ENGINEERING AND MAINTENANCE NOTES

Magnecord INC.

SALES OFFICE
360 N. MICHIGAN AVE.
CHICAGO 1, ILL.

PLANT
225 W. OHIO ST.
CHICAGO 10, ILL.

Engineering Notes

ELECTRICAL & MEASUREMENTS SECTION

I. FREQUENCY RESPONSE

A. Measuring Technique

When measuring frequency response of Magnecord PT Series tape recording equipment it is suggested that you keep in mind that in this sytem the high frequencies are pre-equalized on record. Therefore, when making frequency runs it is best to first adjust the meter on the Magnecord amplifiers to "Zero" at 1000 cycles and then reduce the gain of the amplifier until the meter reads approximately -15 db. Making a frequency response measurement at this level will not give overload of the high end and thus the information will be more accurate.

B. Reasons for Poor Response Measurements

1. Broken head gaps.

If the high frequency response is very greatly reduced with respect to the mid frequency response the trouble may lie in the record/reproduce head. It was reported that the gaps in some of our first heads separated for unaccountable reasons thus leading to an increase in gap width and loss of high frequency response. A technique of manufacture was worked out so that this difficulty no longer arises. If the head has had considerable use the lamination may be worn through at the gap and a replacement necessary. However, it must be kept in mind that the frequency response can be flat only when using a pre-equalizer designed for the tape speed being used. Also, there have been differences in tape which have led to erroneous frequency response results. See below.

2. Unbalanced condition.

A few users have reported measuring large dips and holes in the frequency response of both the tape and the PT6-R amplifier. This trouble can be explained by reference to Figures 1 and 2.

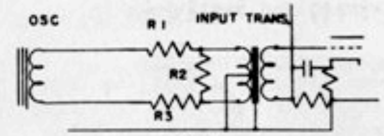


FIG. 1

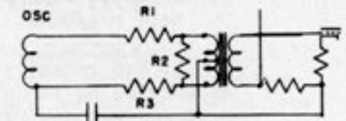


FIG. 2

In Figure 1 is shown the normal arrangement of parts in a balanced circuit. Here the circuit is truly balanced and everything will operate as it should.

In Figure 2 is shown a circuit as commonly encountered in practice. C-1 is the stray capacitance between one side of the output of the oscillator and the ground circuit. Usually this is the unbalanced capacitance; the difference between the capacitance from one side or the other to ground. It can be readily seen that C-1 will have a shunting effect on the input attenuator R-1, R-2, R-3. When this shunting capacitance has a reactance sufficient to cause a voltage across one half the input transformer primary, which is twice the voltage output from the attenuator, the transmission through the network will be zero. Of course, this statement neglects phase shift effects and this accounts for the failure of the response to go to zero.

It is necessary that the input transformer have a ground on its center-tap if a balanced input is to be used. However, if it is desired to use an unbalanced input, one side of the input transformer could be grounded and a great deal of the trouble would probably disappear. What happens depends upon the exact configuration of the feeding circuit.

We have tested various transformers for their balanced and we have found that the Audio Development Co. 114F transformer is very good in this respect. Transformers from other manufacturers have not given satisfactory results. We have used two oscillators to date on these tests: A General Radio 913B and a Hewlett-Packard 200C. The GR unit, when using the balanced output, has not proven satisfactory.

Of course, when feeding the PT6-R unit from a balanced telephone line it is certain to have a good capacitance balanced if it is a line with low noise level. On telephone lines an unbalance is very serious with regard to noise.

3. Improper head alignment and variations in tape response.

It has recently been discovered that the tape we were using to calibrate our heads for frequency response was not representative of that now being put out by the Minnesota Mining & Manufacturing Company. Furthermore, rather wide differences between various lots of tape which were at hand were discovered. We now have a test tape which we believe to be median of the available tapes and we have assurances from the Minnesota Mining Company that the tape now being produced is much more uniform. This has been corroborated by our own tests.

4. Variations in line voltage.

It may be expected that the frequency response will be somewhat dependent upon line voltage. This is because the output of the bias-erase oscillator is affected directly by the voltage supplied to it. The units will normally stay within the limits of the specification for a line voltage variation of approximately 110 to 125 volts. With a low line voltage the high frequency response will be higher while for a high line voltage the high frequency response will be lower. The units are adjusted at the factory for a line voltage of 117.

II. SIGNAL TO NOISE RATIO

A. General Information

Much has been said about the astounding signal to noise ratio possible with magnetic recording tape. Many reports came back concerning the German Magnetophone having 70 to 80 db signal to noise measurements. However, to this date few people have been able to duplicate these results due to the difficulties in measurement-techniques and the band width being covered. Actually, a critical examination of the manufacturers' specifications of all the magnetic recorders now in production will show that, in the best of equipment, wide band signal to noise will fall between 46 and 54 db, despite tricky wording of specifications.

These ratios are obtained by measuring from the erase noise on the tape to a pre-determined maximum recording level: that is, a level having a certain percentage of distortion present in the reproduced signal.

B. Tape Noise

The noise of the tape on the Magnecord units is usually slightly higher than the noise level figures for the amplifier alone depending upon the tape. We advise you to bear in mind that there is some difference in tapes. Therefore, we state that the ratio from erase noise to a peak signal having a total harmonic content of 2% will range between 46 and 50 db. Some low frequency rumble may be encountered which is due to irregularities in the coating thickness of the tape.

C. Hum - Reasons and Remedies

1. Output and hum level.

The output of the Magnecord equipment will vary between 2½ and 4 volts with a total harmonic distortion content of 2%. This is about plus 10 to 15 dbm or plus 2 to 7 db referred to 0.006 watt. The hum level and wide band (20 to more than 20,000 cps) noise level of the reproduce amplifier alone will range between 50 and 60 db below the above output. In actual volts this will be between 3 and 10 millivolts. The minimum noise is limited by low frequency bumps coming through the power supply filter.

2. Hum pickup.

When making measurements on the unit for signal to noise, you are cautioned to ascertain that the unit is as far as possible from extraneous fields coming from various equipment in the room. The play back head is designed to be an extremely sensitive magnetic pick-up and as such it will pick up large external magnetic fields even though it is quite well shielded. One customer reported that he had an unusually high hum level in his unit. This was traced very quickly to the fact that he had placed an electric clock near the head. Needless to say, the clock had a high field around it and induced a considerable voltage into the head. This is generally true for most electrical devices built to a price. Some amplifiers have a very high hum field around their power transformers - in fact, some of them are limited in noise level by the field. If high hum is experienced it is perhaps wise to try orienting the PT6-A unit for minimum pickup. The head connecting cable may be picking up some hum if it is placed close to a power transformer or other disturbances.

3. Position of top head shield.

The head shield, which we call a "flipper", should make a marked difference in hum measurements only when the motor is running. If no difference is noted when moving the flipper, you may suspect that the mu-metal has been cold-worked. This head shield may look out of line with the head: it is intentional as they are oriented to eliminate the maximum amount of hum. Therefore, do not bend it. When the unit is set for operation in a permanent position it may be possible to readjust this shield for even less hum pickup with some success. A slight bend in the hinge may be tolerated but too much will certainly break it. Do not attempt to change the curvature of this flipper. To do so will cold-work the mu-metal and destroy its shielding properties.

It is well to note that for minimum hum it is necessary to be very careful of the grounding on the output circuits.

4. Receptacle on rear of PT6-A unit.

The Cannon receptacle for the head connection on the rear of the PT6-A unit may look to be turned in just any position. This is done specifically to cancel as much of the hum pickup of the plug-in receptacle as possible. It was put in position at the factory and should not be changed except for very good reason.

5. Equipment used for measurements.

If distortion measurements are being made with distortion meters such as the GR equipment, tape noise will cause a reading of between 1% and 1½% distortion which should be deducted from the total to find the actual amount of distortion present in the signal. All measurements mentioned above are made with either a General Radio 913B or a Hewlett-Packard 200C Oscillator and a Hewlett-Packard 300A Harmonic Wave Analyzer.

D. Noisy 12AX7 Tubes

It has recently been our experience that Tung-Sol manufactures a very quiet 12AX7. Magnecord tests include a noise measurement and with Tung-Sol's 12AX7's the rejection rate of tubes is about 2 to 5%. With other makes it has run as high as 50%.

III GAIN ADJUSTMENTS IN THE AMPLIFIERS

A. Adjustment in the PT6-R

There have been several requests for information concerning gain adjustments in the PT6-R amplifier. These units are adjusted to read correct recording level when bridging a 600 ohms line carrying zero dbm with the gain control setting on about 8.

If the level is lower than zero dbm, or if for any other reason it is felt there is too little gain in the amplifier, it is fairly simple to change the input attenuator to accommodate the new requirements.

The bridging attenuator is composed of two 680,000 ohms ½ watt resistors connecting from the input receptacle to the terminals of the input transformer. Changing these to 330,000 ohms each should increase the gain by about 6 db. If a further increase in gain is desired, 6 db more may be had by going to 150,000.

If the maximum gain of the amplifier is desired, removing the bridging resistors will allow the full 95 db. The impedance with this change will be approximately 60 ohms.

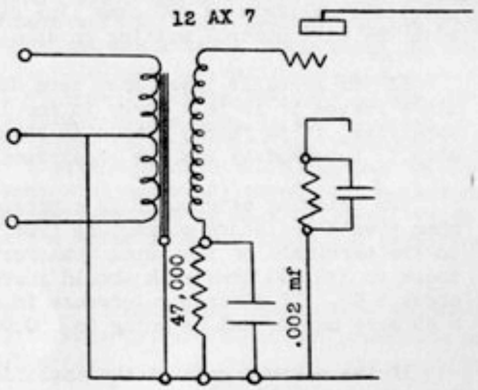
If the 600 ohms input is not satisfactory in the particular installation a similar course may be followed. In this case, changing the 10,000 ohms resistors to 5,000 ohms will give about 6 db increase in apparent gain. These resistors should not be reduced much below about 3,300 ohms without changing the 620 ohms input resistor.

With complete removal of the 620 ohms resistor, it is possible to go to approximately 300 ohms in each side and still preserve the approximate 600 ohms input. In this case, the attenuation should be about 13 decibels.

One word of caution, it is not advisable to operate the PT6-R unit with more than about 20 db attenuation in the gain control. This will result in about 65 db signal to noise ratio on recording and still give sufficient reserve power for peak operation.

B. Adjustment in the PT6-P

Approximately 9 db additional gain from the mike inputs on the PT6-P amplifier is available by eliminating the feedback loop around the first stage (12AX7). This results in an increase in noise which is slightly less than the increase in gain, so something is gained on signal to noise ratio. However, the frequency response without the feedback loop is about 6 db down at 15 kilocycles. This may be partially overcome by shunting the 47,000 ohms resistor between the input transformer and ground with a 0.002 mica condenser. The schematic shown below will illustrate the matter.



To increase the gain available through the bridging input of the PT6-P, the same procedure described in the preceding paragraphs under III. (A) "Adjustment in the PT6-R", should be followed.

IV. HEAD IMPEDANCES AND LEVELS

In response to the many inquiries relative to head impedances it is difficult to give an answer without specifying at what frequency as the nature of the head makes the impedance vary with frequency. One way of answering would be as follows: When recording, the amplifier feeds a level of about plus 8 db above 0.001 watt at an impedance of 600 ohms to the equalizer which gives the correct recording characteristic and level. Approximately one milliampere of recording current is fed through the head from a driving circuit having an impedance of approximately 1200 ohms.

In playback, the output from the head for a maximum level recording at a frequency of 50 cycles is about 0.000016 volt. This head works into a transformer that has an input impedance of 60 ohms. It is well to mention that an equalization curve which has a slope of about 6 db per octave between about 800 and 50 cycles and tails off to a flat response above 3,000 cycles is taken care of in the playback amplifier.

V. MONITOR SPEAKER IN PT6-P

A. Failure of Speaker

In the case of PT6-P units several cases of failure of the monitor speaker have been traced to incorrect placement of the volume control allowing one of the lugs to become grounded. This shorts out the input to the 6V6 tube feeding the monitor speaker. The remedy is to turn the volume control and tighten its holding nut.

B. Hum (In Monitor Speaker)

Originally PT6-P amplifiers were shipped with the filter condensers in the power supply simply crimped in the usual manufacturing manner. After considerable use it was found that these condensers sometimes loosened up in their mountings and were thereby removed from the circuit. This led to increased hum in the monitor speaker. A simple remedy consists of soldering the lugs of the condensers to the mounting wafers.

VI UNBALANCING THE AMPLIFIER

If it is desired to operate the Magnecord PT6-P and PT6-R amplifiers as an unbalanced system, it may be accomplished by removing a set of resistors from one side of the attenuator network and re-inserting these resistors on the other side, thus making a "Tee" attenuator. The side from which the resistors are removed becomes the ground side.

VII. BIAS ON METER

Some of the first units sent out had the bias showing on the VU meter when the unit was used in Record. This may be eliminated by shunting the meter alone with a 0.002 mf mica condenser. This affects the 15,000 cycle response of the meter only slightly but almost completely eliminates the bias showing. If it is desired that the bias show to determine the condition of the oscillator tube, a switch may be used to open and close the circuit to the condenser.

VIII. FM ELIMINATION

A number of users have reported trouble with both PT6-P and PT6-R units when using them near FM transmitters. This trouble has no specific remedy in that it varies with each installation. In one case a great deal of trouble was experienced while operating near a 250 watt installation while the same unit in the same city had no trouble when operating near a 20,000 watt transmitter. It seems that most of the remedies have revolved around the grounding of the 12AX7 tube mounting plate. The location of the various connecting cables usually effects this trouble and the grounding is quite important.

MECHANICAL SECTION

I. WOW AND FLUTTER

A. Measurements

Wow and flutter measurements are made at the Magnecord, Inc. plant on a Furst Electronics wow meter which reads the integrated value of one half peak to peak change in frequency. In order for a unit to pass this test it must have less than 0.3% wow or flutter. Most units average somewhat lower than this value and through continued use may be expected to improve.

B. Spool Problem

Until recently it was not possible to obtain spools which were sufficiently concentric and true to achieve the lowest flutter under all conditions. However, Minnesota Mining and Manufacturing Co. have recently released a new spool having but three spokes and made to much closer tolerances. These spools should give very good results under nearly all conditions. If old six spoke spools are still being used they may be improved somehwat by straightening the sides after heating the spokes to plastic temperature.

C. Tension Adjustments

If wow is discernible on the last one-third of the spool, it may be very easily corrected by slacking off the tension on the supply reel. This is done merely by turning the split knurled washer, on the rear of the supply spool shaft, counter-clockwise one-quarter of a turn, or until the trouble is eliminated. The brake is adjusted to provide about 5 inch-ounces drag on the tape. This means that if an arm 5 inches long is fastened to the spindle a force of approximately one ounce will be required to move it against the brake. The friction is provided by felt washers and it is to be expected that these will wear in with use. Occasional adjustment may be necessary.

D. Capstan

A further cause of wow may be due to poor fit of the capstan with the capstan shaft. This is particularly true when the operation of the unit requires that the capstans be changed rather frequently. It is absolutely necessary, for best results, to thoroughly clean both the capstan and capstan shaft before installing the new capstan. The total indicated run-out of these items is only 0.0002 inches. If this is to be maintained, treat them with reasonable care.

At least one instance of flutter has been traced to a piece of clear Scotch tape sticking to the capstan surface. Proper examinations and maintenance of Magnecord units will make wow and flutter free operation a certainty for thousands of hours of continuous service.

E. Proper Tape Threading

It was found that the additional guide roller incorporated in all but the very first PT6-A, and PT6-AX units, just above the erase head, eliminated the uneven jerks of the tape as it came off the supply spool. Some letters and comments seem to indicate that several users apparently have not read the instruction book included with each PT6-A showing how to thread the tape. The supply spool should go on the left spindle with the tape going over the top of the high guide roller, around to the left of the lower guide pulley, and then over the heads.

F. Sticky Tape Splices

We have received several spools of 111A recording tape in which the splices were imperfectly made. This allows the adhesive tape to show between the ends of the recording tape thus leading to the adhesive tape sticking to the next lower layer of recording tape which prevents the tape from coming off the supply spool smoothly and results in a "bobble" or "skips". The adhesive may also smear over the edges and cause successive layers of tape to stick together slightly. In view of this it is recommended that a new spool of tape be completely rewound before using and any particularly sticky splices either dusted with oil-free powder of some sort or a new splice made.

G. Position

The PT6-A is designed to operate with the same low wow and flutter characteristics in either a vertical or horizontal position.

II NOISY MOTORS

Some trouble has been experienced with the main drive motors becoming excessively noisy or completely stopping. The manufacturer of these motors has been very cooperative in remedying the defects.

On several occasions it was found that a noisy motor was caused by the outside cover of the motor being bent in shipment, allowing the fan to strike the rear of it. If this happens the motor is probably not damaged internally at all and a simple operation with a screwdriver or pliers should remedy the trouble.

III SQUEAK ON FORWARD

In two or three instances the users have noted a very high frequency squeak when running the machine in the forward direction. This has been found to originate in the brake on the supply spool. A drop of oil (and no more should be used) on the felt brake should eliminate the trouble promptly.

IV STOP BUTTON

The stop button located just to the left of the rewind-stop-forward switch on the PT6-A is a safety measure to remind the operator to stop the unit before going to forward from the rewind position. A fast change between these two functions would lead to a rather disastrous throwing of tape.

V KNOCKING NOISE WHEN FIRST USED

After a PT6-A has been idle for some several hours or days a depression will appear in the rubber puck driving the right hand spindle. The Buna N rubber used in these pucks is purposely chosen to have self-healing properties. Thus after a very few

minutes of running the bump will disappear. A very quick way of making it disappear consists of holding the aluminum wheel which the puck drives for the space of about 5 or 6 seconds. In any case, the wow is not increased by the bump because it is only in the takeup spindle puck and beyond the capstan in the tape path.

VI SPRING RUBBING ON FLYWHEEL

The spring which holds one of the drive pucks in place occasionally gets in such a position that it is rubbing on the rim of the flywheel. A disturbing noise is the natural result. A temporary remedy for this trouble is found in moving the spring slightly in the hole until it clears the flywheel. A more permanent remedy is to put a new hole in the side plate in such a position that it will always keep the spring in the clear. This has been done on more recent units.

GENERAL INFORMATION

I LINE UP TAPE

The heads on the Magnecord PT6-A are aligned at the factory using Minnesota Mining's line-up tape. This line-up tape is stated to be correct within 1½ minutes of arc and makes possible very good uniformity from one machine to the next. This tape may be obtained by writing direct to:

Mr. R. L. Westbee
"SCOTCH" Electrical Tapes Division
Minnesota Mining & Manufacturing Company
900 Fauquier Avenue
St. Paul 6, Minnesota.

This tape should be used if heads are changed or re-adjusted for any reason. When using this tape to line up the head (operator facing the unit), merely turn the screw at the left hand side of the playback head in one direction or the other while watching the meter: when the point of maximum output is found, the head is in proper alignment.

It should not be assumed, however, that a high output with a line-up tape means that the machine is going to have a good high frequency response. The actual frequency response of a unit obviously depends upon much more than this factor alone.

II SWITCHING POPS

Disturbances due to switching of the motor in a PT6-A unit may be eliminated by putting a 0.1 mf 600 volt paper condenser across the switch contacts. A similar treatment for the rewind motor and solenoid contacts will eliminate clicks on rewind switching.

III SPLICING TAPE (#41).

It is apparent that few users are aware of #41 splicing tape made by Minnesota Mining specifically for making splices in magnetic recording tape. This tape for this purpose is white and is far superior to the cellulose Scotch tape used in the past. It may be obtained from your local Minnesota Mining distributor or from the Minnesota Mining & Manufacturing Company direct.

IV REPEATING MESSAGES ON PT6-A.

It is possible to use a loop on a PT6-A with a maximum time of approximately 10 seconds (about 12 ft. of tape at 15 inches/second). This may be quite convenient for repeating messages for a considerable length of time. At Magnecord several weighted pulleys have been made which are hung on the bottom of the loop while the PT6-A unit is sitting on a bench. This is handy for checking frequency response and other tests in that no rewinding is necessary.

V TAPE AND HEAD LIFE

Observation and later tests have led to the opinion that head life should be in excess of 1000 hours. This is dependent somewhat upon speed used and the care taken in operation of the unit. Tape should always be removed from the record/playback head during high speed operation to prevent undue wear.

A recent test of tape life gave the information that in excess of 400,000 revolutions of a loop under normal operating conditions were not sufficient to render the coating inoperative. In fact, it was still going strong when after some 300 hours the test was discontinued. This was a loop made by joining a piece of #111 tape with #41 splicing tape.

Maintenance Notes

BASIC RECORDER MECHANISM

I LUBRICATION

Most bearings throughout the PT6-A equipment are "Oilite" bronze, which retain oil over long periods of time. Usually it is necessary only to replace the oil lost by evaporation. All bearings are considerably oversize with respect to their loading so little or no wear will be encountered. The "Oilite" bearings are kept oil damp by their felt pad wicks. The wicks should be oiled, not the shafts or bearings themselves.

CAUTION: <u>DO NOT</u> over-oil. To do so will cause all manner of trouble, as excesses of oil will find its way past the various oil-stop barriers and grooves and get onto the friction drive surfaces. Slip always results. If drive surfaces become oily, clean metal and synthetic (oil resistant) rubber with carbon tetrachloride (carbona, etc.) on a rag. The surfaces must be dry of oil to function properly.

A. Drive Motor

Two or three drops #30 motor oil, front and back bearings every three months.

B. Capstan Shaft Bearings

Equipped with felt pads between panel and retainer. Two or three drops #30 motor oil on <u>felt pads</u> every six months.

C. Intermediate Idler Wheels

(Two in PT6-A2, three in PT6-A, four in PT6-AH) Equipped with felt washer at hub. One drop of #30 motor oil on felt washer each six months. It may, in rare cases, be necessary to re-lubricate the sliding surfaces supporting the idlers with "Lubriplate", a non-drying, white grease. Vaseline may be used in an emergency. Work lubricant between sliding surfaces.

D. Takeup Clutch

Do not oil unless clutch begins to squeak; then one or two drops of oil on each of two felt pads.

<u>CAUTION</u>: Do not over-oil. To do so will throw oil onto friction surface of the rubber idler roller, thence to motor shaft and ultimately to capstan shaft drive surface. Slip, wow, non-positive drive, playing time variation, etc. will result. Clean excesses of oil away with carbon tetrachloride.

E. Rewind Motor

Oil bearings with two or three drops of #30 motor oil every six months.

F. Rewind Brake

Treat same as takeup clutch.

II CAPSTAN DRIVE SYSTEM

Two independently supported synthetic rubber-bonded idler wheels transmit the motor torque to the capstan shaft drive hub. Each is supported on a sliding suspension permitting sheets to equalize their position in two dimensions. The supporting arms are lightly spring loaded to hold the wheels in the proper position.

Mechanical shocks to the recorder have been known to force the rear wheel out of position and hang its arm up on one of the motor mounting screws. It may easily be pushed back into place.

No other adjustments are necessary.

III TAKEUP SYSTEM

A sliding suspension arm supports a synthetic rubber bonded idler wheel in contact with the motor shaft and the takeup shaft drive wheel. This position is maintained by a spring between the sliding arm and the bottom panel of the recorder. Rotation of the drive motor imparts torque through the idler wheel to the takeup shaft. The takeup shaft receives its torque from the friction coupling between the large dural drive wheel, driven from the rubber idler wheel, and the disc-type friction clutch assembly. The tension of this clutch, and therefore, the torque transmitted, is a function of the pressure exerted by the sponge neoprene washer on the felt pads. Tightening the split and knurled nut increases this pressure and therefore, the driving torque, and in turn the tape tension. Loosening the nut reduces the torque.

A DC operated solenoid is energized during rewind, which pulls against the aforementioned spring and lifts the idler wheel away from the motor shaft by 1/16", but maintains contact between the idler wheel and the takeup shaft to run free. When the mechanism is switched from REWIND to STOP, the solenoid relaxes and the spring returns the idler wheel to contact with the drive motor shaft. This shaft, of course, is not turning. Therefore, the idler wheel is prevented from turning and thus stops the free rotation of the drive wheel on the takeup shaft which in turn acts as a brake on this shaft.

Adjustments to this system consist of so positioning the solenoid to accomplish the above results. The solenoid is mounted by means of two screws in slotted holes in the back panel above the drive motor. Care should be taken that, when readjusting the solenoid, the plunger does not bind within the tube. To check this, place the recorder with its panel horizontal (reel shafts vertical) and operate the control knob (with power applied to mechanism) between REWIND and STOP. The return spring has adequate tension to return the idler wheel to its normal position when there is no binding of the solenoid plunger.

The torque transmitted to the takeup shaft should be adjusted to about 4 to 5 inch-ounces. This may be measured by means of a 0 to 1 pound spring balance on one end of a string wound several times around the hub of a 7" reel mounted in the normal manner on the takeup hub. The "inch-ounce" of torque is the number of ounces pull registered on the spring balance multiplied by the distance in inches from the center of the takeup shaft to the tangency of the string coming off the reel. Spring balance should be pulling the string vertically upward

with power "on" and recorder running FORWARD. Readjust by loosening the socket head set screw in the knurled split nut first. Then rotate this nut, lock the nut with the set screw after each adjustment and before measuring result.

IV REWIND SYSTEM

The rewind motor is equipped with a uni-directional and adjustable friction drag system mounted to the rear of the motor on its shaft. When the recorder is running FORWARD with tape threaded in the normal manner, this motor is not energized, and the shaft rotates clockwise as a simple shaft. The friction drag system operates to impart tension in the tape. When the recorder is set to run REWIND, the motor is energized and runs counter-clockwise. The friction drag is released when the motor shaft is running in this direction. Its uni-directional characteristics are achieved through the use of a pawl and ratchet with a self-energizing pawl spring.

Adjustments to this friction drag system are made in a similar manner to that described above under Takeup System. The spring balance method of measuring the torque (drag in this case) should be made with the recorder set to STOP, and with no tape on the machine. Since the drag is being measured, the string on the reel should be wound on to come off clockwise and the spring balance should be pulled slowly upward against the friction drag. It should be about 4 to 5 inch-ounces.

The pawl spring, wrapped around the ratchet disc, and riding in a groove, acts as a self-energizing brake band to pull the pawl into the ratchet during forward winding and to release the pawl during rewind. The pawl travel, in release, is stopped by a pin in the pawl mounting bracket which allows the pawl to clear the ratchet by about 1/32 inch.

The amount of drag (tension in tape) is determined by the amount of pressure exerted on the ratchet disc by the friction felts, as in the takeup system. Tightening the knurled-split nut increases tension. Always loosen the set screw in the split nut before adjusting and retighten before running or measuring.

I CLEANING

Since most presently used recording tape is of the coated variety, it is only reasonable to expect to have some of the coating wear off and adhere to the heads. The amount varies depending on tape tension, the elapsed time and the type of binder in the tape itself.

Usually the tape tension in the Magnecorder is sufficiently high to prevent an accumulation of this sludge at the gaps themselves, with resultant loss of high end frequency response. However, it is advantageous to clean off this rather hard deposit from time to time. This is accomplished by wiping the heads with a soft rag dipped in carbon tetrachloride.

CAUTION: The binder in the tape is soluble in carbon tetrachloride. Therefore, have the tape off of the machine when cleaning the heads; and be sure that the heads are dry of this cleaner before re-threading the tape.

II WEAR

Because of the construction of the Magnecorder erase head, years of service may be expected. The record and/or reproduce head on preliminary tests appeared to have a life of about 500 hours at normal playing speeds. (High speed winding over these heads increases the wear, of course.) However, recent reports from the field indicate life far in excess of this value, approaching 1500 to 2000 hours. A worn-out record/reproduce head is characterized by a loss of high end frequency response (not to be confused with a dirty head). The frequency response obviously should be checked with a known length of tape under similar conditions. It is characteristic of a worn head that the high end response goes bad over a very short period of time.

The cost of head replacement is nominal through the distributor from whom the machine was originally purchased.

In order to achieve interchangeability of recordings between machines, it is necessary that the gaps of the various machines be aligned one with the other. This may be achieved in one of several ways. One way is by recording a signal of, say, 10,000 cycles on one machine and playing it back on another. The first machine becomes the standard; the reproduce head on the second and all others are then adjusted, physically, to give a maximum signal, electrically, from this tape. A better way is to use a so-called standard alignment tape. Minnesota Mining and Manufacturing Company has made up such lengths of tape under controlled conditions. They are available from them.

To date, all Magnecorder PT6-A equipment has been aligned with one of these tapes at the factory. A dab of glyptol has then been placed on the threads of the record/reproduce head adjusting screw to prevent changes in alignment.

Should it become necessary to readjust alignment of the head, such as when replacing it with a new one, the glyptol should first be dissolved or softened with acetone or lacquer thinners before attempting to rotate the head mounting screws. Failure to do this will result in stripped threads in the panel and no end of subsequent grief.

The right hand mounting screw of the head is drawn up securely. This side of the head holder is provided with a rocker action. The left hand mounting screw is associated with a compression spring. Rotating this screw changes the gap alignment with respect to the tape. Proper alignment is achieved when the maximum signal, at a given setting of the gain control is reproduced from the standard tape, as the head alignment screw is turned in or out. The absolute value of this signal level is unimportant.

Some slight discrepancies in alignment tapes have been reported by some users. However, they have been found to be sufficiently accurate for all general use. Specific groups of recorders should be checked with the same length of tape for best results.

AUXILIARY SPOOLING MECHANISM

I LUBRICATION

A. Takeup and Rewind Motors

Two or three drops #30 motor oil, front and back bearings, every six months.

B. Intermediate Idler Wheels

Equipped with felt washer at hub. One drop #30 motor oil on felt washer each six months. It may in rare cases be necessary to re-lubricate the sliding surfaces supporting the idlers with "Lubriplate", a non-drying white grease. Vaseline may be used in an emergency. Work lubricant between sliding surfaces.

C. Takeup Clutch

Do not oil unless clutch begins to squeak; then no more than one or two drops of oil on each of the two felt pads.

CAUTION: Do not over-oil. To do so will throw oil onto friction surface of the rubber idler roller, thence to motor shaft and ultimately to capstan shaft drive surface. Slip, wow, non-positive drive, playing time variation, etc. will result. Clean excesses of oil away with carbon tetrachloride.

D. Rewind Brake

Treat same as takeup clutch.

II TAKEUP SYSTEM

A sliding suspension arm supports a synthetic rubber bonded idler wheel in contact with the motor shaft and the takeup shaft drive wheel. This position is maintained by a spring between the sliding arm and the bottom panel of the unit. Rotation of the drive motor imparts torque through the idler

wheel to the takeup shaft. The takeup shaft receives its torque from the friction coupling between the large dural drive wheel, driven from the rubber idler wheel, and the disc-type friction clutch assembly, The tension of this clutch, and therefore, the torque transmitted, is a function of the pressure exerted by the sponge neoprene washer on the felt pads. Tightening the split and knurled nut increases this pressure and therefore the driving torque, and in turn the tape tension. Loosening the nut reduces the torque.

A DC operated solenoid is energized during rewind, which pulls against the aforementioned spring and lifts the idler wheel away from the motor shaft by 1/16", but maintains contact between the idler wheel and the takeup shaft to run free. When the mechanism is switched from REWIND to STOP, the solenoid relaxes and the spring returns the idler wheel to contact with the drive motor shaft. This shaft, of course, is not turning. Therefore, the idler wheel is prevented from turning and thus stops the free rotation of the drive wheel on the takeup shaft which in turn acts as a brake on this shaft.

Adjustments to this sytem consist of so positioning the solenoid to accomplish the above results. The solenoid is mounted by means of two screws in slotted holes in the back panel above the drive motor. Care should be taken that, when readjusting the solenoid, the plunger does not bind within the tube. The return spring has adequate tension to return the idler wheel to its normal position when there is no binding of the solenoid plunger.

The torque transmitted to the takeup shaft should be adjusted to about 16 inch-ounces. This may be measured by means of a 0 to 1 pound spring balance on one end of a string wound several times around the hub of a 7" reel mounted in the normal manner on the takeup hub. The "inch-ounce" of torque is the number of ounces pull registered on the spring balance multiplied by the distance in inches from the center of the takeup shaft to the tangency of the string coming off the reel. Spring balance should be pulling the string vertically upward with power "on" and recorder running FORWARD. Readjust by loosening the socket head set screw in the knurled split nut first. Then rotate this nut, lock the nut with the set screw after each adjustment and before measuring result.

III REWIND SYSTEM

The rewind motor is equipped with a uni-directional and adjustable friction drag system mounted to the rear of the motor on its shaft. When the recorder is running forward with tape threaded in the normal manner, this motor is not energized, and the shaft rotates clockwise as a simple shaft. The friction drag system operates to impart tension in the tape. When the recorder is set to run REWIND, the motor is energized and runs counter-clockwise. The friction drag is released when the motor shaft is running in this direction. Its uni-directional characteristics are achieved through the use of a pawl and ratchet with a self-energizing pawl spring.

Adjustment to this friction drag system are made in a similar manner to that described above under Takeup System. The spring balance method of measuring the torque (drag in this case) should be made with the recorder set to STOP, and with no tape on the machine. Since the drag is being measured, the string on the reel should be wound on to come off clockwise and the spring balance should be pulled slowly upward against the friction drag. It should be about 6-inch-ounces.

The pawl spring, wrapped around the ratchet disc, and riding in a groove, acts as a self-energizing brake band to pull the pawl into the ratchet during forward winding and to release the pawl during rewind. The pawl travel, in release, is stopped by a pin in the pawl mounting bracket which allows the pawl to clear the ratchet by about 1/32 inch.

The amount of drag (tension in tape) is determined by the amount of pressure exerted on the ratchet disc by the friction felts, as in the takeup system. Tightening the knurled-split nut increases tension. Always loosen the set screw in the split nut before adjusting and retighten before running or measuring.

ENGINEERING AND MAINTENANCE NOTES

Magnecord INC.

SALES OFFICE
360 N. MICHIGAN AVE.
CHICAGO 1, ILL.

PLANT
225 W. OHIO ST.
CHICAGO 10, ILL.