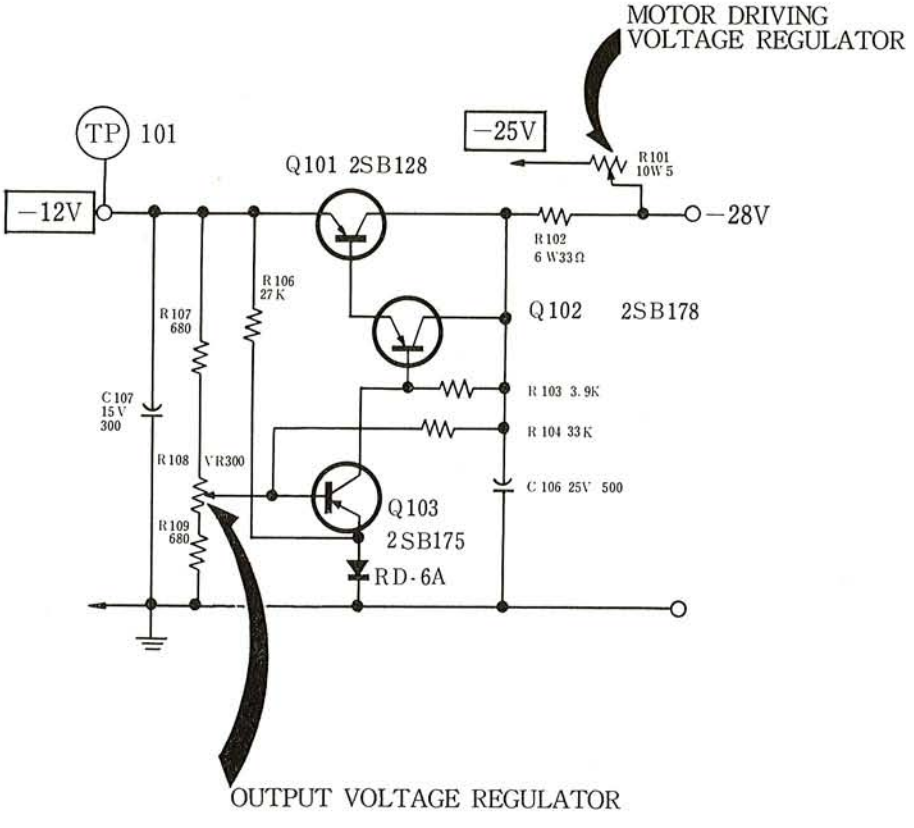


Fig. 34 STABILIZED DC POWER SUPPLY CIRCUIT

1. Connect the A-C Power Cord, turn the power switch "on" and set the recorder for either Record or Play-back mode.
2. After connecting VTVM to the -12V output terminal (TP101), adjust the output voltage regulator (R108, VR300Ω) to obtain -12V.
3. Adjust the motor driving voltage regulator (R-101, 10W5Ω) to obtain -25V.

CONTROL CIRCUIT

WHEN RECORDING :

1. Adjustments of the Astable Multivibrator and the Motor Driver Amplifier :

A. Connect an oscilloscope to TP202 (collector of Q-207) and after setting the Astable Multivibrator in free running condition (set the recorder in Record mode and remove the video signal input), adjust R233 (VR10KΩ) to obtain the OFF period of 18msec and ON period of 18msec to 22msec as shown in Fig. 35.

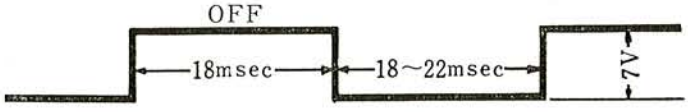


Fig. 35 Wave-form at TP202

B. After the adjustment item A is completed, connect the video signal to VTR and confirm the wave-form at TP202 as shown in Fig. 36.

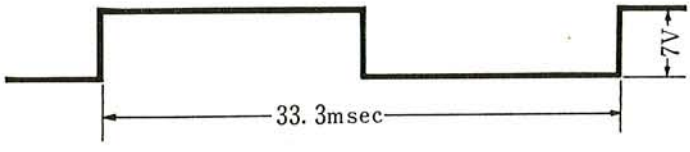


Fig. 36 Wave-form at TP202 when video signal is fed to VTR.

C. After confirming that the motor is running in synchronous to the Astable Multivibrator at either the Collector of Q213 or Q214, connect the video signal and confirm that the motor, now, is rotating in synchronous to the Vertical Sync. Signal (VSS) of the video signal. The determination whether the motor is rotating in synchronous to the VSS can be made by observing the wave forms as below.

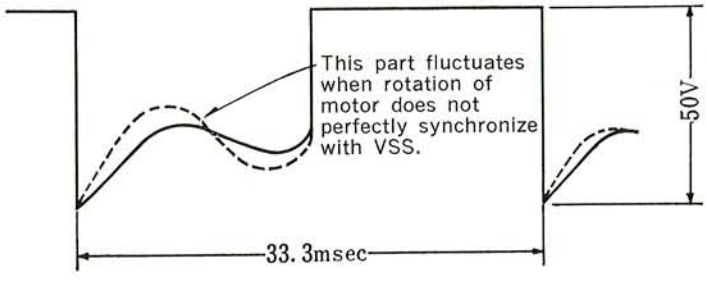


Fig. 37 Wave-form of Collector of Q213 of Q214.

D. Adjust R101 (10W, 5Ω, wire-wound resistor) to obtain 25V at 3rd pin of the Connector (P102).

2. Adjustments of the V.S.S.Sep. and the Rec. Phase Control :

A. The adjustment of the V.S.S.Sep. is unnecessary when video signal more than 0.3V p-p (minimum required video signal), is obtainable at the base of Q201. In this instance, the positive pulse will appear at the Collector of the Q-203.

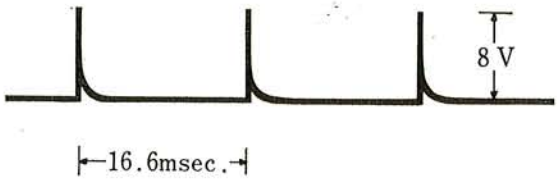


Fig. 38 Wave-form of Collector of Q203.

B. The adjustment of the Rec. Phase can be made by connecting an oscilloscope to TP201 (collector of Q205) and by setting R220 (VR 50KΩ) to obtain the wave-form as shown in Fig. 39.
The head switching line position must be set at 3 to 5H before the front porch of V.S.S. of the television signal while alternately recording and playing back. The final adjustment, however, must be conducted after the adjustment of the playback circuit is completed.

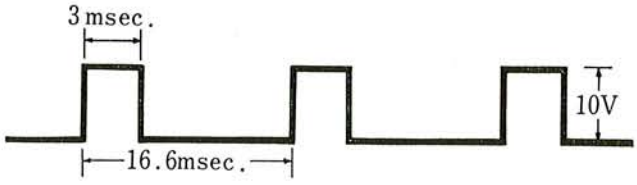


Fig. 39 Wave-form at TP201.

3. Confirmation of Cont. Sig. Rec. Amp.:

Connect the oscilloscope to the terminals of control head and confirm the wave-form as shown in Fig. 40.

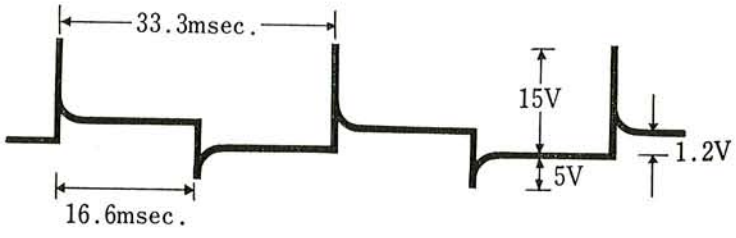


Fig. 40 Wave-form at control head terminals.

WHEN PLAYING BACK

1. Adjustment of Cont. Sig. Amp.:

First record the control signal pulses on a tape. When playing back the tape, confirm the wave-form at TP203 (collector of Q218) and the collector of Q217 as shown in Fig. 41.

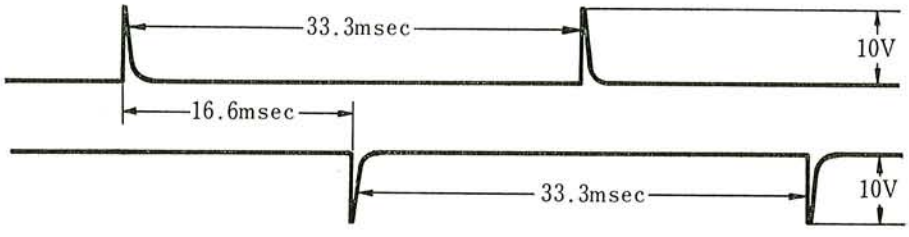


Fig. 41 Wave-form at TP203 and collector of Q217.

While observing the wave-form at TP203 and TP204 (Collector of Q222) with a Dual-Beam oscilloscope confirm that the falling of the TP204 R271 (VR50K) is adjusted.

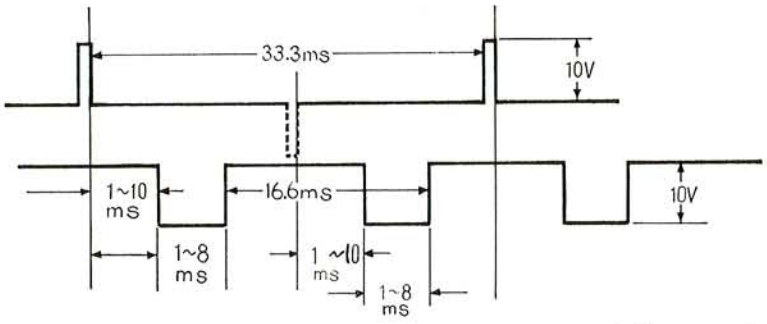


Fig. 42 Wave-forms for Playback Phase Adjustment.

2. Adjustment of Buffer Oscillator :

A. Connect an oscilloscope to TP205 (Q225) while the tape is not moving, and set the time axis of the Line Sync. (60 cps.) at 5msec. Then, adjust R292 (VR3KΩ) so that the wave-form as written per the Line Sync. is stabilized with the oscillated sine wave-form obtained from TP205 when it comes to 60 cps.

B. Confirm that the played back signal appears at the place as shown in Fig. 43 when the tape is played back and there must be an approximately 6msec. phase difference between the pulses at TP205 and TP206.

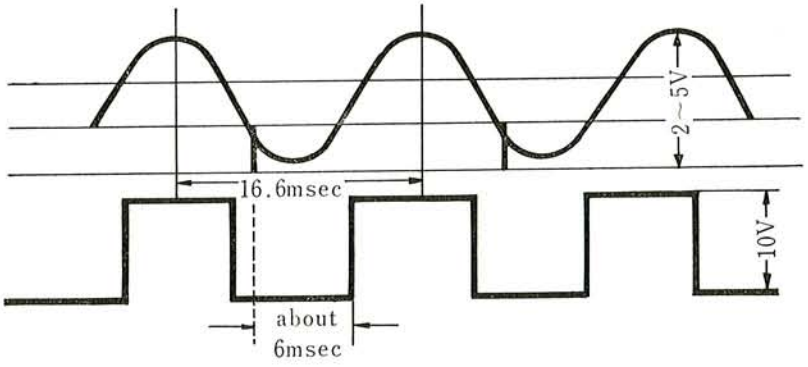


Fig. 43 Wave-form at Buffer Oscillator

C. However, this phase difference must come to 8msec. by adding it with the minimum shifting volume (approximately 2msec.) of the playback phase control. If the 8msec. (combination of the phase differences of the playback phase control, Buffer oscillator and the Schmitt circuit) is unobtainable, re-adjust R292.

3. Adjustment of the Delay and the Gater Circuits :

A. After connecting an oscilloscope to TP207, adjust the R2112 (VR100KΩ) to obtain a Delay time of 8msec.

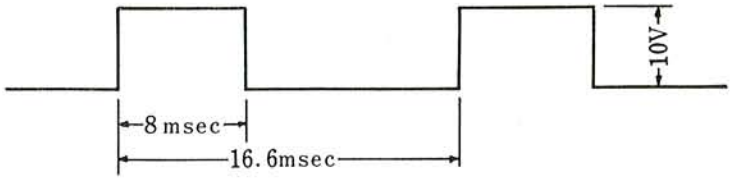


Fig. 44 Delay time adjustment

B. After connecting an oscilloscope to TP208, adjust the R212 (VR100KΩ) to obtain a Gater Delay time of 16.6 msec. with duty cycle of approx. 50:50.

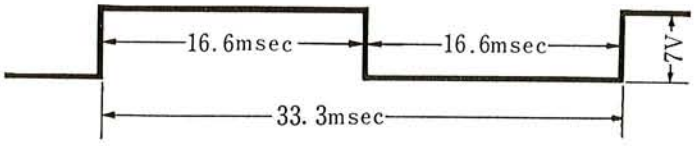


Fig. 45 Gater delay time adjustment

C. After the above adjustments are completed, connect a Double-Beam Oscilloscope to TP210 and confirm that the wave forms on the screen must have the phase relationship as shown in Fig. 46 (having phase difference of 16.6 msec. each other), and further when comparing the wave forms between either one of TP209 or TP210 and the TP202, the timing of the delay must coincide as shown in Fig. 46. Also confirm that this relationship must not be affected even when the R271 (playback phase control) is rotated. Otherwise, repeat the above adjustments.

Also, in order to observe the relationship with the S/N ratio of the video signal in playback mode, confirm that the timing of the wave forms at TP203 and TP209 must coincide when observed with a Double-Beam Oscilloscope to obtain the best S/N ratio and the variable range of wave form of TP210 must be ±6 to 7 msec. against the wave form of TP203 when the playback phase control is rotated.

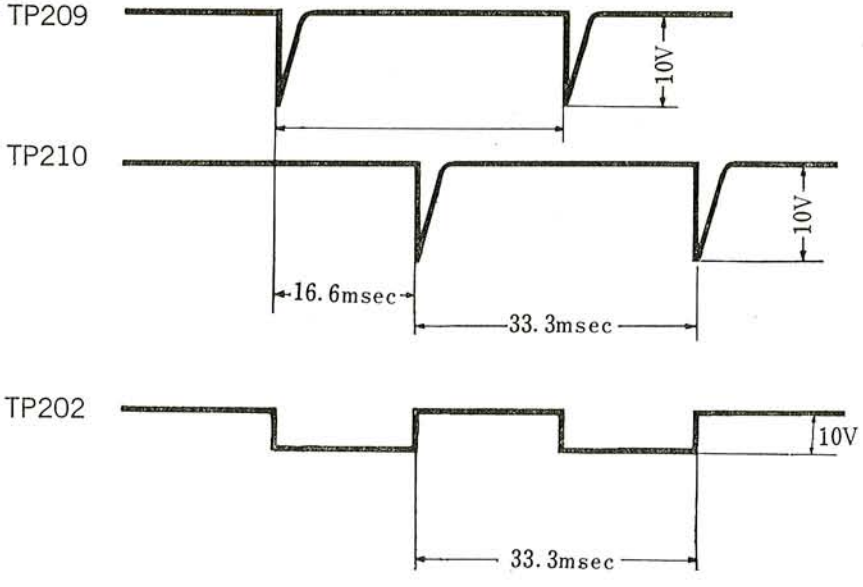


Fig. 46 Wave form relationship at Control Circuits.

VIDEO CIRCUIT

Adjustment of the Modulator

1. Connect a oscilloscope to TP301 and a Standard Signal Generator to J301 and set the switch S301 at "CAMERA".

2. Set the SSG for 100Kc and R302 at maximum position and cofirm that the wave form on the oscilloscope can be amplified to 4V p-p with negligible distortion with REC button depressed.
3. Connect a frequency counter to TP302 and adjust R314 to obtain the output frequency of 2.7 MC on the counter, with R302 set at minimum position.

Adjustment of the Low-Pass Filter of the Demodulator

1. Disconnect CU-1 and CU-2 and connect a Standard Signal Generator as shown in Fig. 47.
2. Connect a monitor television to J302 and a VTVM to TP306.
3. Set SSG for 100KC and adjust outpnt level control of the SSG to obtain −10db reading at VTVM.
4. Then set SSG for 2.9 MC and adjust L311 to obtain minimum reading (less than −70db) at VTVM.
5. Then set the SSG for 2.7 MC and adjust L310 to obtain −50 to −55 db reading at VTVM. When two tuning points are found set it at the upper (closer to the screw head of the dust core) one.
6. Set the output at the 100KC for 0 db, plot the VTVM indications on a section paper by changing the SG frequencies, as shown in Fig. 48.

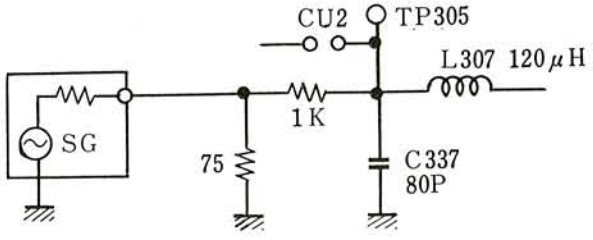
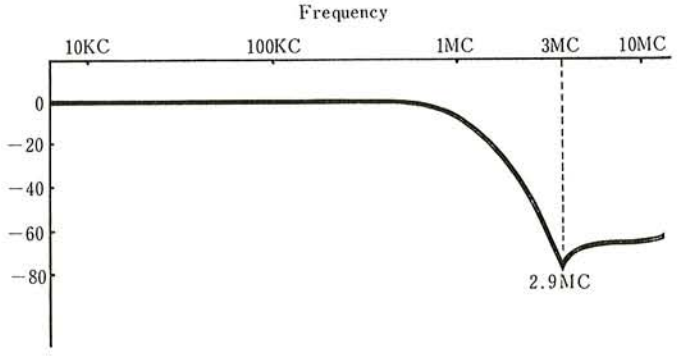


Fig. 47 Low-Pass Filter adjustment



7. After completion of the above adjustments, be sure to re-connect CU-1 and CU-2.

Overall Adjustments of the Modulator and Demodulator :

1. Turn the power switch ON, and confirm the snow-noise on the picture of amonitor receiver.
2. Set the video level, R302, at minimum position.
3. Set the selector switch to CAMERA.
4. After depressing the REC. button, confirm that the snow-noise is eliminated.
5. Connect the oscilloscope to TP302 and confirm that the rectangular wave-form of 2.7 MC is found between 1 V and 1.5 Vpp.

6. Confirm that the wave-form of 2.7 MC at the collector of Q304 is about 0.3 Vpp.
7. Confirm that the wave-form of 2.7 MC at the collector of Q305 to Q308 are between 0.5 and 0.6 Vpp.
8. Confirm that the wave-form of 2.7 MC at the collector of Q309 is about 0.8 Vpp.
9. Confirm that the output of the differential wave-form of 2.7 MC at TP304 is between 1 V and 1.5 Vpp as shown in Fig. 49.

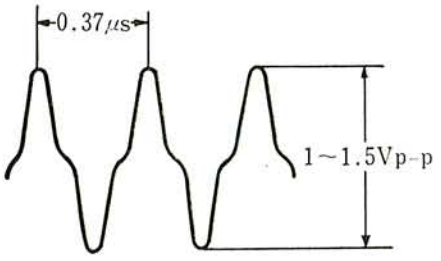


Fig. 49 Wave-form at TP304.

10. After connecting a oscilloscope to TP305, adjust R348 and R355 to obtain the balanced wave-form of 5.4 MC on the oscilloscope as shown in Fig. 50.

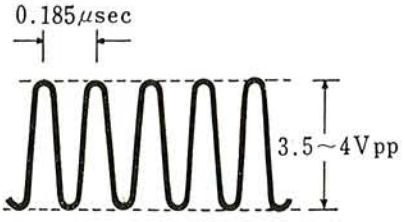


Fig. 50 Wave-form at TP305.

11. Connect SSG to J301 and set SSG for 10 KC.
12. Connect a oscilloscope to TP306 and set the video level, R302, at maximum position and confirm that the monitor receiver is connected at J302.
13. Adjust the output of SSG and set it at the position just before the phenomenon as shown in Fig. 51-A happens, on the output wave-form at TP306.
14. The output wave-form at the above point is to be found as Fig. 51-B, so adjust the R313, R348, and R355 to abtain the wave-form as shown in Fig. 51-C.

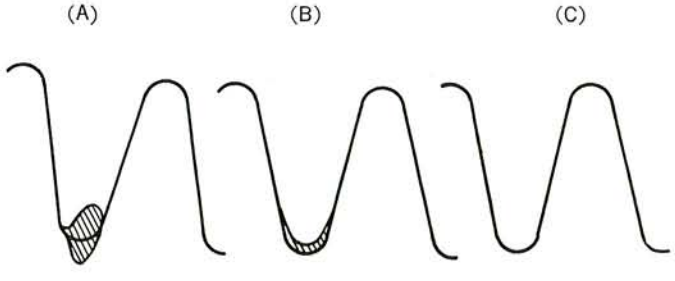


Fig. 51 Wave-form TP306 for over-all adjustment of modulator and demodulator.

15. When the adjustment item 13 is completed and the oscillation as shown in Fig. 52 is obtained, adjust R370 to eliminate the oscillation. This adjustment, however, is a temporary one so that R370 must further be adjusted according to the output voltage of the video head, not to show the distortion caused by the overmodulation when recording, but with the deepest possible modulation.

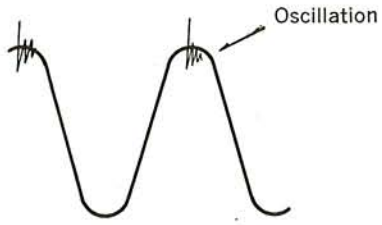


Fig. 52 Oscillated Wave-form at TP306 for Level Indicator Circuit Adjustment.

AUDIO CIRCUIT

VU Meter Adjustment :

1. Connect a Standard Signal Generator to the Microphone input (J401) or AUDIO AUX. input (J402) and set SSG for 1 KC.
2. Connect a VTVM to TP401, turn the power switch "on" and depress the REC button, and set the audio gain control R419 at minimum position.
3. Adjust the output gain control of the SSG with input volume control of the unit (R402) set at maximum to obtain output voltage of 2 V rms at TP401.
4. With the above setting, adjust R431 to obtain O-VU reading on the VU Meter.

Adjustment of the wave forms for the Bias and Erasure Oscillator :

1. Depress the REC button.
2. Connect a oscilloscope to TP402, and set the audio level R403 at minimum position.
3. Confirm that the output wave form on the oscilloscope appears as sine wave without much distortion as shown in Fig. 53.

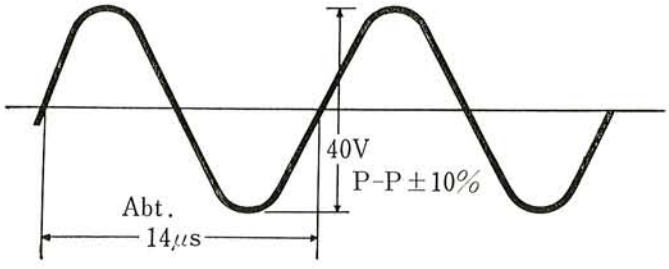


Fig. 53 Wave-form of Bias and Erasure Oscillator

Adjustment of Trap Circuit for the Bias Signal :

1. Depress the REC button and set the R402 at minimum position.
2. The frequency of about 70 KC, leaking from the oscillator for recording and erasing bias, is to appear on the oscilloscope if it is connected to the TP401.
3. Adjust variable inductance L401 in the attenuating trap circuit for 70 KC and obtain minimum wave form of output level on the oscilloscope.

Adjustment of Audio Recording Bias Current :

1. Insert a 10Ω resistor between the H_2 terminal on the printed circuit board and the audio record head, and connect a high-sensitivity VTVM (capable of reading 1 mV) across the resistor, as shown in Fig. 54.
2. Depress the REC button and set R402 at minimum position.

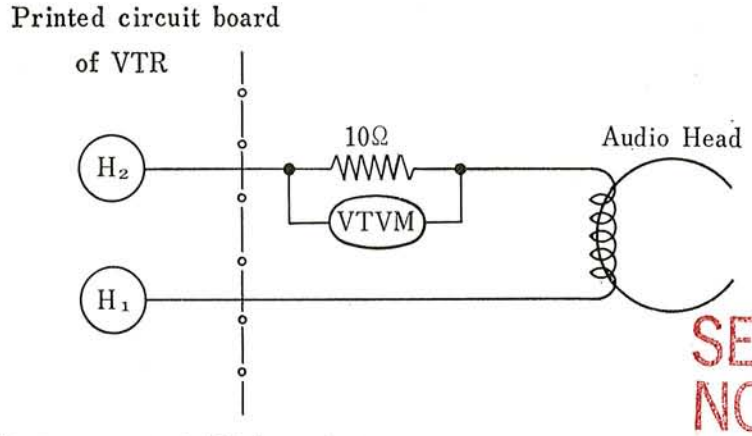


Fig. 54

3. Adjust the Bias Adjustment control (R432) to obtain 3 to 3.5 mV rms reading on the VTVM.

Adjustment of Audio Gain Control :

1. Connect Standard Signal Generator to the Microphone Input (J401) and set SSG for 1 Kc.
2. With the audio level control set at maximum, adjust the output level control of the SSG so that the VU Meter indicates O-VU.
3. With the above setting, record the audio signal on a tape.
4. Adjust the Gain Adjustment control (R419) to obtain O-VU reading on the VU meter when the tape is played back.

RECORDING AND PLAYBACK AMPLIFIER ADJUSTMENTS :

Recording Amplifier Adjustment :

1. Depress the REC button, set the R302 at minimum position and connect a oscilloscope across the pins Nos. 2 and 3 of P501. Then confirm that the output of the square wave form of the 2.7 Mc is approximately 1.0 to 1.5 Vpp.
2. Connect a High-Sensitivity Oscilloscope to TP501, set R517 at minimum and set R-502 at maximum and confirm that the output is approximately 200 mV p-p. Then set the R502 at minimum and set the R517 at maximum and also confirm that the output is approximately 200 mV p-p.
3. After setting the R517 at minimum, adjust the R502 to obtain output of 130 mVpp at TP501, then adjust R517 to obtain 260 mVpp at TP501.

Playback Amplifier Adjustment :

1. Connect a Standard Signal Generator having output impedance of 75Ω to TP501 and set it for 3.3 MC and set the output level at 1 mVpp (abt. 51 db) and connect a VTVM across the pins Nos. 4 and 3 of P501.
2. Short-circuit both terminals of C505 and C516 with a capacitor 0.047μF alternately and adjust C505 and C516 to give maximum reading at VTVM with 3.3 MC frequency from SSG.
3. Change the SSG for 2.7 MC and adjust R529 while alternately short-circuiting the C505 and C516 with the above mentioned capacitor 0.047μF so that the reading at the VTVM becomes approximately same.

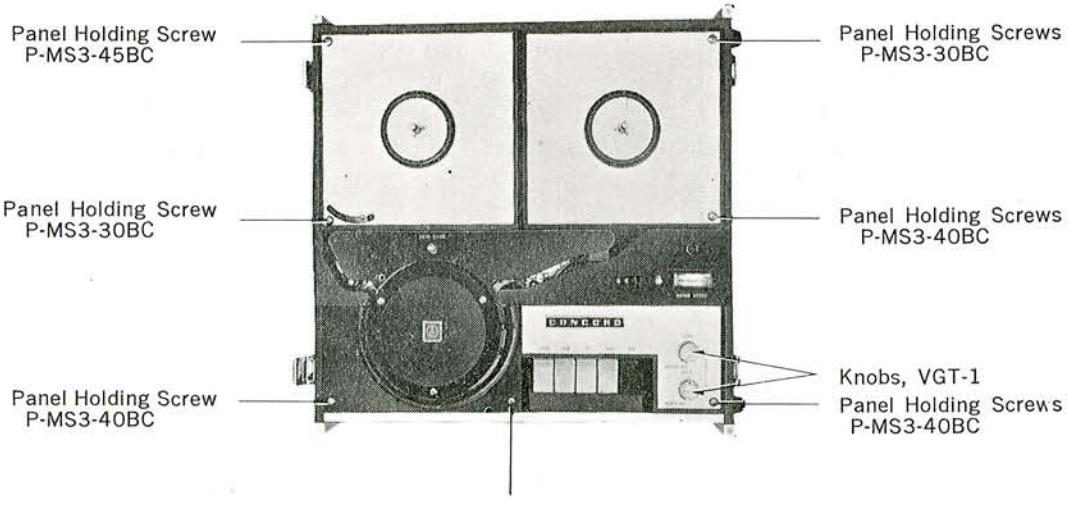
Confirmation of Audio Dubbing Mode :

1. Turn the power switch ON and record the video and audio signals on the tape, and confirm that the playback works properly.
2. Set the video level R302 at the audio dubbing mode, and rewind the recorded tape.
3. Connect a microphone to MIC. INPUT, J401, and record the audio signal on the tape, which is in the audio dubbing mode.
4. Reset the video level R302 at normal mode and rewind the tape.
5. Confirm that the audio dubbing works in play back mode.

MECHANISM ADJUSTMENTS

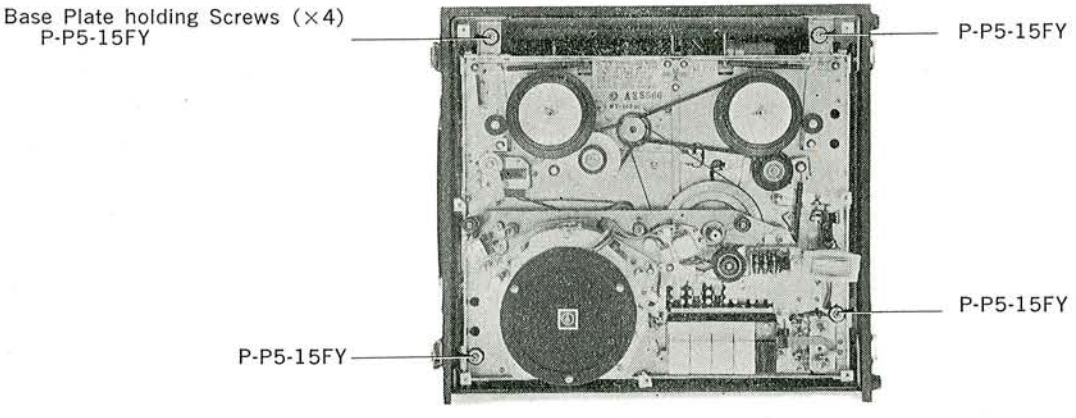
DISASSEMBLING AND ASSEMBLING

TO REMOVE TOP PANEL :



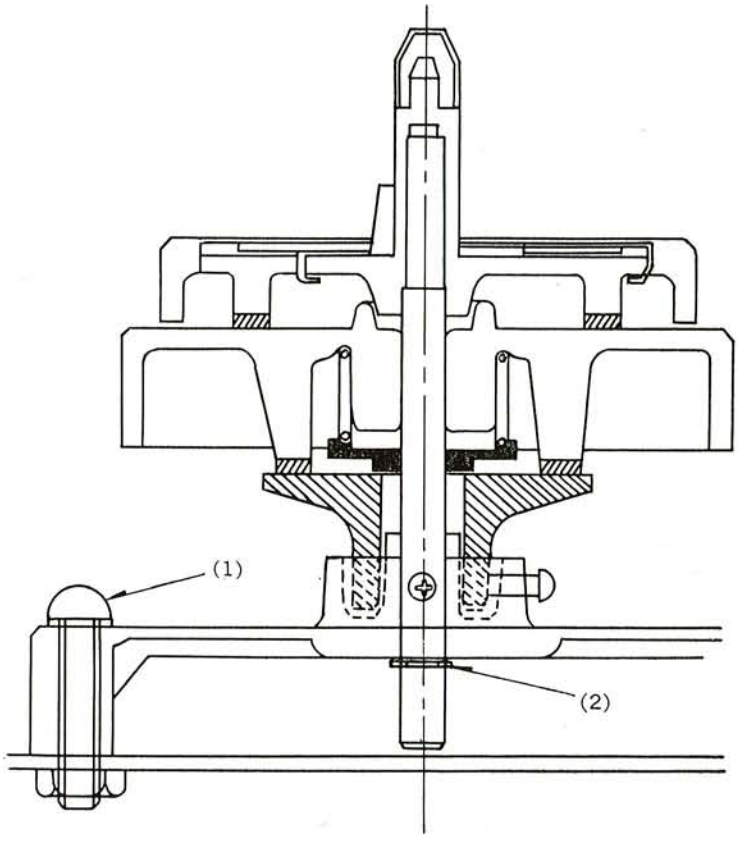
1. Pull out all control knobs.
2. Pull out the head mount.
3. Unscrew 7 panel holding screws, then the top panel can be removed.

TO REMOVE MECHANISM FROM CABINET :



1. Unscrew and remove four screws.
2. Pull the mechanism out from the cabinct with care.

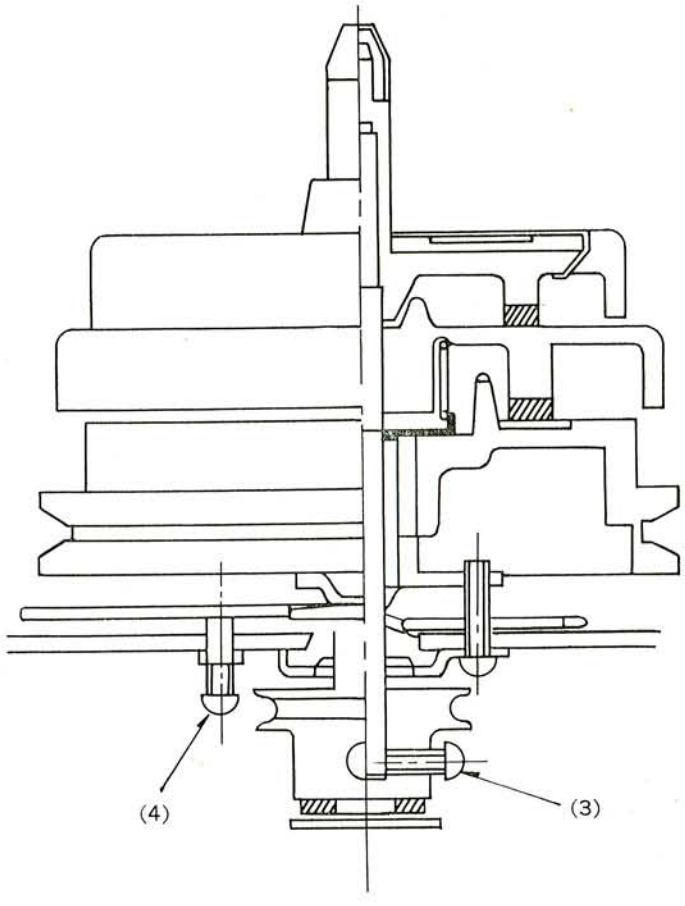
SUPPLY REEL HUB :



How to disassemble

1. Unscrew and remove screw (1). (P-P4-25FY)
2. Remove E-Washer (2). (EW-5)
3. Pull out the reel hub upward.

TAKEUP REEL HUB :

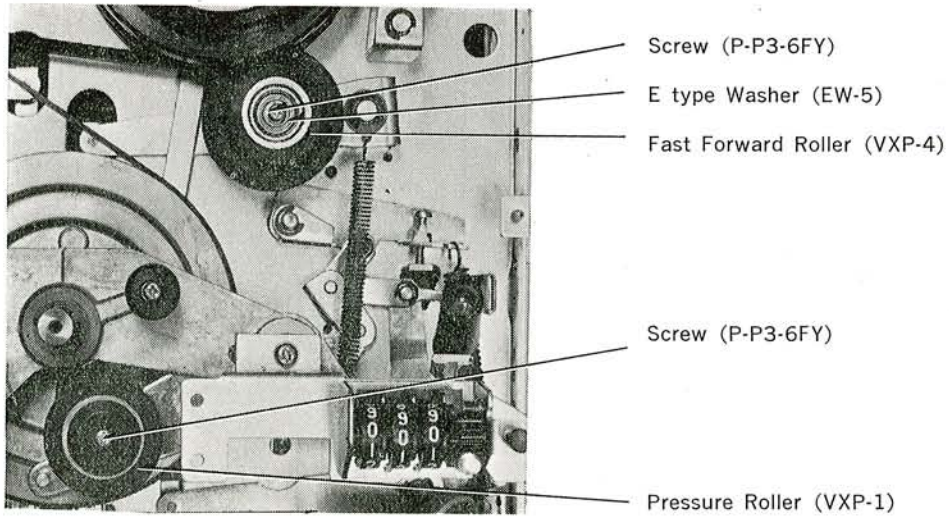


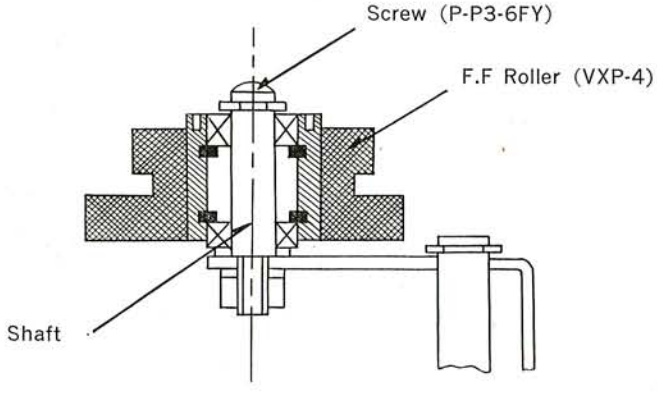
How to disassemble

1. Loosen the screw (3). (P-P4-12FY)
2. Pull out the reel hub upward.
3. Pull out the reel hub pulley upward.

NOTE : The screw (4) is for reel hub height adjustment.

FAST FORWARD ROLLER :



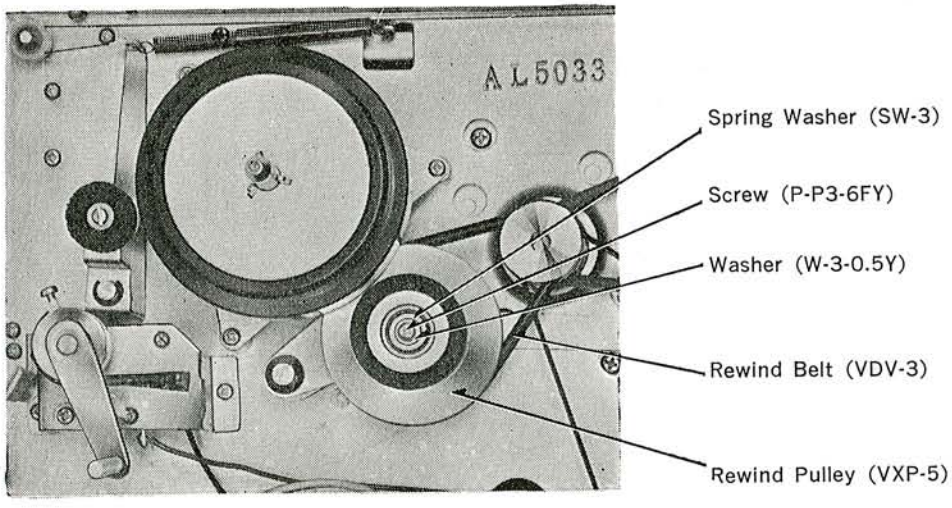


How to disassemble

1. Remove Screw and Washer.
2. Take out F.F. Roller from F.F. Roller Shaft.

NOTE : The above procedure must be followed after removal of the Take up Reel Hub.

REWIND PULLEY :



(1) Screw (P-P3-6FY)

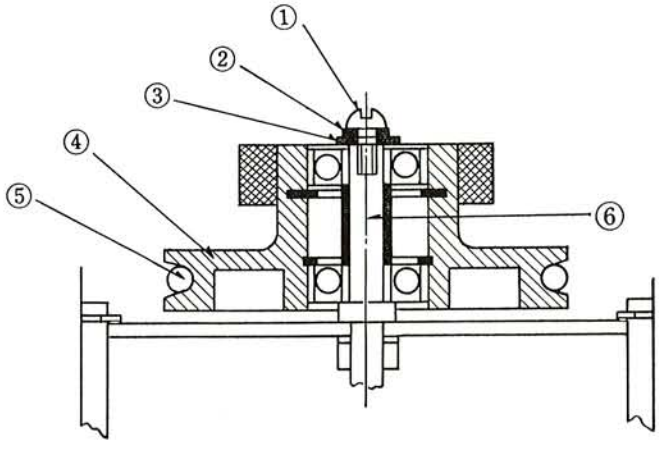
(2) Spring Washer (SW-3)

(3) Washer (W-3-0.5Y)

(4) Rewind Pulley (VXP-5)

(5) Belt (VDV-3)

(6) Shaft

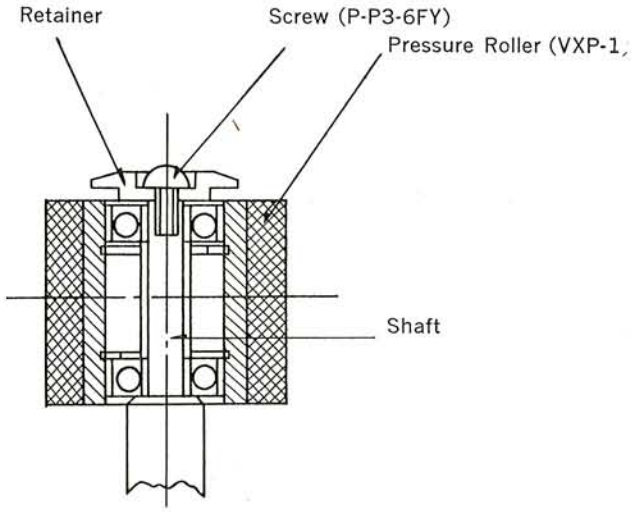


How to disassemble

1. Unscrew and remove screw (1).
2. Remove Spring Washer (2) and Washer (3).
3. Disengage Rewind Belt (5).
4. Take out Rewind Pulley from Rewind Pulley Shaft with care.

NOTE : The above procedure must be followed aftor removal of the Supply Reel Hub.

PRESSURE ROLLER :



How to disassemble

1. Unscrew and remove screw.
2. Remove Retainer.
3. Take out Pressure Roller from Pressure Roller Shaft.

TO REMOVE ROTARY HEAD UNIT:

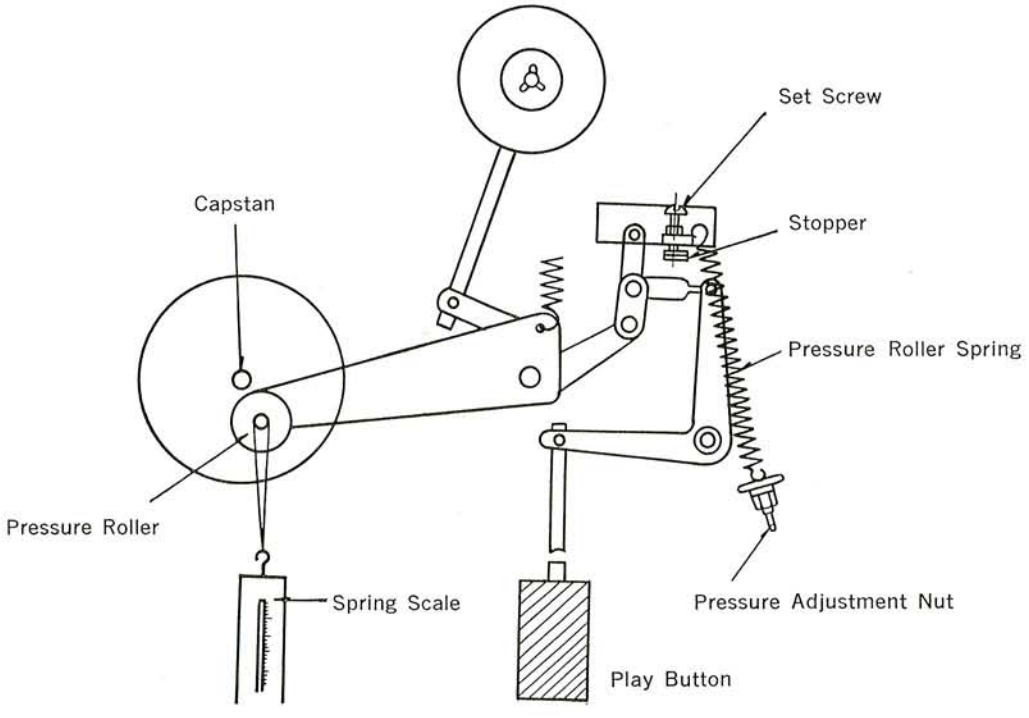
1. Unsolder and remove connections to the motor.
2. Unscrew and remove four screws holding the Rotary Head Unit.
3. Gently take out the unit upward.

ADJUSTMENTS :

CAUTION

1. The surface of every part which tape contacts must be carefully treated so that it cannot be scratched. Especially, utmost care must be taken for the heads and head guide posts.
2. Be sure to lubricate every bearing of rotating part after the necessary mechanical adjustment is made. In this case, limit the amount of lubrication so it does not spread the oil to other parts, especially to the belt and rubber rollers.
3. Prior to adjustment of tape drive path make sure that the surface of every part which the tape contacts is free from oil or dust. Cleaning shall be made either with Benzol or Trichloro-Trifluoroethane.

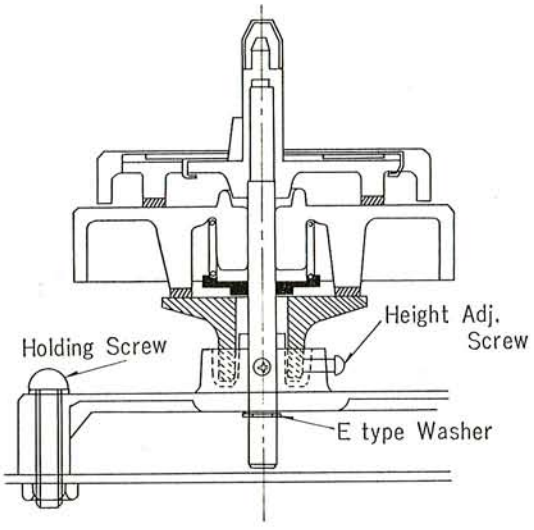
PRESSURE ROLLER ADJUSTMENT :



1. Proper pressure between Pressure Roller and Capstan is about 1,800-2,000 grams (about 4-4.4 lbs.). Pressure can be adjusted by turning the Pressure Roller pressure adjustment nut. However, this adjustment must be done after loosening the set screw.
2. Depress PLAY Button so that the Pressure Roller engages against Capstan and turn the set screw until the screw end contacts the stopper.
3. Shaft of Pressure Roller must be adjusted parallel to Capstan.

REEL HUB ADJUSTMENT :

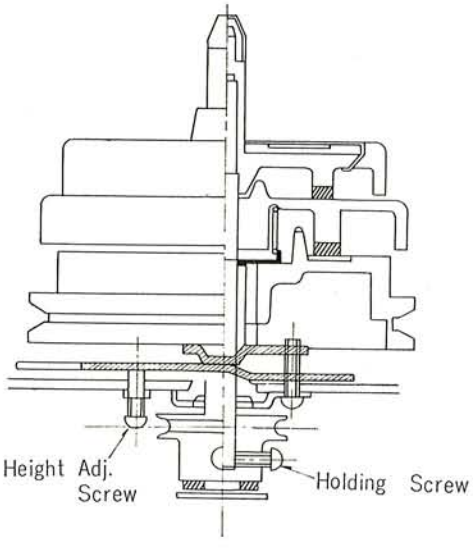
1. Supply Reel Hub :



A. Height can be adjusted by turning the height adjustment screw. Proper height is about 67 mm (about 2-5/8″).

B. Lubrication to reel hub shaft bearing and felt must be made. (It is recommended to use "Spindle Oil #34″ produced by ESSO.)

2. Takeup Reel Hub :



A. Height can be adjusted by turning the height adjustment screw. Proper height is about 52 mm (about 2-1/16″) in recording or playback mode.

B. The gap "a" must be kept over 0.3 mm (about 1/64″) and the gap "b" over 0.5 mm (about 3/128″). This can be done by turning the Counter Pulley holding screw.

C. Reel Pulley bearing must be lubricated.

D. Felt must be oiled with high viscosity oil such as Silicone Oil.

TAPE RUNNING PATH ADJUSTMENT :

Run the tape in playback mode.

1. Tape Running Adjustment on Tape Guides :

Adjust Tape Guide Post-A and B and Tapered Guide Posts A and B so that the tape runs smoothly on the Tape Supporter. Proper height of the running tape is adjusted by the Tape Guide Posts. The peripheral contact angle (180°) of the tape against the video head must be adjusted by the Tapered Guide Posts.

2. Erase Head and Audio Record Head Adjustment :

The proper adjustment must be made so that tape runs in parallel to heads while the tape is contacting center azimuth of the heads with slight pressure.

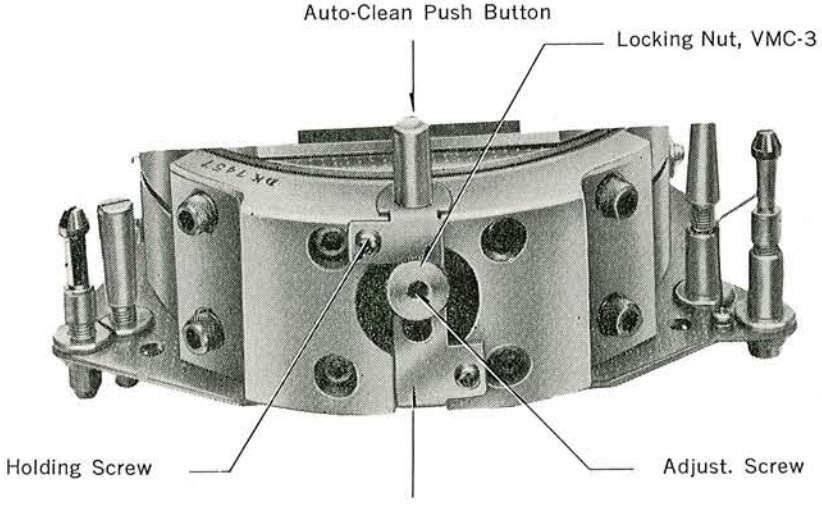
3. Tape Guide Roller and Tension Arm Adjustment :

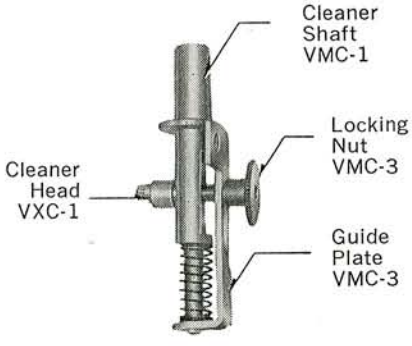
Tape Guide Roller and Tension Arm must be constantly paralleled to tape. The height of Tape Guide Roller must be adjusted so that the center of the roller matches the center of the tape.

4. Reel Hub Adjustment :

The height of Reel Hub must be adjusted so that tape does not scrape the reel.

HEAD CLEANER ADJUSTMENT :





1. The correct contact depth between the brush at the head of cleaner holder and the head chip at the top of head bar is 0.1 to 0.15 mm (0.04 to 0.06 inch).
2. This can be adjusted in the procedure that :
   A. Depress the head cleaning button while running the Head Motor.
   B. Turn the screw on the Guide Plate so that the brush lightly contacts the heads, then lock it with the locking nut.

Caution : One rotation of the cleaner holder is 0.5 mm (1/8″) in lateral movement of brush.

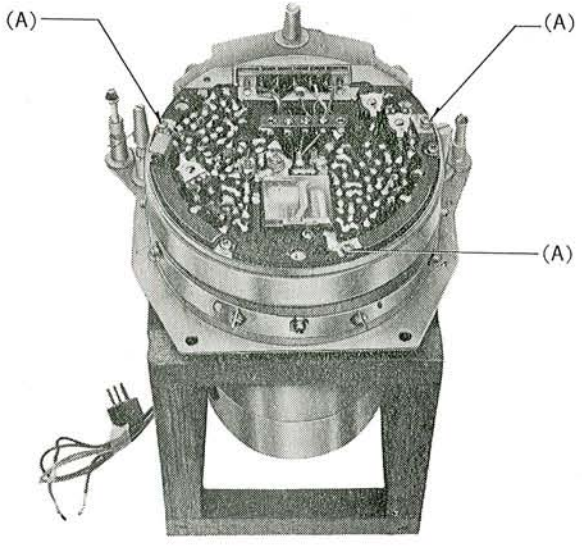
IMPORTANT : When Ferrite Video Heads are used, DO NOT DEPRESS the button in excess of ONE SECOND to avoid damage to the heads.

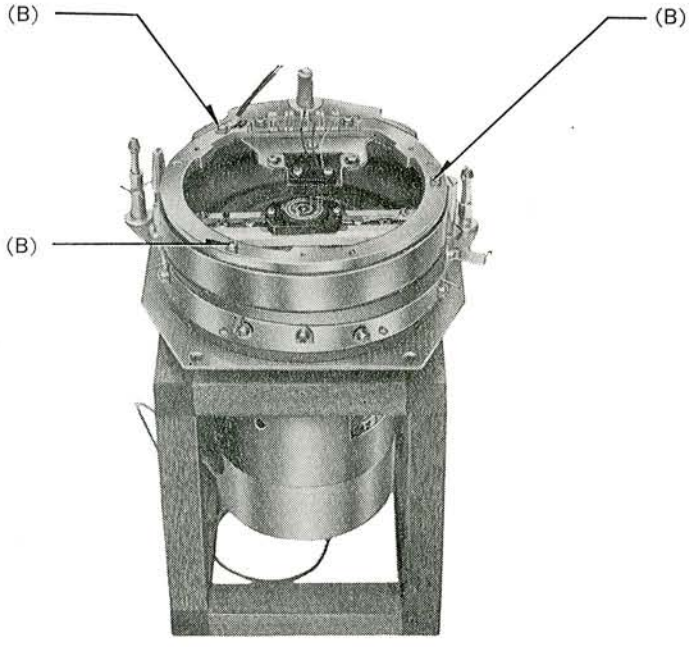
TO REPLACE VIDEO HEAD CLEANER :

1. Turn off the A-C Power Switch and wait until the rotation of the video head assembly comes to a complete stop.
2. Turn the head mounting bar so that either of heads is not in contact to the head cleaner.

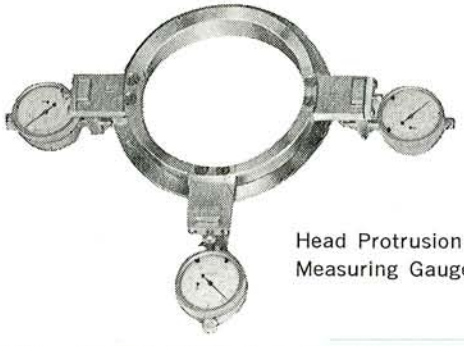
3. Unscrew and remove screw (1) and remove guide (2).
4. Unscrew and remove locking nut (3) and rotate brush shaft clockwise until it falls off inside.
5. As soon as the brush is removed, the cleaner shaft will pop out.
6. Remove spring at bottom of cleaner shaft.
7. For adjustment after installation of new brush, refer to "Adjustment of Head Cleaner".

TO REPLACE VIDEO HEAD BAR ASSEMBLY :





1. Turn off the A-C Power Switch and wait until the rotation of the video head assembly comes to a complete stop.
2. Unscrew and remove three screws and remove Drum-Cap.
3. Unscrew and remove three screws (A) and unsolder connections to the Slip Ring Brush and remove Head Amplifier Printed Circuit Board.
4. Unscrew and remove three screws (B) and remove Head Amplifier Mount.
5. In order to maintain the original azimuth, note the heights and the amounts of protrusion of the head tips



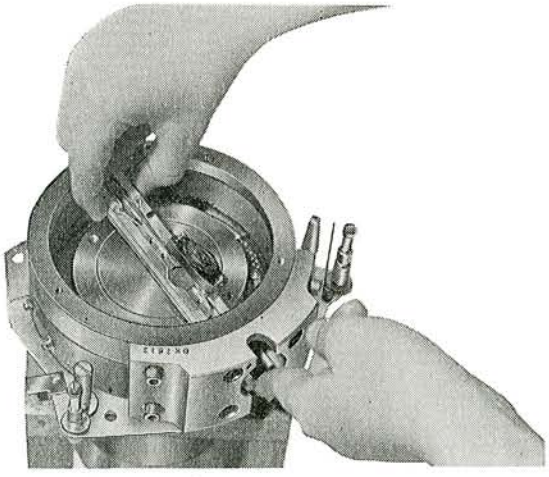
Head Protrusion Amount
Measuring Gauge

before removing the head assembly. For this purpose, a Head Protrusion Amount Measuring Gauge and a Tape Guide Height Measurement Gauge becomes necessary.

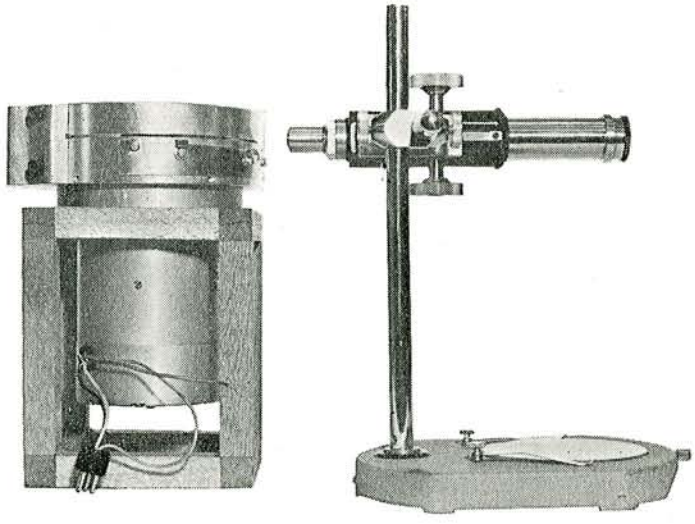
6. Photo below shows the method of measuring the difference in the head tip heights.

The measurement upto 1/100 mm is necessary. First, measure the height of head tip-A and rotate the assembly and measure height of head tip-B.

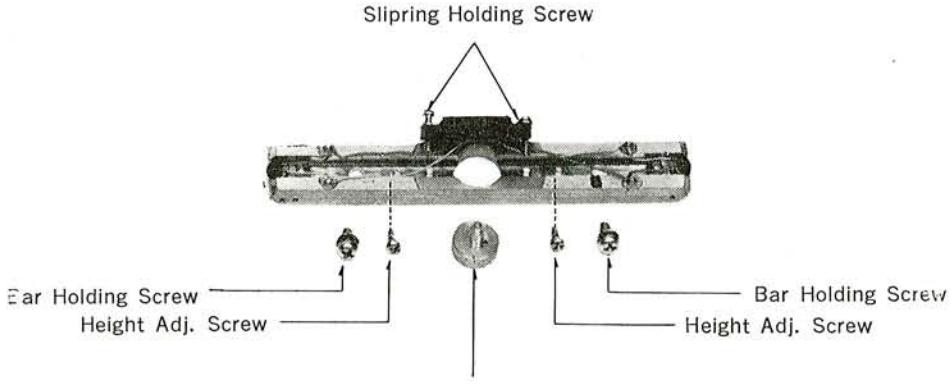
7. Before removing the head assembly, remove head cleaner by unscrewing two holding screws.
8. Unscrew slip ring holding screws and unsolder connections on Head Bar and take out a centering pin beneath it.
9. Unscrew and remeve two screws fixing the Bar to the disc of the motor, and first lift one end of head assembly and insert it into the hole provided on the round tape guide for mounting head cleaner, then lift up the other end and remove the entire head bar assembly from the housing.



10. Clean the inside of tape guide and surface of the bar disc on which the bar assembly is mounted.
11. Place a new bar assembly before mounting the slipring on it. The centering pin has to be inserted after the Bar is put on the disc.

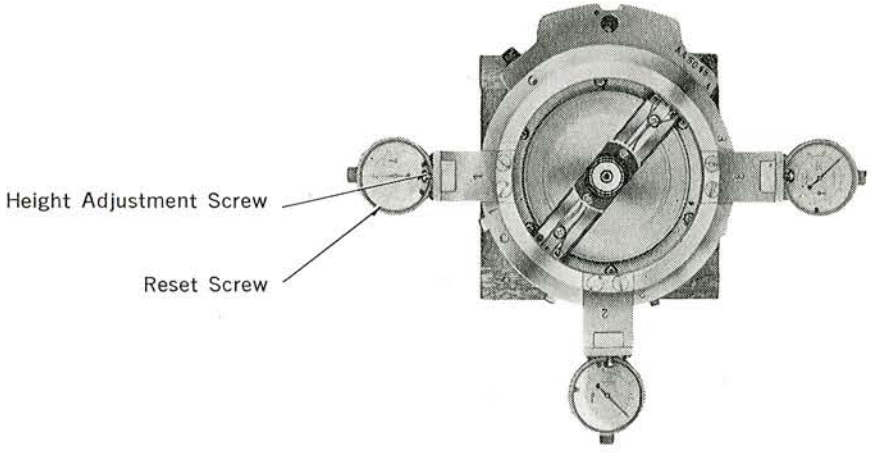


12. Put two holding screws on the Bar temporarily.
13. Confirm smooth rotation of Bar assembly in the slit by giving slight rotation by hand.
14. Measure the difference of heights of head tips per step-6 above. If pre-measurement before removing the



old head assembly is not made, keep the difference in height of head-A and -B within 1/100 mm. The height adjustment is to be made by the screws as shown in the figure above.

15. Then measure the protruding amounts of both head tips.
    As shown in photo, place the Head Protrusion Amount Measuring Gauge on the tape guide. In this instance, care must be taken so that the head tips will not be damaged by the gauge.
16. Adjust all the gauges to "zero" with the tips of the gauges contacting to the tape guide.
17. Measure and adjust the protruding amounts of both heads by using all three gauges by giving slow rotation to the head assembly in order not to damage the head tips. The difference of protruding amounts between head tips is to be less than 1/100 mm.
18. Tighten Bar assembly holding screws where the difference of protruding amounts between the head tip is minimum.

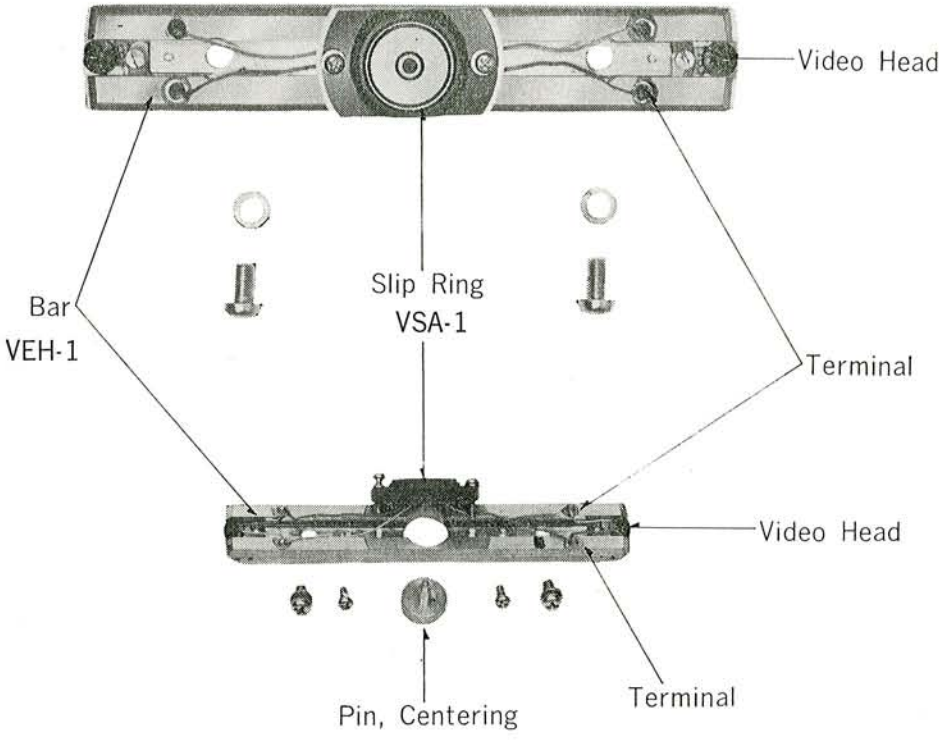


19. After tightening the head assembly holding screws, re-confirm the protruding amounts and the height of both heads.
10. Tighten slip-ring holding screws.
21. Install Head Cleaner, Head Amplifier Mount, Head Amplifier Printed Circuit Board and Drum-Cap. When installing the Head Amplifier Printed Circuit Board, care must be taken not to damage the brush attached to the Brush Angle Holder and make sure that the brushes are contacting to the right places on the Slip Ring.
22. Demagnetize the head tip and the tape guide.
23. Finally, adjust the current to be fed to the head amplifier referring to the steps in the paragraphs in "Adjustment of Record and Playback Amplifier".

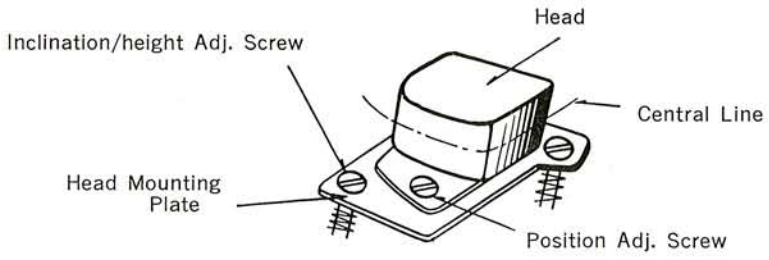
TO REPLACE SLIP-RING :

When the "slip-ring noise" appears on the monitor screen frequently, replace the slip-ring.

1. Remove Drum-cap, Head Amplifier and Head Amplifier Mount referring the steps as explained in "to replace video head assembly".
2. Unscrew and remove two each screws and washers holding the slip-ring.
3. Unsolder and remove four lead wires.
4. Lift the slip-ring and slip-ring holder up with care.
5. Place a new slip-ring on the slip-ring holder with each set of lead wires taken out from respective holes provided and place them on the head bar assembly and tighten them with screws.
6. Cut the lead wires and solder them onto the respective terminals with smallest possible amount of solders.
7. Make conductivity tests by VOM. The resistance between terminals will be 2 to 3Ω. Also confirm that the respective terminals are well isolated from the head assembley.
8. After conducting the above tests, BE SURE TO DEMAGNETIZE HEAD TIPS.



PRIMARY ADJUSTMENT OF ERASE HEAD AND AUDIO RECORD HEAD :



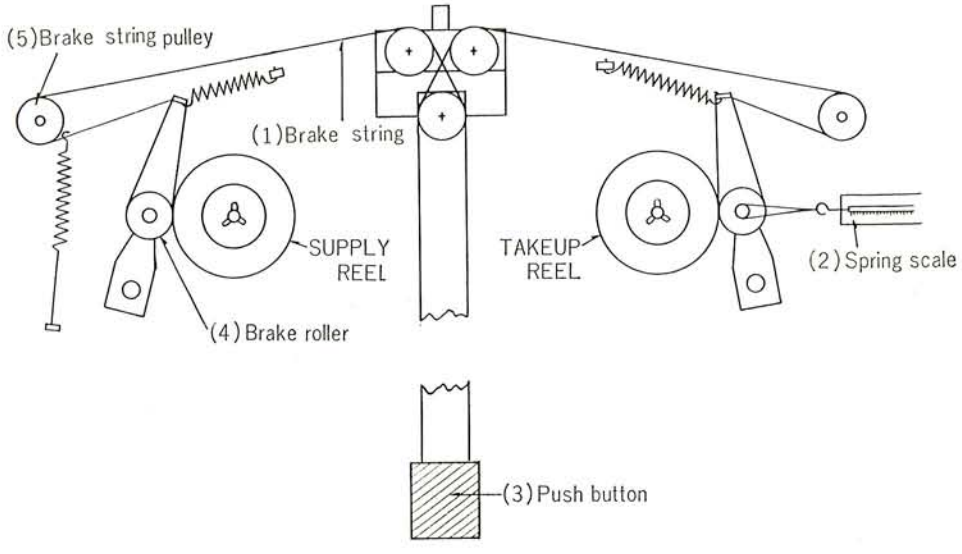
1. Erase Head Adjustment :

Adjustment is to be made by turning 2 screws for inclination/height adjustment and position adjustment. Proper position of the central line of Erase Head is 38 mm (1-1/2″) above the baseplate, and the height of head mounting plate is 6 mm (31/128″) above baseplate. Erase head surface must be positioned in parallel to the tape.

2. Audio Record Head Adjustment :

Adjustment is to be made by turning 2 screws. Proper position of the central line of Record Head is 22 mm (7/8″) above the baseplate. The Record Head surface must be parallel to the tape.

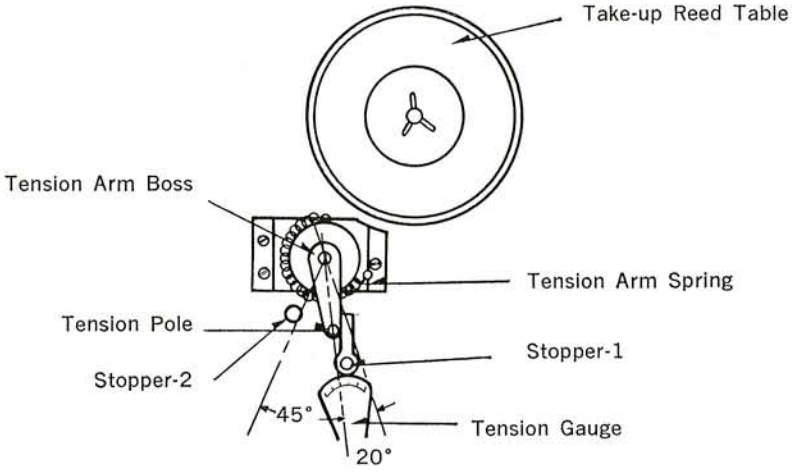
BRAKE ADJUSTMENT :



1. Proper pressure of Brake Roller is 800 grams (about 1.76 lbs.) when STOP Button is depressed.
2. Proper distance between Roller and Reel must be 2.5 to 3 mm (13/128″ to 15/128″) when the brakes are released. This distance must be equally kept on left and right reel tables.

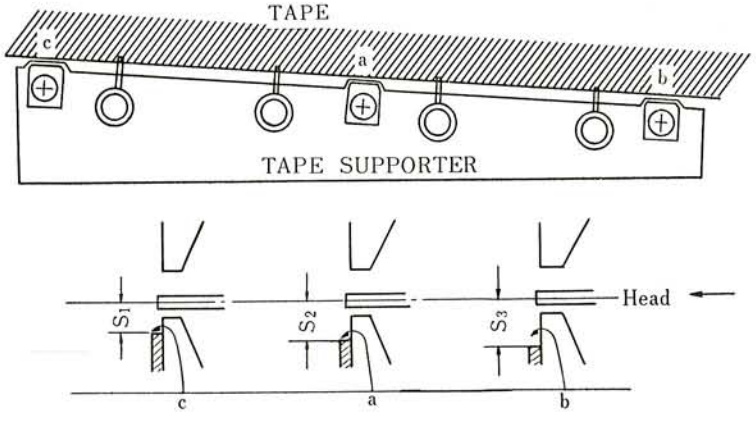
3. Pulley for brake string must be so adjusted that it can be turned with the fingers.
4. A knot on brake strieg must be smooth and paint-locked.
5. Oil or dust must not be on Rubber Roller and Reel Table.

AUTOMATIC SHUT-OFF SWITCH AND TENSION ARM ADJUSTMENT :



1. Proper stroke of the stoppers #1 and #2 is within the range of $-20° \sim +45°$, as shown in the drawing.
2. Tension pole contacts stopper when tape is not loaded (or when the loaded tape becomes slack). In this state, a cam plate pushes the tension pole. Loosen screws on tension arm boss and adjust the position of the cam plate so that the micro-switch is turned "on" at a distance of 1.5 to 2 mm (1/16″ to 5/64″) from the stopper.
3. Proper pressure of the tension pole is 13 to 18 grams (0.5 to 0.6 oz.).

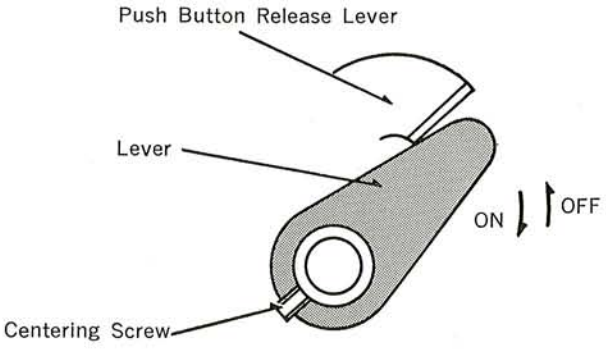
TAPE GUIDE AND SUPPORTER ADJUSTMENT :



1. Set correct position of the tape supporter as shown in the drawing.

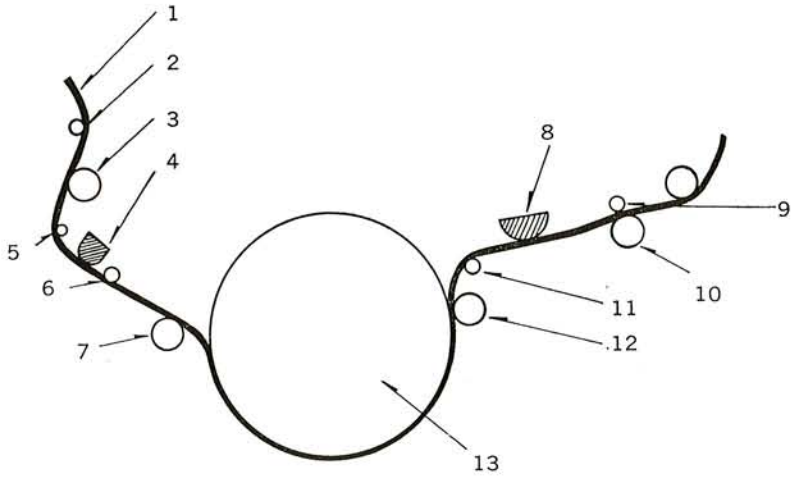
2. Correct position of Tape Supporter is as follows:
   S_1=1.35 mm (7/128″)
   S_2=6.35 mm (1/4″)
   S_3=11.35 mm (57/128″)
3. The figures mentiond above are to be followed when adjustment is required.
   It is recommended that the adjustment by a microscope is first made to the points "a" and "b" then adjust "c":

POWER SWITCH AND LEVEL CONTROL ADJUSTMENT:



1. Lever is mechanically interlocked with Power on/off Switch and all pushbuttons.
   Adjust the lever correctly so that it pushes the pushbutton release lever when power is turned "off".
   The lever height must be adjusted to be positioned at the center of the release lever.

TAPERED GUIDE POST AND OTHER TAPE GUIDE POSTS ADJUSTMENT :



1. Tape
2. Tension arm, VMS-23
3. Tape guide roller, VDP-3
4. Erase head, WY-707Z,
5. Tape guide post A, VMS-30
6. Tape guide post B, VMS-31
7. Tapered post A, VMS-32
8. Audio/Control Head (WY-619Y) WY-619Z
9. Capstan, VMS-13, VMS-14
10. Pressure roller, VXP-1
11. Tape guide post A
12. Tapered post B, VMS-33
13. Tape guide drum, VAG-2

1. Tape Guide Post-A :

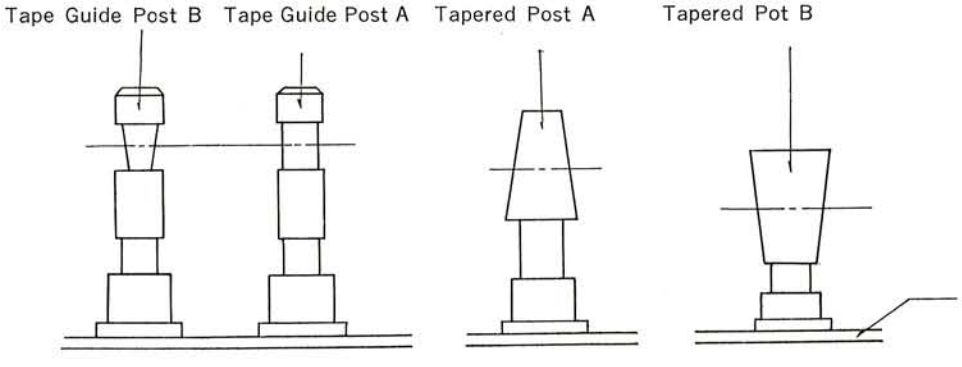
Proper position of the center line is 38 mm (1-1/2″) above the baseplate. This adjustment can be done by turning the post and be sure to lock it with paint after the adjustment.

2. Tape Guide Post-B :

Proper position of the center line must be 22 mm (7/8″) above the baseplate. This can be adjusted by turning the post and be sure to lock it with paint after the adjustment.

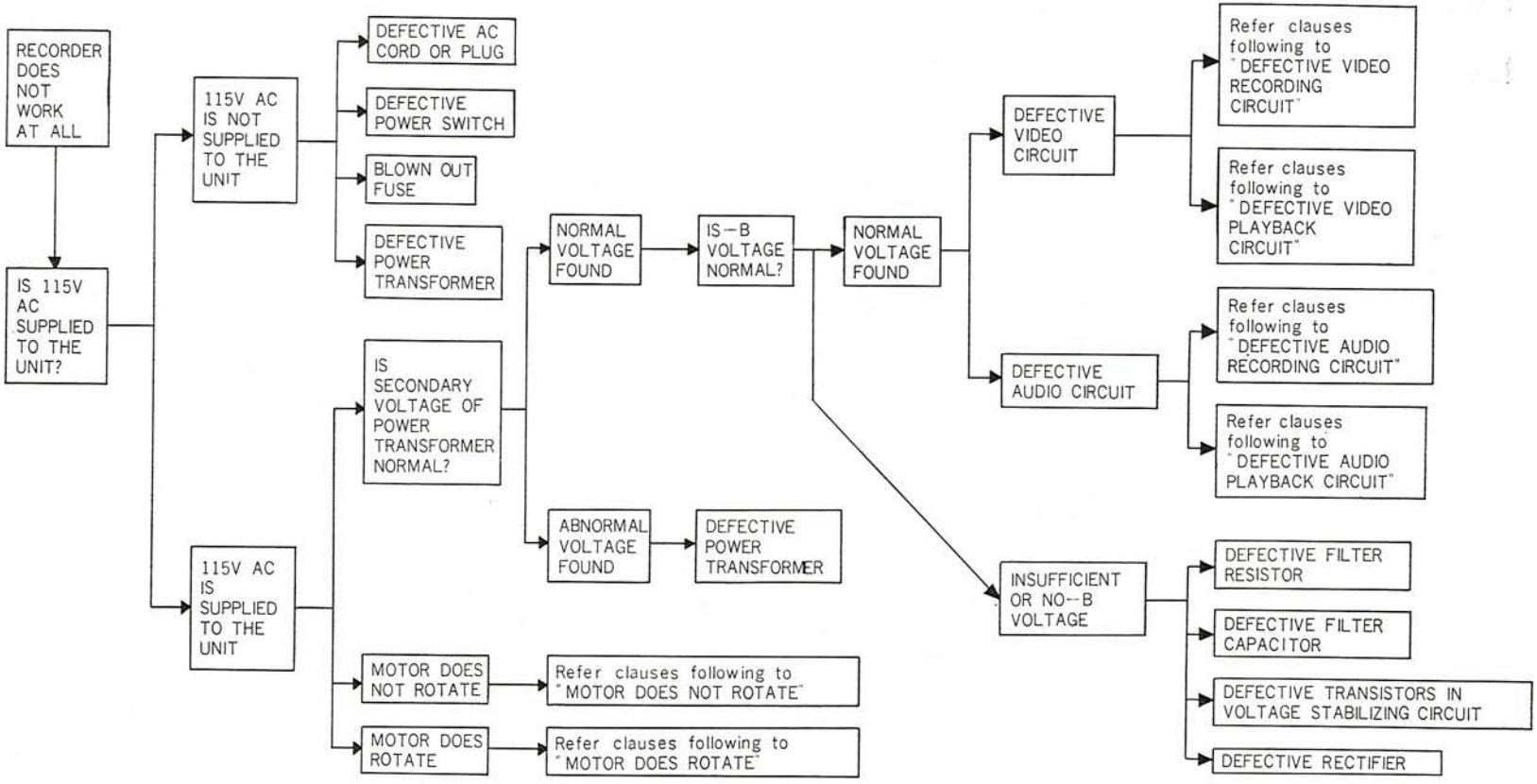
3. Tapered Post-A and -B :

These posts are to regulate the tape path correctly on the Tape Supporter. Adjustment should be done very carefully by watching the movement of tape.



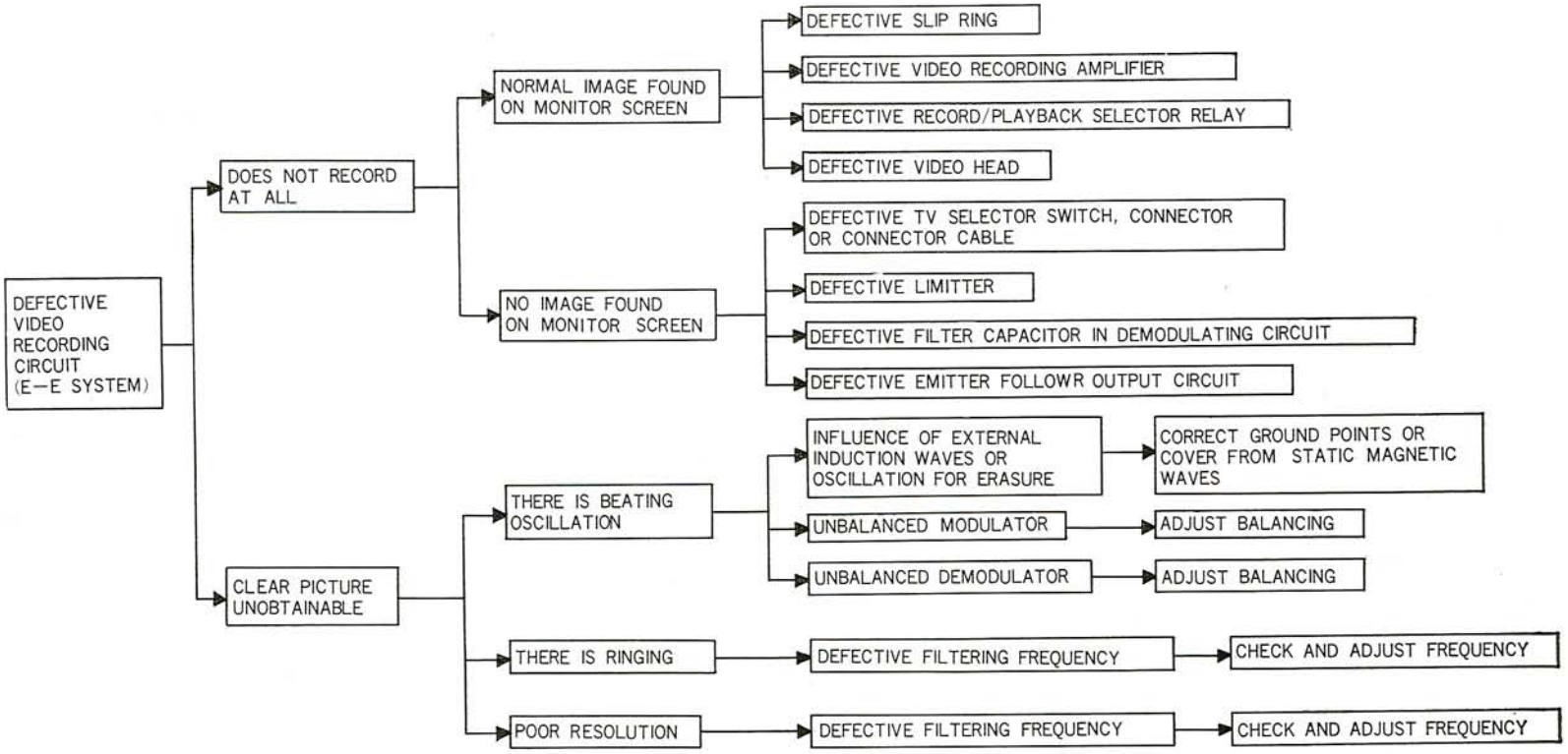
TROUBLE SHOOTERS' GUIDE : 1

NO PLAYBACK OR RECORD :



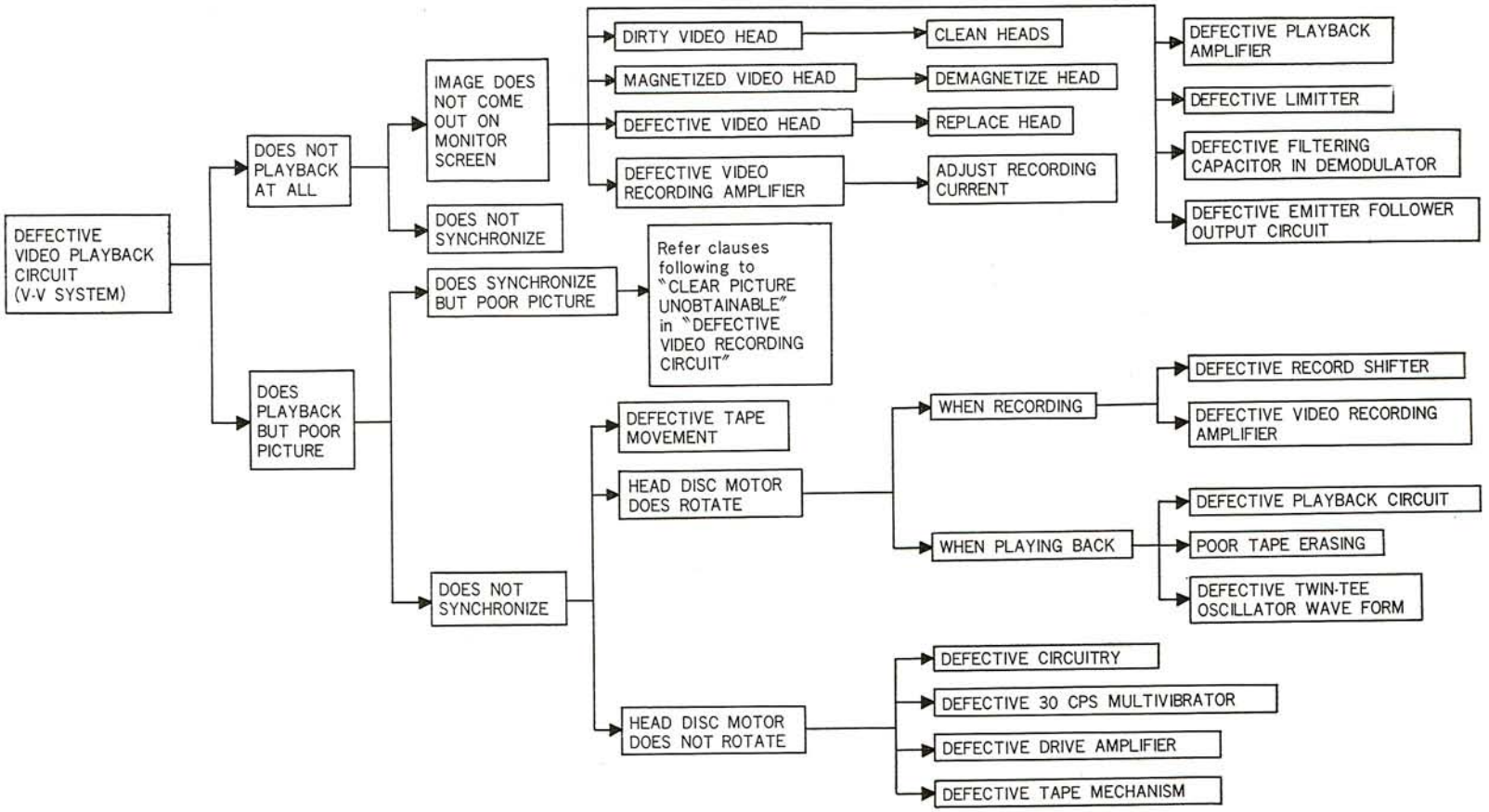
TROUBLE SHOOTERS' GUIDE : 2

DEFECTIVE VIDEO RECORDING CIRCUIT :



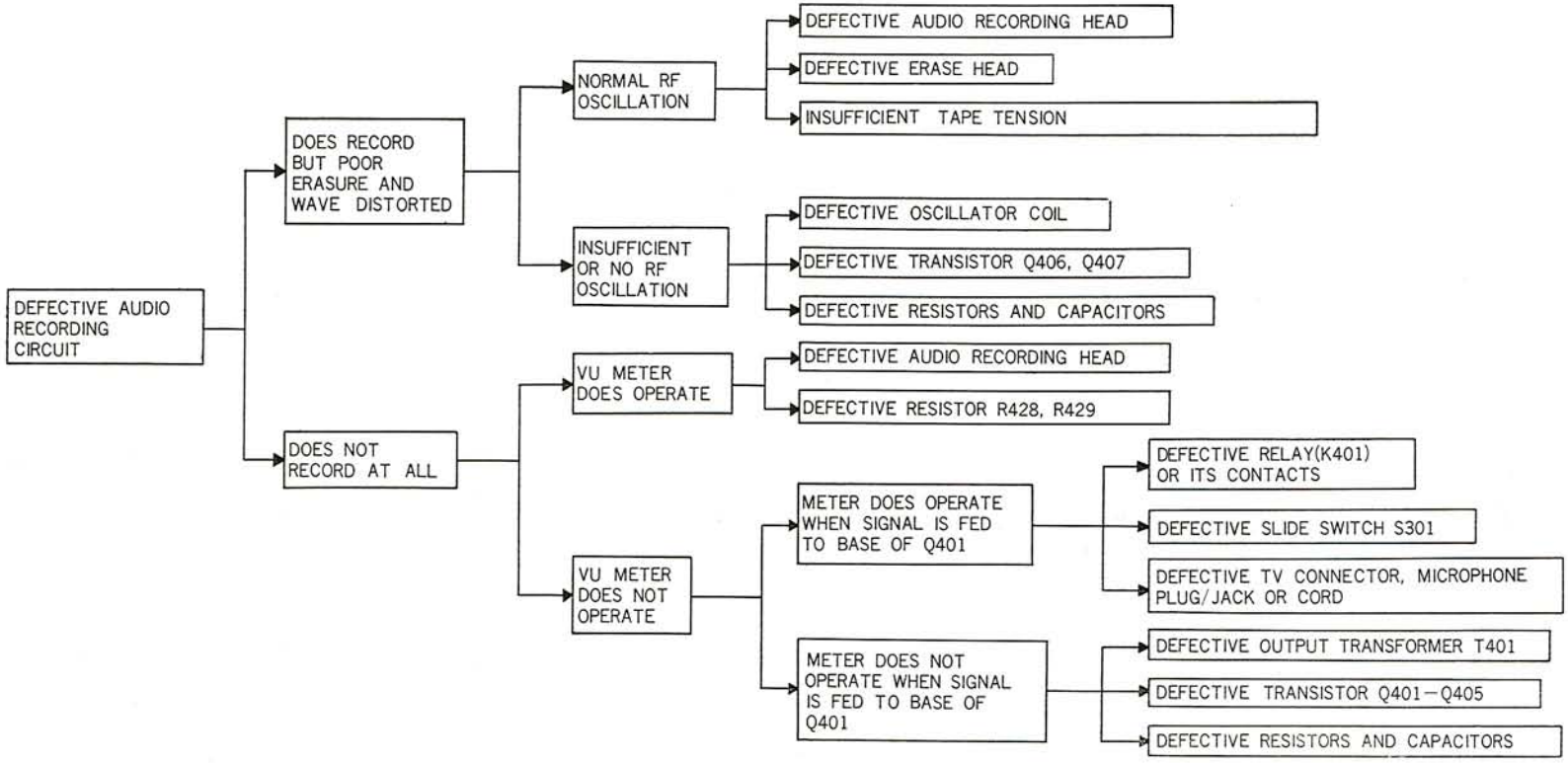
TROUBLE SHOOTERS' GUIDE : 3

DEFECTIVE VIDEO PLAYBACK CIRCUIT :



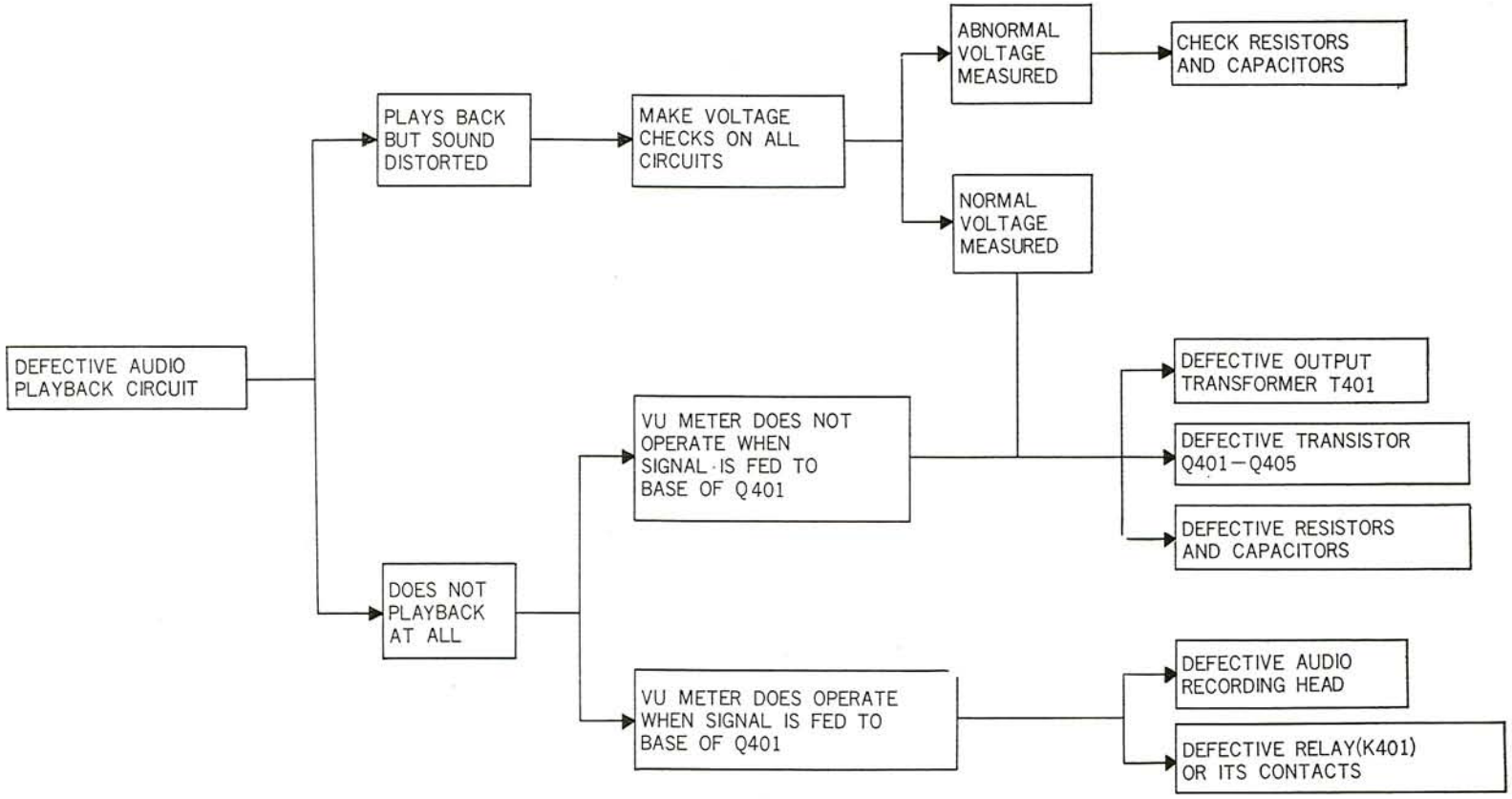
TROUBLE SHOOTERS' GUIDE : 4

DEFECTIVE RECORDING CIRCUIT :



TROUBLE SHOOTERS' GUIDE : 5

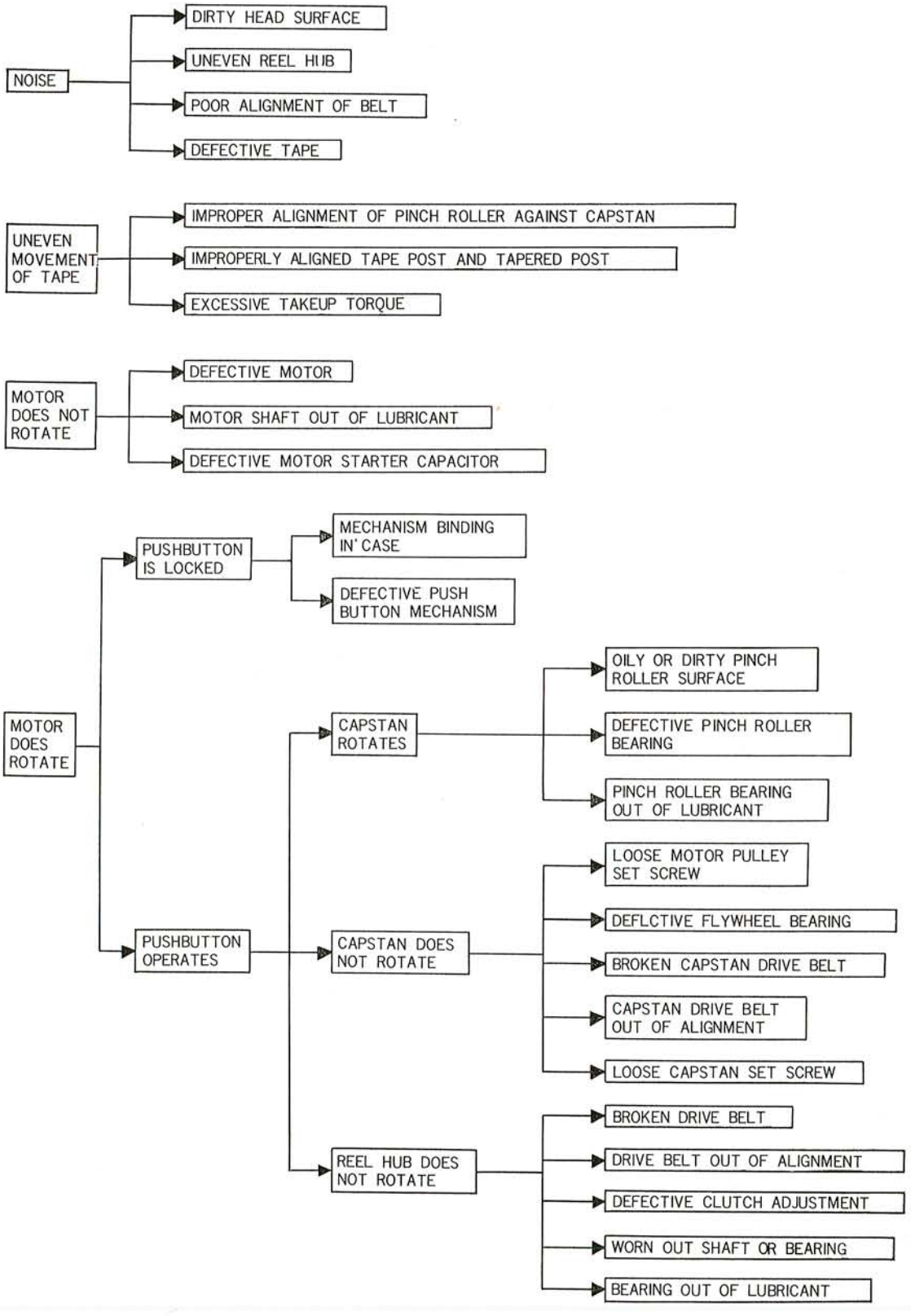
DEFECTIVE AUDIO PLAYBACK CIRCUIT :



TROUBLE SHOOTERS' GUIDE : 6

MALFUNCTIONS IN PLAY/RECORD MODE :

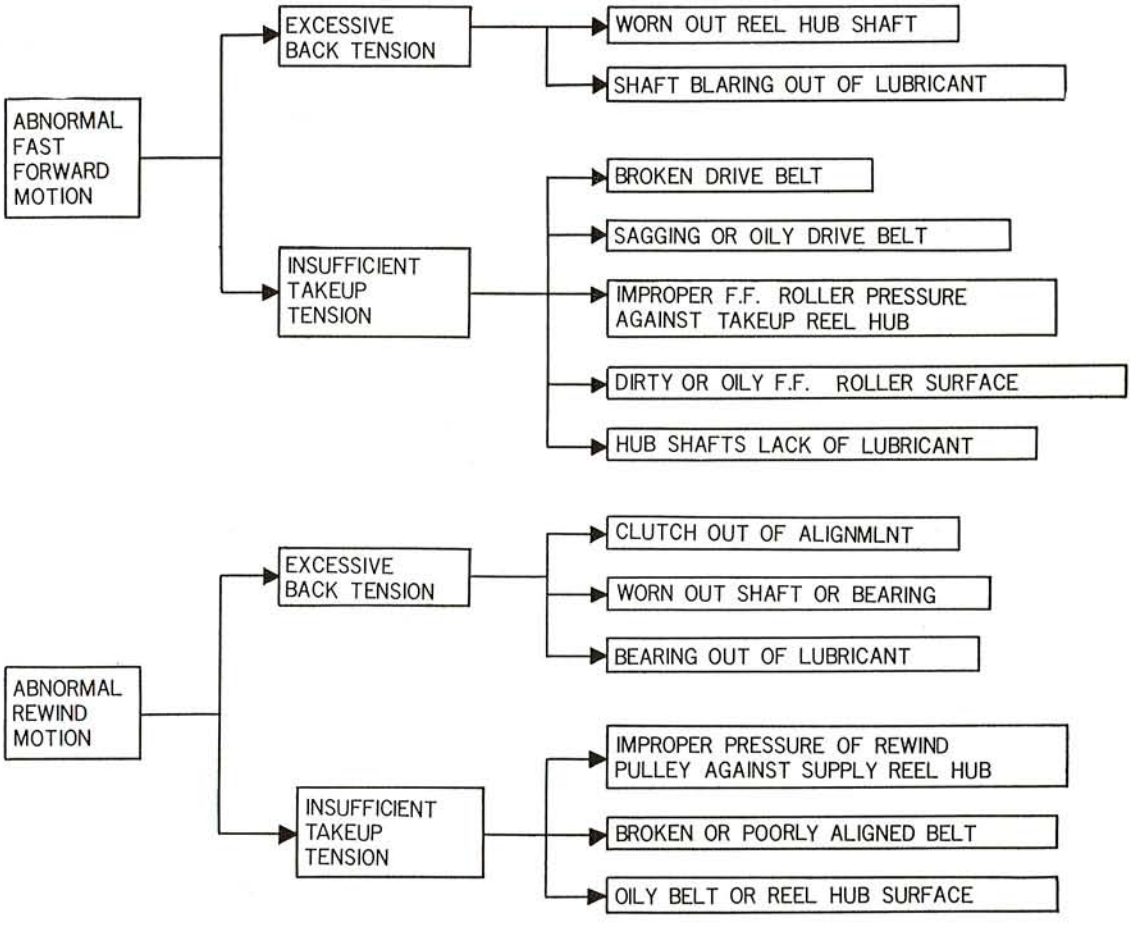
(Tape Pransport Mechanism)



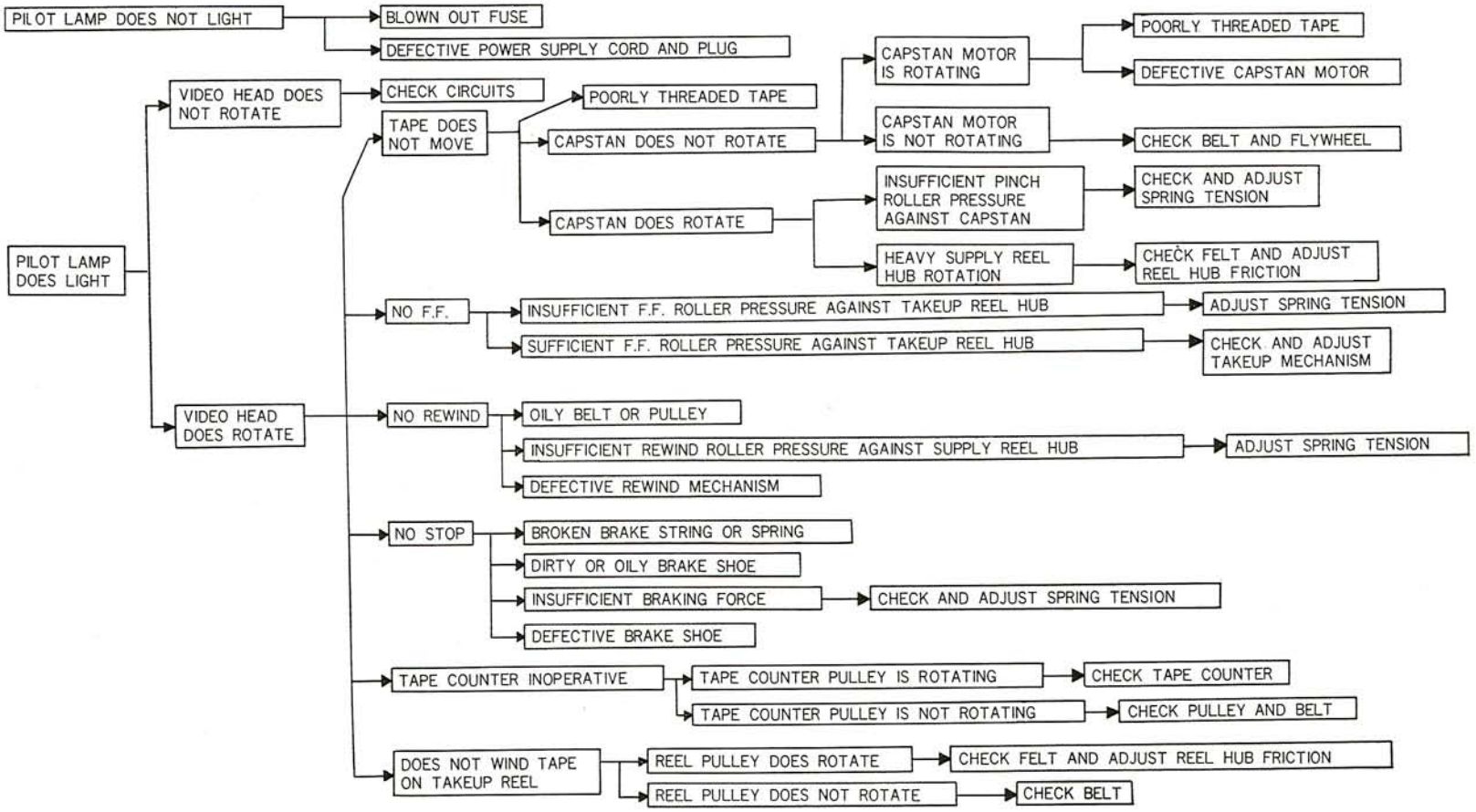
TROUBLE SHOOTERS' GUIDE : 7

MALFUNCTIONS IN F.F. AND REWIND MODES :

(Tape Transport Mechanism)



(Tape Transport Mechanism)



SUPPLY REEL HUB – IMPROPER BACK TENSION and POOR REWIND

REWIND PULLEY – BELT AND REEL HUB DO NOT ROTATE and POOR REWIND due to Insufficient Pressure of Rewind Roller against Supply Reel Hub and Dirty Rewind Roller Surface.

TENSION ARM – INOPERATIVE due to Spring out of position.

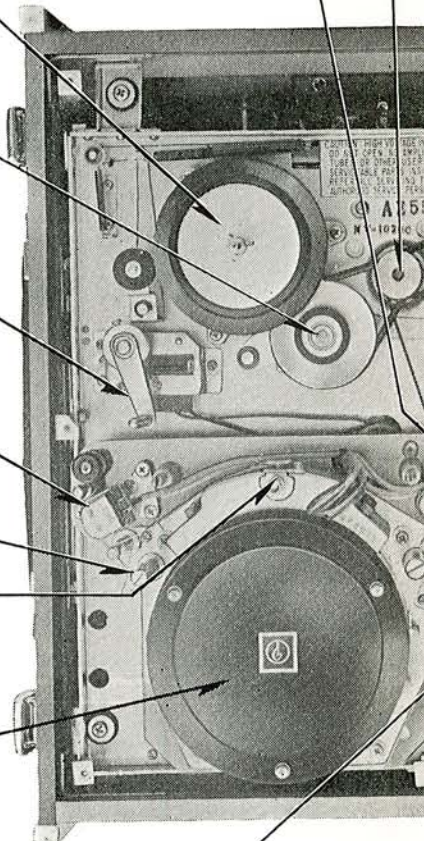
ERASE HEAD – IMPROPER ERASURE due to poor Alignment.

TAPERED POST

HEAD CLEANING DEVICE IMPROPER HEAD CLEANING due to worn – out Brush.

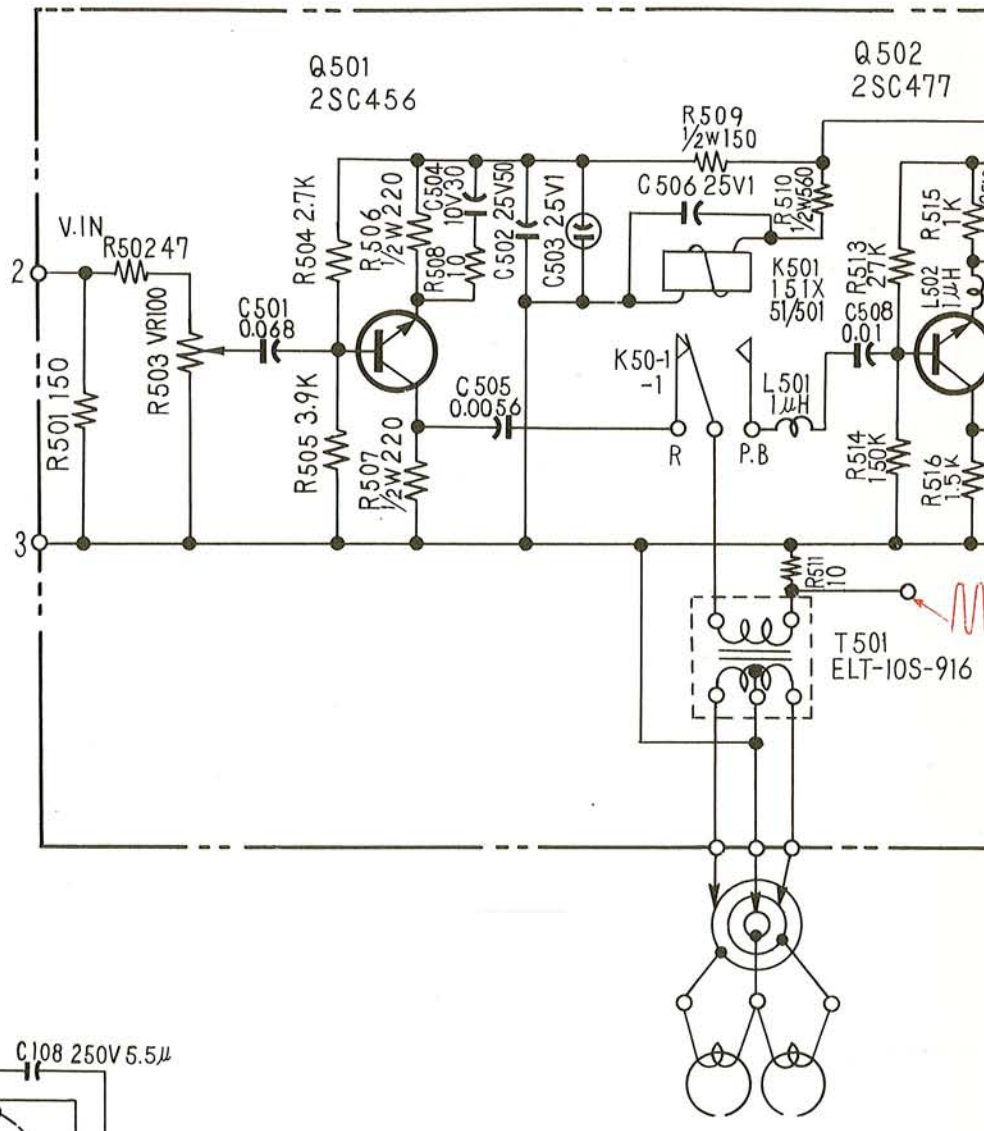
ROTARY HEAD ASSEMBLY – NOISE due to worn – out Brush or Dirty Slip – Ring and worn – out Head

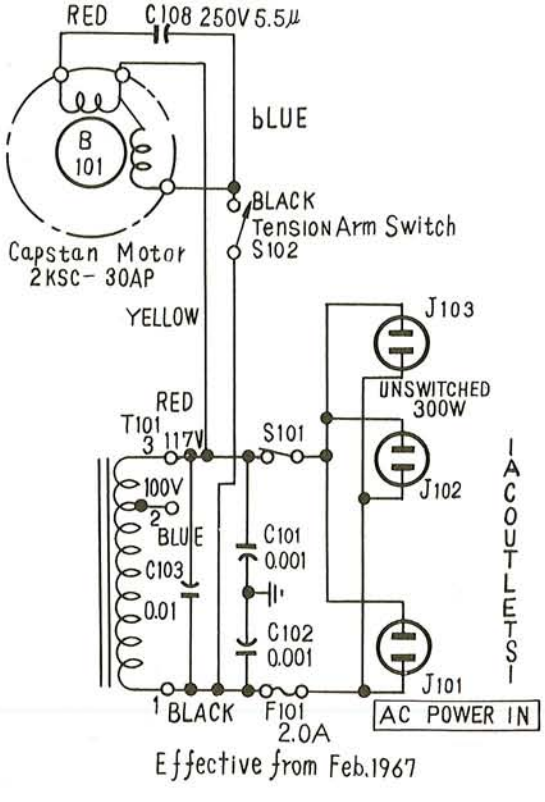
AUDIO/CONTROL HEAD – POOR RECORD/PLAYBACK or FAULTY SYNCHRO – NIZATION due to Dirty or Poorly Aligned Head.



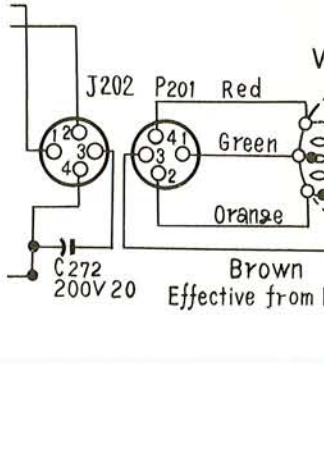
PRESSURE ROLLER – UN
due to Improper Pressu
Pressure against Capst

CHANGES IN SCHEMATIC DIAGRAM





Effective from Feb. 1967



Effective from

SUPPLY REEL HUB – IMPROPER BACK TENSION and POOR REWIND

REWIND PULLEY – BELT AND REEL HUB DO NOT ROTATE and POOR REWIND due to Insufficient Pressure of Rewind Roller against Supply Reel Hub and Dirty Rewind Roller Surface.

TENSION ARM – INOPERATIVE due to Spring out of position.

ERASE HEAD – IMPROPER ERASURE due to poor Alignment.

TAPERED POST

HEAD CLEANING DEVICE IMPROPER HEAD CLEANING due to worn – out Brush.

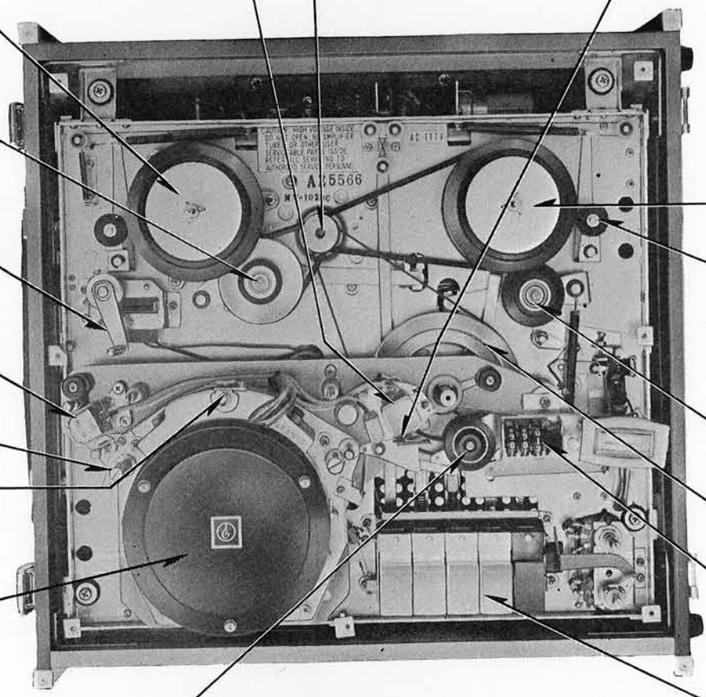
ROTARY HEAD ASSEMBLY – NOISE due to worn – out Brush or Dirty Slip – Ring and worn – out Head

AUDIO/CONTROL HEAD – POOR RECORD/PLAYBACK or FAULTY SYNCHRO – NIZATION due to Dirty or Poorly Aligned Head.

MOTOR PULLEY – NO TAPE MOVEMENT due to loose Motor Pulley Holding Screw.

TAPE PRESSURE PAD – POOR RECORD OR PLAYBACK due to Insufficient Pad Pressure against Head.

TAKEUP REEL HUB – NOISE due to Improper Alignment of Hub, UNEVEN TAPE MOVEMENT due to Excessive Takeup Torque, LACK OF TAKE-UP TENSION due to Poor Clutch Alignment, POOR REWINDING due to Excessive Back Tension to tape and NO TAKEUP due to lack of lubrication to shaft.



BRAKE – TAPE SLACK due to Improper Adjustment.

F.F. ROLLER – POOR F.F. due to Improper F.F. Roller Pressure against Takeup Reel Hub or Oily or Dirty F.F. Roller surface.

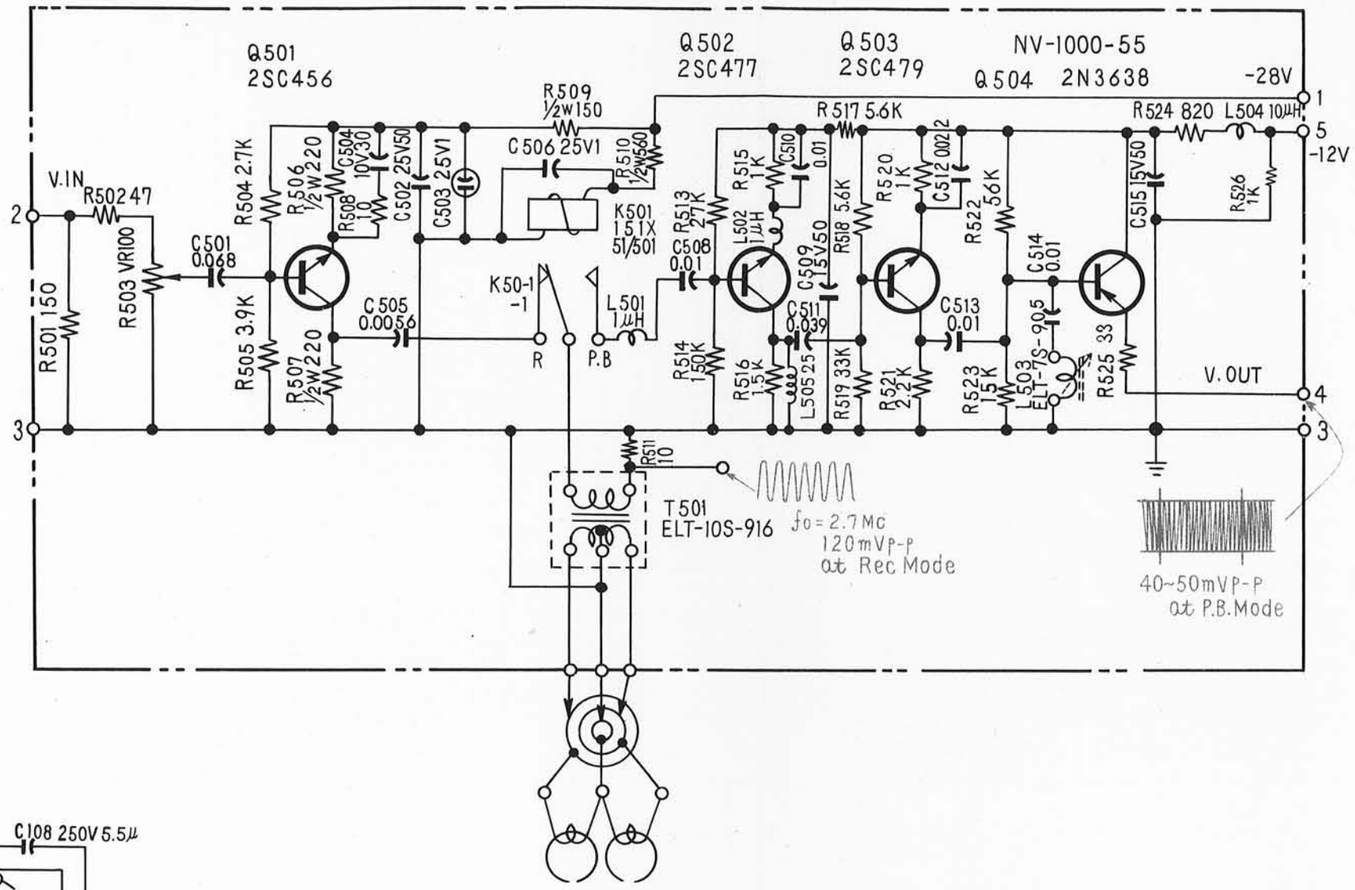
FLY WHEEL

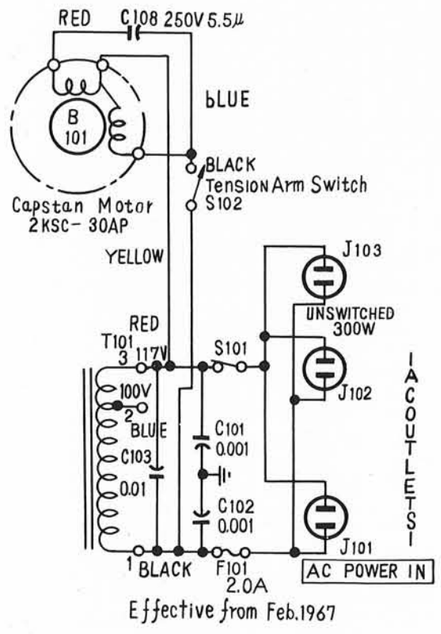
TAPE COUNTER

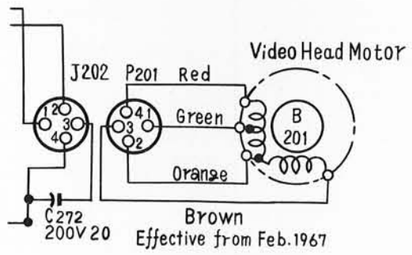
PUSHBUTTONS

PRESSURE ROLLER – UNEVEN TAPE MOVEMENT due to Improper Pressure Roller Alignment or Pressure against Capstan

CHANGES IN SCHEMATIC DIAGRAM





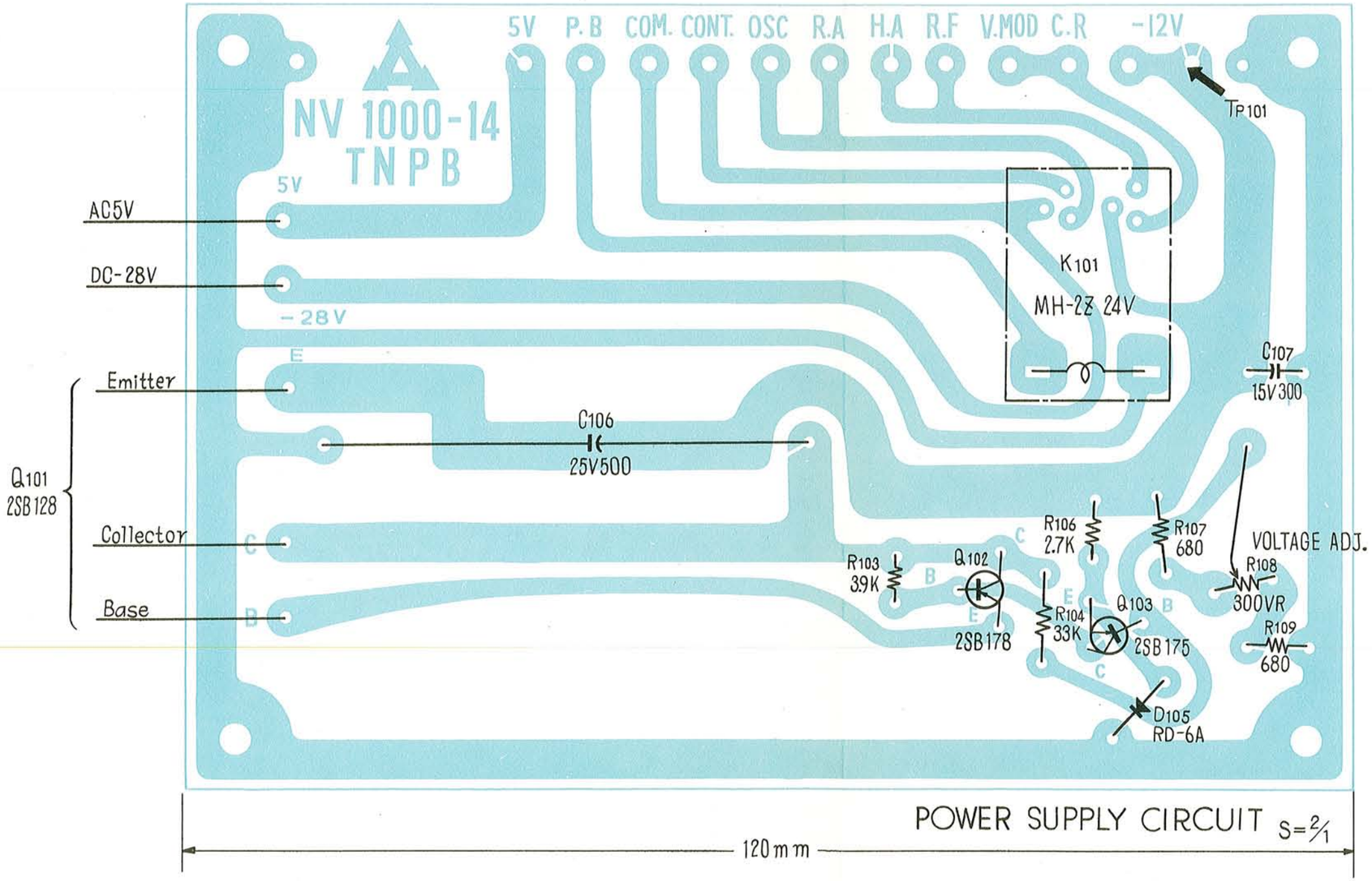


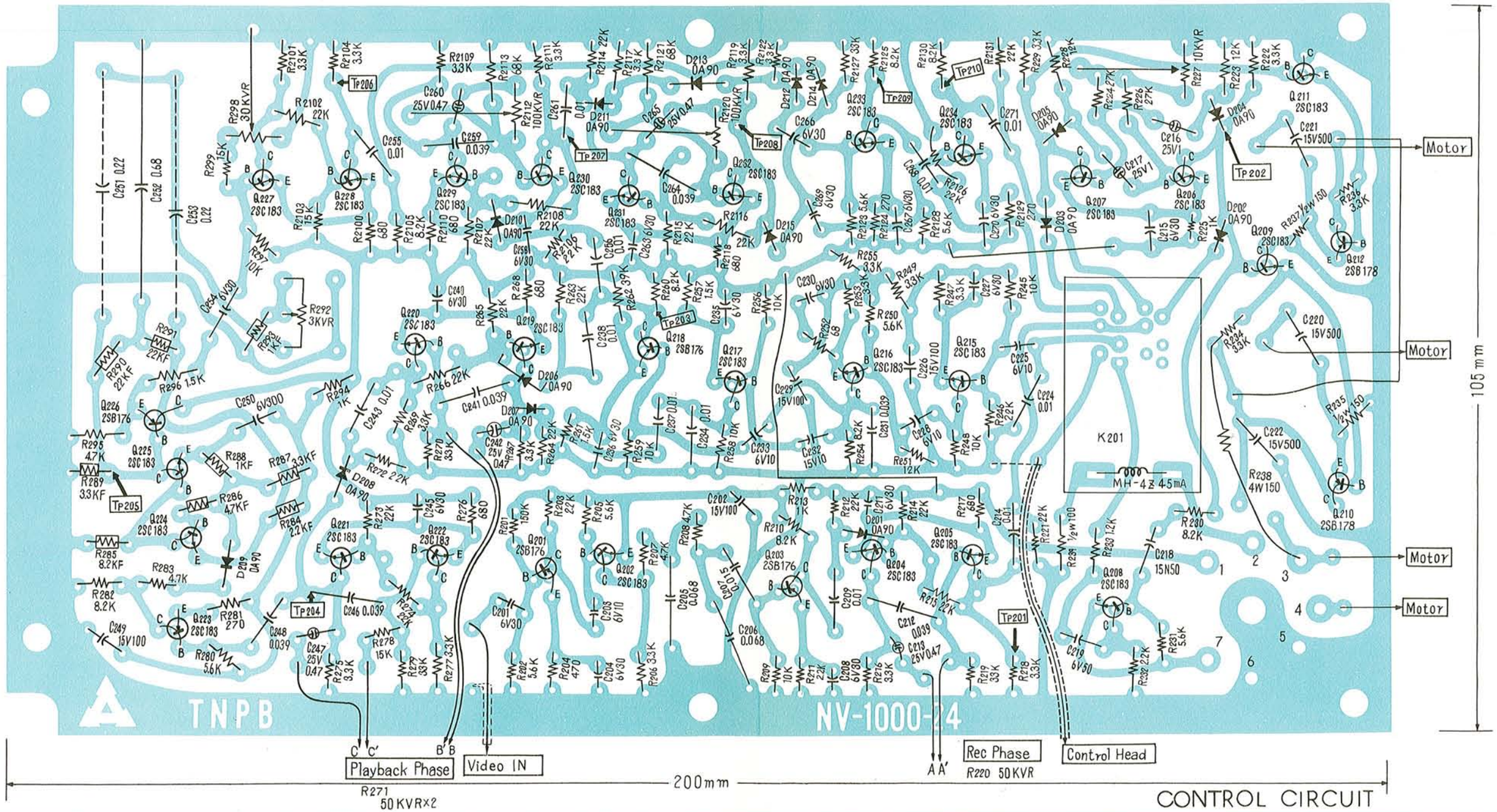
NOTE:

A. Change in Circuit Board
Effective with VTR-500 serial number D-001532 and VTR-600-1 serial number D-001788.
Circuit Board NV-1000-54 is changed to Circuit Board NV-1000-55.

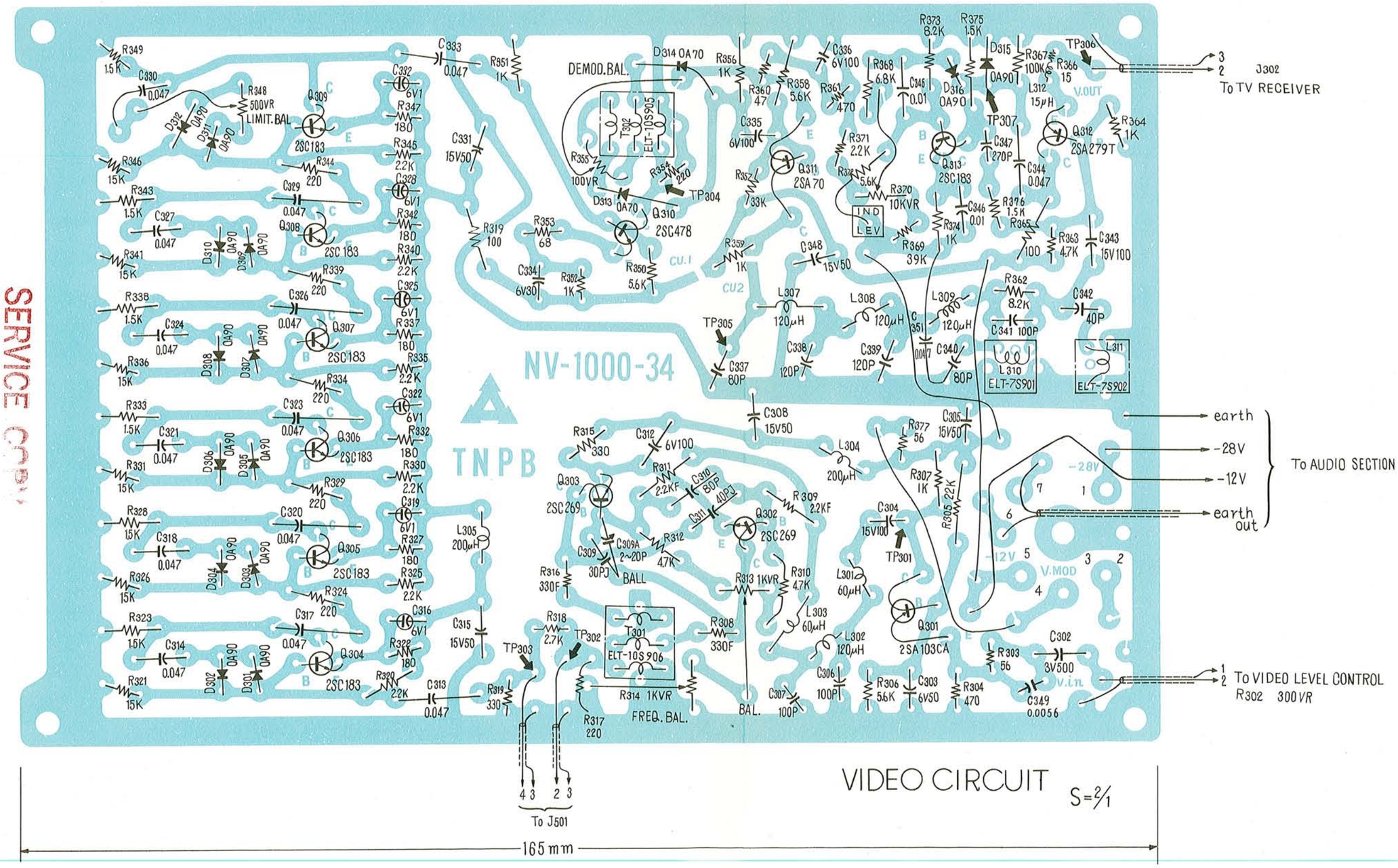
B. Change in Capstan Drive Motor:
Motor 2KSC-30AP is used instead of Motor 2KC-30AP effective with same serial number as item A

C. Capacitor C272 is located at J202 instead of P-201 with serial number 001343 for VTR-600-1 and 001314 for VTR-500.


NV 1000-14
TNPB
5V
P.B
COM.
CONT.
OSC
R.A
H.A
R.F
V.MOD
C.R
-12V
TP101
AC5V
DC-28V
-28V
K101
MH-2Z 24V
C107
15V300
Emitter
Collector
Base
Q101
2SB128
C106
25V500
R106
2.7K
R107
680
VOLTAGE ADJ.
R108
300VR
R103
3.9K
Q102
2SB178
R104
33K
Q103
2SB175
R109
680
D105
RD-6A
POWER SUPPLY CIRCUIT S=2/1
120mm

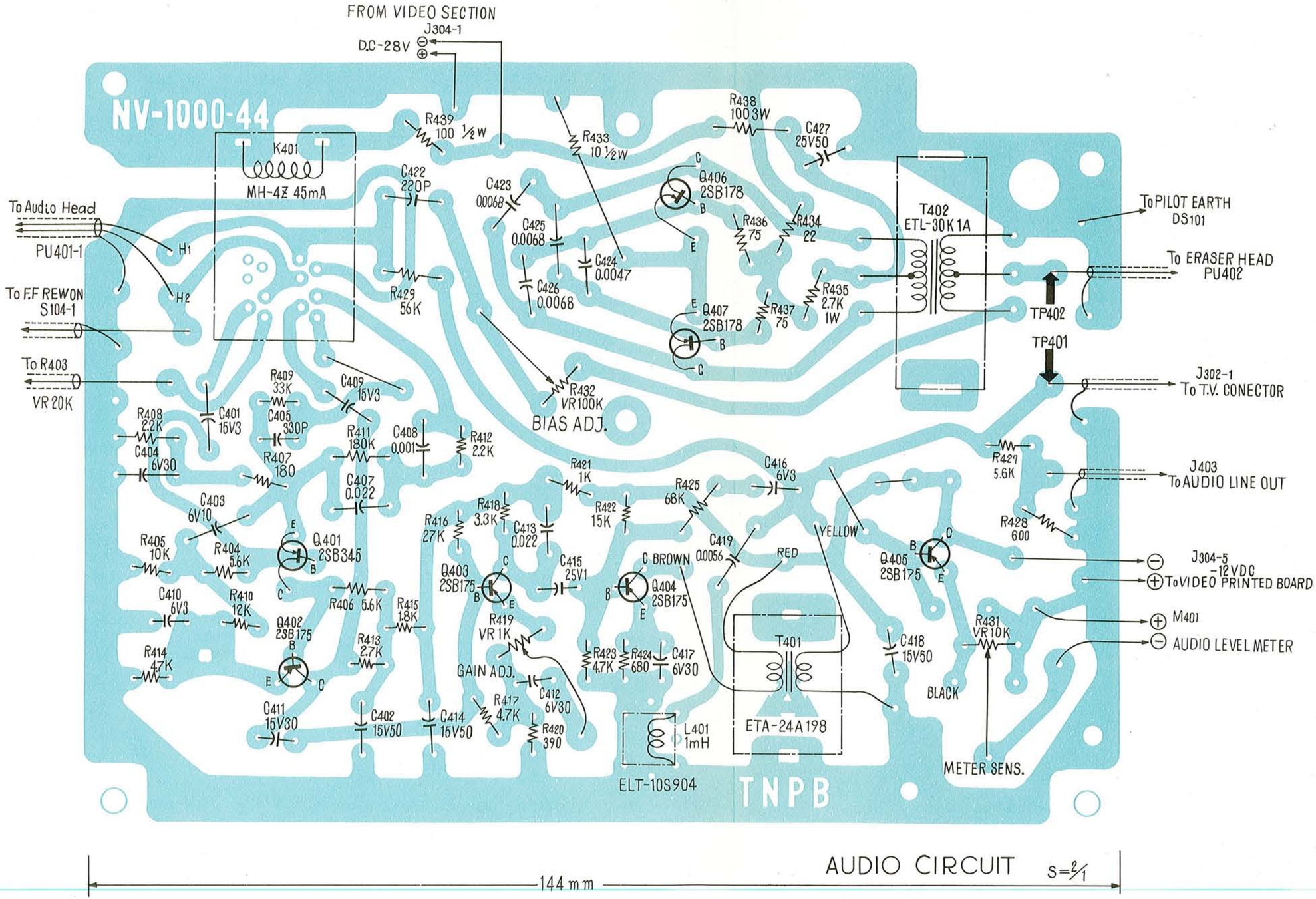


CONTROL CIRCUIT
(REVISED)



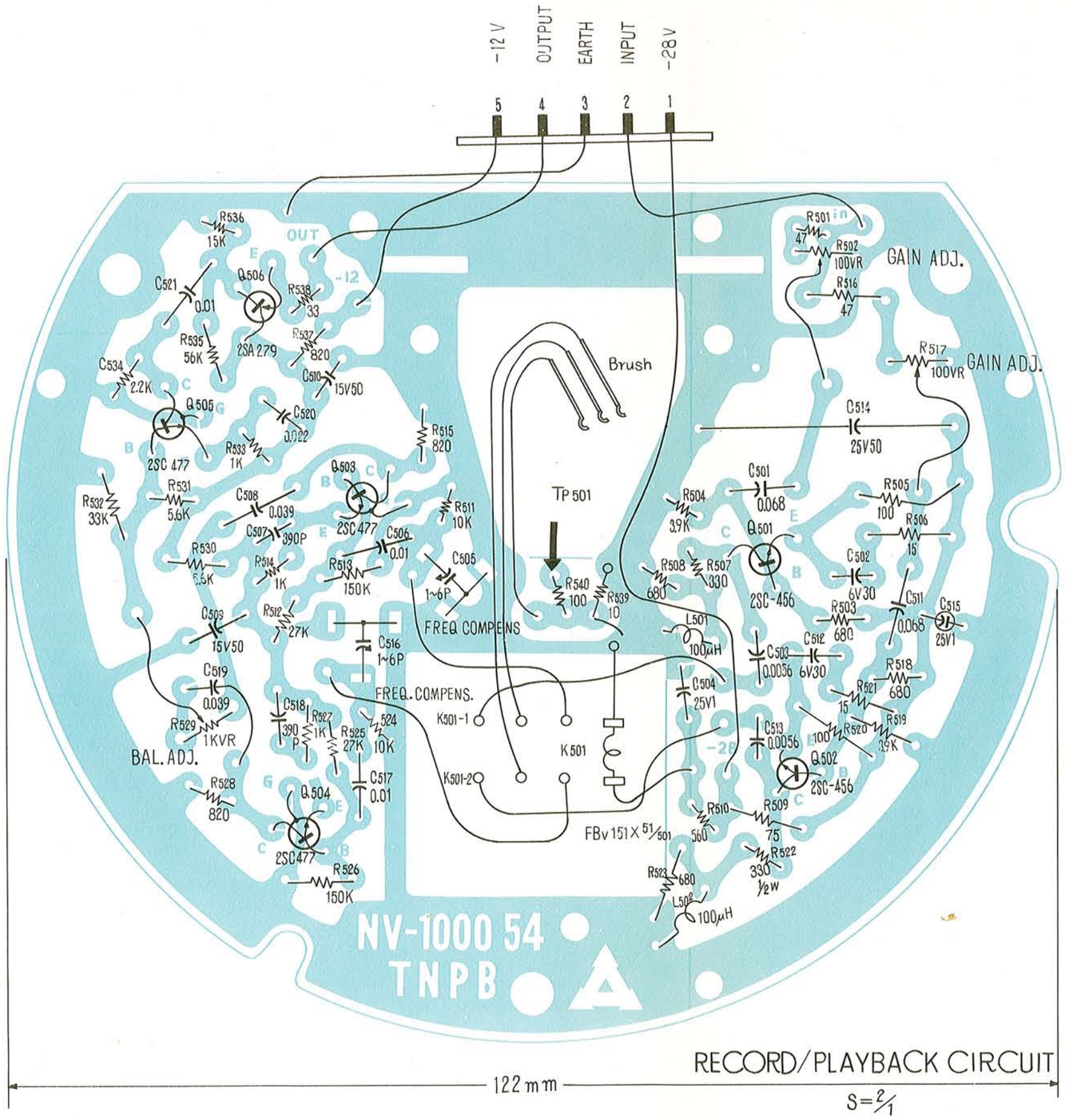
VIDEO CIRCUIT S=2/1

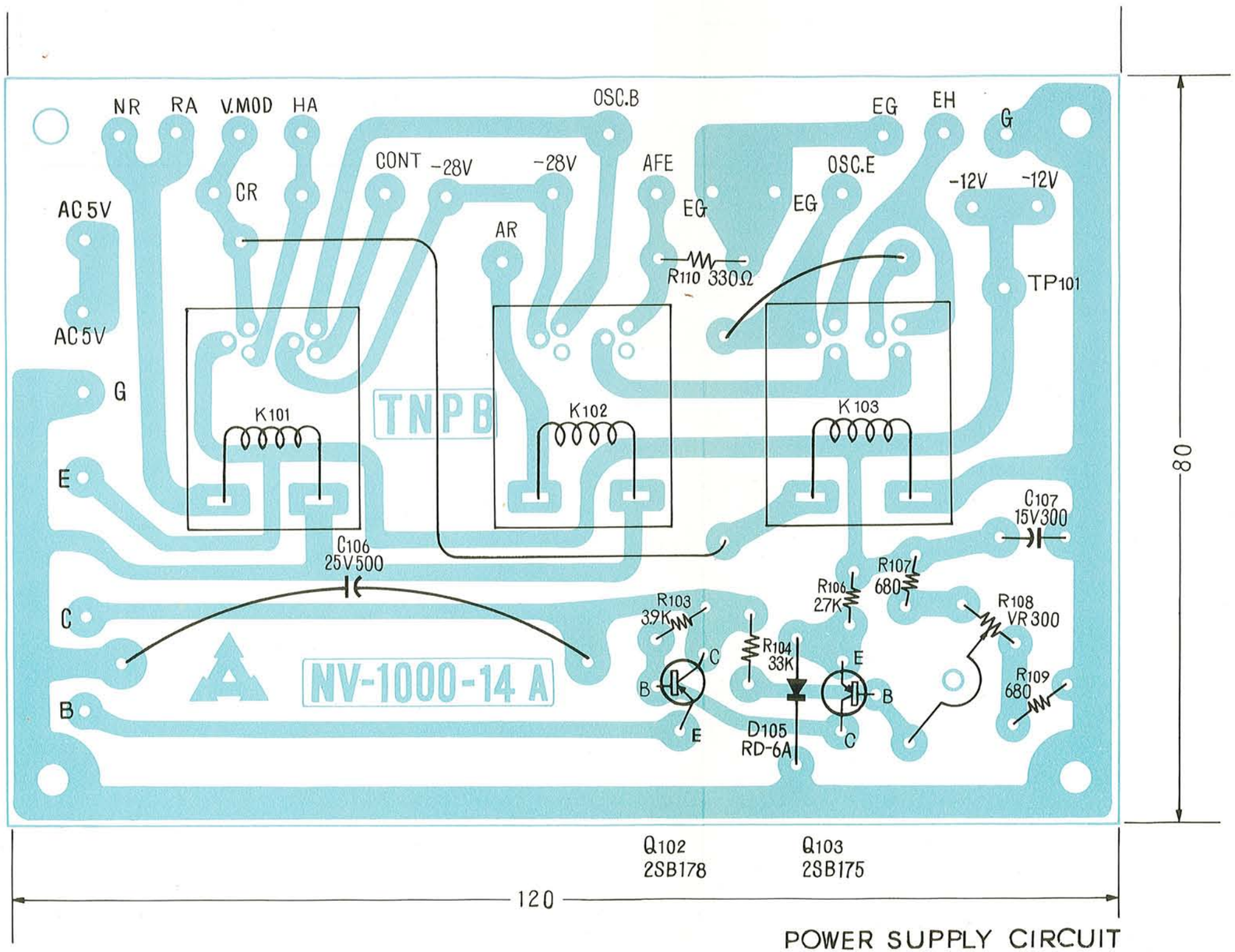
165 mm



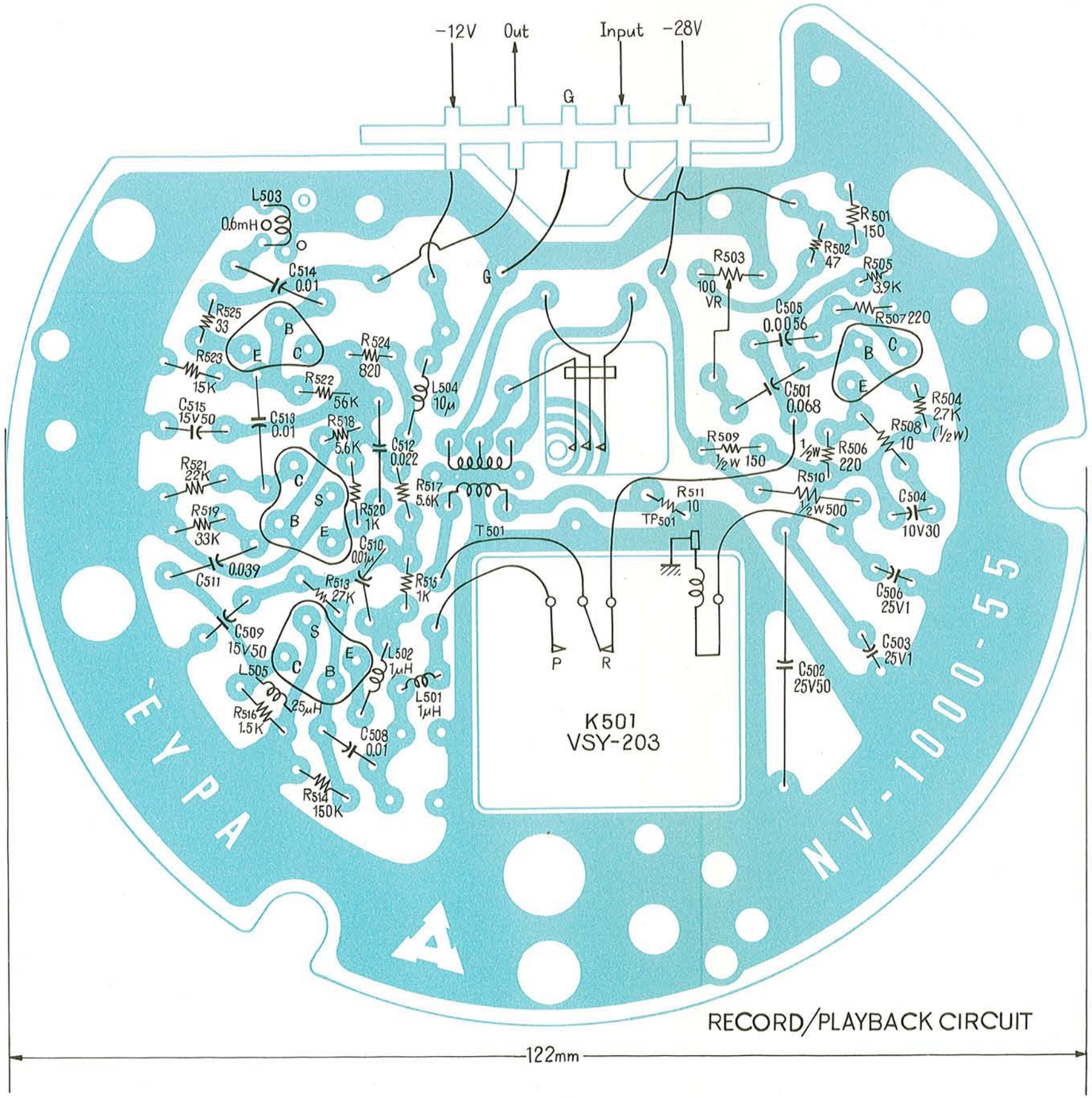
144 mm

AUDIO CIRCUIT S=2/1


-12 V
OUTPUT
EARTH
INPUT
-28 V
5
4
3
2
1
R536 15K
OUT
-12
C521 0.01
Q506
2SA 279
R538 33
R535 56K
R537 820
C534 2.2K
C510 15V50
Q505
2SC 477
C520 0.022
R533 1K
R515 820
R532 33K
R531 5.6K
C508 0.039
C507 390P
Q503
2SC 477
R511 10K
R530 5.6K
R514 1K
C506 0.01
R513 150K
C505 1~6P
C503 15V50
R512 27K
C516 1~6P
FREQ COMPENS
C519 0.039
R529 1KVR
BAL. ADJ.
C518 390 P
R527 1K
R525 27K
R524 10K
C517 0.01
R528 820
Q504
2SC477
R526 150K
FREQ. COMPENS.
K501-1
K501-2
K501
Brush
TP 501
R540 100
R539 10
L501 100μH
C504 25V1
FBv 151 X 51/501
R523 680
L502 100μH
R501 47
in
R502 100VR
GAIN ADJ.
R516 47
R517 100VR
GAIN ADJ.
C514 25V50
C501 0.068
R504 3.9K
R505 100
R506 15
Q501
2SC-456
R508 680
R507 330
C502 6V30
R503 680
C511 0.068
C515 25V1
C512 6V30
C503 0.0056
R518 680
R521 15
R520 100
R519 39K
C513 0.0056
Q502
2SC-456
R510 560
R509 75
R522 330 1/2W
NV-1000 54
TNPB
122 mm
RECORD/PLAYBACK CIRCUIT
S=2/1



POWER SUPPLY CIRCUIT



RECORD/PLAYBACK CIRCUIT

122mm

SCHEMATIC DIAGRAM

VIDEO TAPE RECORDER

MODEL VTR-500 VTR-600

VIDEO SECTION

RECORD & PLAYBACK AMP SECTION

AUDIO SECTION

CONTROL SECTION

POWER SECTION

NV-1000-34

NV-1000-54

NV-1000-44

NV-1000-24

Video Head SF-3YR

Capstan Motor 2KC30AP

Video Head Motor

Tension Arm Switch

Remarks:

1. Resistors without specifications are in terms of Ω. (1K=1000Ω)
2. Wattage of resistors without specifications is ¼W.
3. Allowance of resistor without specifications is ±10%(F: ±1%), ±5%
4. Capacity of capacitors without specifications is in terms of μF(1P=μμF)
5. Solid Aluminum Capacitor(+)
6. Semi-Solid Resistor
7. Printed Circuit Board
8. TP: Testing Point
9. S□□□: Interlock Switch of R□□□
10. S□□□: Automatic Shut-off Switch
11. S□□□: Picture Record-Playback Shut-off Switch(Schema shows picture recording status.)