MODEL 77 Mk. IIIB

SERVICE AND MAINTENANCE MANUAL

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SECTION 1 — GENERAL DESCRIPTION OF TAPE TRANSPORT MECHANISM

1.1

The main deck frame consists of a high grade aluminium casting which has been stabilized before final machining has been completed.

By the use of suitably shaped flanges on the deck frame, mounting on slightly out of parallel racks or carry case supports can be tolerated without upsetting tape tracking. A three motor drive system is employed, two spooling motors being used for supply and take-up of tape. The motor end bells are a die-cast component and are subjected to very fine tolerance machining to ensure correct alignment of the rotor within the stator. The shafts are of a hardened steel variety and ground to a micro-finish to produce smooth running and a long life. The bearings are machined in phosphor bronze and are assembled into the end bell along with a felt oiling ring. The bearings and oil rings are retained by a formed spring plate; by this method self-aligning bearings are obtained.

The capstan motor utilizes one rear die cast end bell and one front steel pressed end bell. The retaining of the bearings is identical to the spooling motors. As well as its rotor, the capstan shaft carries a flywheel which damps out any short term speed fluctuations. The whole rotor, flywheel and shaft assembly is dynamically balanced to guard against any transmission of vibration to the tape motion. (Balance is to better than 20 milligram inch.)

The capstan itself is formed by precision grinding the motor shaft (which has previously been hard chromed) to required size. The diameter of the shaft is held to 0.0001" and the ovality is better than 0.00002".

The pressure roller consists of a rubberized aluminium core which has a self-lubricating bearing pressed into it. When preliminary operations have been completed on the roller, it is set up on a mandril and concentrically ground.

The roller runs on a hardened steel pillar which is also ground to a fine finish. This pillar is mounted on a cast pressure roller arm. The arm in turn is mounted on a hardened steel shaft which pivots in a bearing machined into the main deck casting, a retaining circlip being fitted to captivate the whole assembly. The pressure roller arm is connected, via an adjustable link, to the solenoid arm. The edit cam also operates the pressure arm, via an adjustable stop.

The brake drums are moulded in a phenolic material, an aluminium core being bonded in the drum during moulding. The drums are ground on all faces during processing, thus ensuring concentric running. Brakes are cork lined for efficient operation and long life and are set so a servo-action takes place during braking. This provides more powerful braking to whichever spool is unwinding tape. By employing this method any possibility of tape throwing during "shuttling" is overcome. A timing mechanism is mounted on three pillars which are adjustable to allow the timing roller to be aligned correctly in the tape path. The scale is accurately graduated in minutes. The timing roller is a soft rubber moulding which is ground to a standard dimension to maintain accurate timing. Mounted concentrically with the tape stabilizing roller is a tape over-run arm with an inbuilt tape guide. This arm actuates a micro-switch.

Centrally placed on the main deck casting is the "triple head assembly" mounting bracket. This is cast in stabilized aluminium and is jig machined to ensure consistent positioning of heads. The heads are held in the bracket by one rear locking nut. Azimuth adjustment of record and replay heads is accomplished via a pressed steel bracket which locates on the head mounting shaft. The azimuth adjustment utilizes a screw operating against a tension spring to provide back-lash-free operation.

Two solenoids are mounted on the rear face of the main deck casting, one operating the pressure roller, the other the brakes. Attached to the solenoid shafts are armatures which can be adjusted to provide parallel contact between the solenoid core and the mild steel plate of the armature assembly.

1.2

All basic electrical and electronic operations or functions of the transport are carried out via relays. The relays are operated via press buttons or link-operated micro-switches. All operating modes of the deck are monitored by indicator lamps which are mounted under the appropriate press buttons. All relay and micro-switch contacts are fitted with short-time R-C networks for spark and click suppression.

The capstan motor provides two speeds. Speed changing is accomplished by means of winding switching, to enable the motor to run as a four pole machine in the high speed position, and an eight pole, consequent pole machine in the low speed position. At both speeds the motor runs synchronized with the 50 c/s mains supply. (High Speed 1500 R.P.M. — Low Speed 750 R.P.M.)

The spooling motors are of the high starting torque, capacitor start/run, induction type, and will provide extremely smooth hold back when they are being rotated by tape travel during the record or play mode.

Five relays are employed in the transport mechanism, three of these being mounted on a common bracket on the left side of the control box. Contact cleaning or adjustment of the relays

may be carried out by removing the inspection plate fitted to the end of the control box. The D.C. supply for operating the solenoids and relays is obtained from a full wave, voltage doubling, twin silicon rectifier system. By the use of adequate filtering, very low ripple current flows in the solenoids which are in close proximity to the record and replay heads.

Two solenoids are used to operate the braking and pressure roller assemblies. The solenoids use standard E laminations and a bobbin wound coil. The assembled coil and laminations are mounted on a cast frame which is in turn mounted on the main deck casting.

A push-pull, fully-balanced, cross-coupled power oscillator operating at a frequency of 85 Kc/s (approximately) is used to drive the erase head. Bias is derived from the erase head series feed capacitor. The bias voltage thus developed is applied to the bias adjustment potentiometer. Bias to feed the record head is then obtained via an isolating capacitor. The audio feed to the record head is fed through a bias isolating trap. The bias adjustment potentiometer appears on the top face of the control box. The bias trap adjustment appears adjacent to the record head socket (top right hand corner of transport mechanism, when viewed from the rear of the unit).

The record and replay heads are connected to two sockets located at the top left of the transport mechanism.

Two 3 amp mains fuses are also fitted to the control box, one in each side of the mains supply. The mains lead which enters the control box is of the plastic-sheathed, rubber inter-core type and will give long life under normal usage.

Means are provided for the use of an auxiliary spooling mechanism via an eight pin octal socket. During normal machine usage this socket is fitted with a dummy plug wired with three bridging links.

The amplifier section of the machine obtains its power and interconnection with the deck via an eight pin rectangular socket mounted on the control box.

A remote control socket is fitted to the control box and will provide the following facilities:—

Record.
Play.
Shuttle.
Stop.

In the shuttle mode the direction of tape motion will be governed by the position of shuttle control on the transport.

A key switch is provided on the top face of the control box, to guard against accidental erasure or over-record of pre-recorded tape. The key can be removed from the switch in the SAFE position.

SECTION 2 — GENERAL DESCRIPTION OF AMPLIFIER

2.1

Basically the amplifier chassis consists of five formed panels which are screwed together to form a complete assembly. Each panel is coated with epon which is a very durable and clear coating. All the lettering on the front panel and chassis plate is carried out before the epon is applied, thus protecting the lettering against wear. The amplifier section is mounted by four nylon-bushed, socket-head, captive screws. The five control knobs are phenolic mouldings, fixed on to their spindles by socket-head grub screws.

2.2

The amplifier has been designed to permit the simultaneous recording, playing and monitoring of a signal on magnetic tape. These functions can proceed independently and simultaneously, thus providing the utmost in operational flexibility.

In order to understand the manner in which this is accomplished, it is convenient to consider separately the four main sub-sections of the amplifier:—

(a) Record Channel.
(b) Play Channel.
(c) Monitor Amplifier.
(d) 600 ohm Line Amplifier.

(a) **Record Channel:**

The input from the 50 ohm microphone socket is coupled through a balanced and shielded transformer to VI, an EF86 low-noise pentode microphone pre-amplifier. Also provision is made through resistive networks to couple to the primary of the microphone input transformer, from a 600 ohm line source with line or bridging loading impedance. Negative feedback is placed around this stage to produce a small amount of bass lift.

From the output of VI the monitor amplifier receives its record input, also the "RECORD GAIN" control is placed across the output of this stage. The output of the "RECORD GAIN" control is fed via a high frequency adjusting network to the grid of V2-EF86. This stage is also provided with a negative feedback loop. Derived from the output of this stage is the 600 ohm line amplifier record input, also the pre-set record level control. The output from this control is fed via an isolating resistor into V3-12BH7 Section A, which acts as a buffer stage for V3-12BH7 Section B. The output of the latter section V3 is the record head drive amplifier providing constant current through the recording head.

Equalization is applied by means of a series tuned circuit placed across the current feedback loop in the cathode of V3-12BH7 Section B. The resonant frequency of the series tuned circuit is varied by using two different value capacitors which are automatically switched by a relay to provide the correct equalization for the tape speed.

(b) **Play Channel:**

The output from the play head is coupled directly into V4-EF86. The output from this stage is applied through a suitable network to V5-EF86. In this stage, full play equalization is carried out. The equalization network provides the following adjustments: Low frequency correction and individual high frequency correction for both tape speeds. The output from this stage provides the monitor amplifier with its play input, also the 600 ohm line amplifier its input via the "Replay Gain" control.

(c) **Monitor Amplifier:**

The input to the monitor amplifier is via the A/B gain control. By the use of an earthed centre-tapped linear-gain control, both record and replay can be monitored at a suitable listening level. The A/B monitor control provides zero output at its centre setting, clockwise rotation monitors the play channel, and anti-clockwise rotation the record channel. The valve employed in this section (V8-6GW8) consists of a high gain triode section and a power output pentode section. Output from the monitor amplifier can be obtained via a twin carrier jack located on the right side of the front panel. When an external speaker is plugged into the amplifier, the internal speaker is automatically muted.

(d) **600 ohm Line Amplifier:**

This amplifier consists of V6, a 12AX7 with one half operating as an amplifier and the other as a phase inverter. This is followed by V7, a 12AU7, operating in push-pull.

Feedback derived from a tertiary winding on the output transformer is applied to the cathode of the V6 amplifier stage.

The output from the line amplifier is applied to the V.U. meter. It is also available on the front panel via the "600 ohm Output" twin carrier jacks. An internal 600 ohm load resistor is placed across the output line. This load is automatically removed when plugs are inserted.

The input for this amplifier may be selected by a switch from either the Record or Play channel, thus allowing the V.U. meter to be used on either as required.

SECTION 3 — GENERAL DESCRIPTION OF UNIT OPERATION

3.1 PLAY MODE

When the "REPLAY" button is pressed relay RL1 is earthed so causing it to energize. Relay contact RL1/1, which is closed by RL1, forms a holding circuit, via a series resistor R19, relay contacts RL2/2, the tape break switch (which is closed by tape), the two normally closed contacts on the "STOP" Buttons, and a link in the remote control dummy plug from pins 2 to 1 which is earthed. This enables RL1 to remain energized after the "REPLAY" button is depressed. By placing the tape break switch and the stop buttons in the RL1 holding circuit, the pressing of either "STOP" button or breakage of the tape will open the RL1 holding circuit, so de-energizing relay RL1, and stopping the play mode.

A relay RL4 and its associated series feed electrolytic condenser are connected in parallel with the pressure roller solenoid. This relay operates for approximately .5 second when the "REPLAY" button is pressed. Contacts RL4/1 and RL4/2 apply additional hold-back and take-up tension during initial tape acceleration, by placing resistor R38 via RL4/1 in parallel with the take-up motor series feed resistors and resistor R42 in parallel with the supply motor series feed resistor. This additional tension is applied to counteract inertia at the starting of tape motion. The brake and pressure roller solenoids are operated via contact RL1/2. The pressure roller solenoid power also passes through relay contact RL3/3 which is a normally closed contact. The brake solenoid operates both brake shoes via mechanical linkages so removing the shoes from the brake drum when the solenoid is energized. The shoes are applied to the drum by tension springs. The pressure roller solenoid operates the pressure roller assembly via an adjustable mechanical link. Coupled mechanically to the pressure roller arm is a tape lift arm which lifts the tape off the record and replay head during shuttling. Spring loaded against this arm is the head shield assembly which closes when the pressure roller is operated.

The replay indicator lamp is connected in parallel with the pressure roller solenoid via a voltage dropping resistor, R21, a bypass capacitor, C25, and contacts RL2/3. The capstan motor operation depends on the position of the press-on-press-off-"PRESS TO EDIT" switch (SW1). When this switch is in the ON position the fast start indicator lamp will light via Pole 2 of SW1, and the capstan motor will be running continuously. In the OFF position of SW1 the capstan motor will run only during the replay or record mode period.

The spooling motors are supplied with their power via relay contacts RL1/6 and RL1/4, the supply motor power is governed by a series resistor, R33. The take-up motor power is governed by two series resistors, R23 and R25 and parallel resistor R40.

3.2 RECORD MODE

When the "RECORD" button is pressed (with the machine resting in normal stopped condition) relay RL2 is earthed, causing relays RL1 and RL2 to become energized.

Relay contact RL2/2, which is closed by RL2, forms a holding circuit, via relay contacts RL2/2, the tape break switch (which is closed by tape), the two normally closed contacts on the "STOP" buttons, and a link in the remote control dummy plug from pins 2 to 1 which is earthed.

This enables RL2 and RL1 to remain energized after the "RECORD" button is depressed. By placing the tape break switch, and the stop buttons in the RL2 and RL1 holding circuit, the pressing of either "STOP" buttons or breakage of the tape will open the holding circuit, so de-energizing relays RL2 and RL1, and stopping the record mode.

A relay RL5 and its associated parallel electrolytic condenser and series feed resistor is placed in parallel with relay RL2 and its series feed resistor R15. When the "RECORD" button is pressed the operation of RL5 is delayed by approximately 25 milliseconds.

H.T. is supplied to the erase/bias oscillator via relay contacts RL2/1 and RL5/1 and series resistor R45 plus a short time-constant delay network R3, C3, C4 and C2. Due to the slightly delayed action of RL5, H.T. supply to the oscillator is also slightly delayed, so allowing the tape to reach almost full speed before the oscillator comes into action. Pressing the "STOP" button or the "RELAY" button causes RL2 and RL 5 to de-energize and, due to almost instant opening of the relay contact RL2/1 and the short time constant H.T. network the oscillator drops smoothly and quickly out of operation.

Transient free operation of the record amplifier is achieved by automatically reducing its gain during "REPLAY" mode and returning it to normal during "RECORD" mode. This form of operation is achieved through the use of a Light Dependent Resistor and an associated lamp which is in turn switched via contacts RL2/1.

A further relay contact, RL2/3, changes over, applying power to the record indicator lamp. All motor and solenoid switching is carried out by contacts on RL1 and RL4, the functions of which have been described in detail in Section 3, Play Mode (3.1).

Placing relays RL1 and RL2 in series allows changing the machine operational mode from Record to Replay or vice-versa without stopping the tape motion. This facility makes "word drop-in" editing possible. Assuming the machine to be in the Record mode, by pressing the "REPLAY" button, an earth is placed on relay RL1. All current

flowing through RL2 ceases, causing it to de-energize and allowing the machine to change to the replay mode. The RL1 holding circuit is made through resistor R19, across which approximately 10 volts is developed. When the "REPLAY" button is depressed this voltage appears on the lower end of RL1. On pressing the "RECORD" button, an earth is placed on the lower end of relay RL2 and as its upper end is connected to the lower end of RL1, via resistor R15, RL2 will become energized due to the 10 volts appearing on the lower end of RL1. This energization leads to the relay contact RL2/2 changing over, thus forming a holding circuit for relay RL2 as detailed in normal record mode. The holding resistor, R19, which holds RL1 energized, is also opened by contact RL2/2. This completes all the main changes that take place when switching directly from "RECORD" to "REPLAY" and back to "RECORD" again. Placed in series with RL2 is a two position "PLAY/SAFE" switch, which when set in the "SAFE" position opens the circuit from RL2 to the Record button, making it impossible to record.

3.3 SHUTTLING

When the "SHUTTLE" button is pressed, an earth is placed on relay RL3, causing it to energize and operate contact RL3/4, forming a holding circuit to earth, through the tape break switch and the two stop buttons, to Pin 2 of the remote control socket. An external link in the dummy remote control plug bridges Pins 1 and 2, so completing the circuit to earth. The brake solenoid is energized (releasing the brakes), via relay contacts RL3/2, and a further relay contact RL3/3 opens, preventing any supply of power to the pressure roller solenoid. The spooling motors receive their power via relay contact RL3/5, which supplies power to the moving arm of a 50 watt W.W. potentiometer, the supply motor receiving its power directly from one end of the potentiometer, and the take-up motor receiving its power from the other end of the potentiometer, via a normally closed relay contact, RL1/3.

Rotation of the "SHUTTLE" control provides variable speed movement of the tape in either direction. The operation of this control is extremely smooth, and allows inching of the tape to find a particular position. Relay contact RL3/6 (normally closed) opens during shuttling, and prevents relay RL1 or RL2 from becoming energized.

However, one can go directly from replay or record into shuttling, due to relay contact RL3/6 opening and cancelling any previous mode of operation.

3.4 REMOTE CONTROL

Remote control of record, replay, shuttling and stop is accomplished via the 5 pin Remote Control socket. In the record and replay function the remote press-button consists of simple, normally open, micro-switches which are placed in parallel with their internal counterparts. All relay operations are the same in remote control as in normal machine operation.

In the shuttling function the remote press button consists of a simple, normally open, micro-switch, which is placed in parallel with its internal counterpart. All relay operations are the same in remote control as in normal machine operation.

The stop button consists of a simple, normally closed, micro-switch, placed across pins 1 and 2 of the remote control socket, and simply replaces the link between these pins in the remote control dummy plug.

SECTION 4 — SERVICE AND MAINTENANCE

4.1 REMOVING FRONT PANEL (TRANSPORT)

To remove the front panel, the pressure roller will have to be removed from its spindle, and the tape lift arm button unscrewed. The panel is secured by four or six screws which will also have to be removed before the panel is free. (The number of securing screws will depend on the serial number of the machine.) When the panel is removed, the undermentioned components are accessible for inspection and adjustment:—

(a) Brake Drums, Brake Shoes and Tie Rods.
(b) Tape Over-run Switch and Actuating Arm.
(c) Timing Mechanism.
(d) Pressure Roller Arm, Tape Lift Arm, Edit Cam and Head Shield Opening Mechanism.

4.2 BRAKE SERVICING

Inefficient braking usually causes a prolonged period of tape travel after shuttling. In more serious instances, the tape may even "throw a loop" and become entangled around the spool. This fault could result from:—

(a) Oil on brake drums and brake shoes.
(b) Displacement of spooling motors.

NOTE.—Later models are fitted with a locating spigot, and trouble (b) should not be encountered.

Remedy (a).—Remove the brake shoes from their mounting pillar by lifting them away from the main deck casting where they may be detached from their return springs and removed. The brake drums may now be removed by loosening the set screws which lock them to the motor shaft. A 3/32" hexagonal key is used for this purpose, and each screw should be slackened off a few turns, to ensure complete clearance from its recess in the shaft.

If it is found that the brake drum cannot be withdrawn easily, two screwdrivers may be used as levers against the deck casting, using an even pressure 180° apart. Failure to observe this 180° placement could result in a bent motor shaft.

Clean all oil from the brake drums, brake shoes and deck casting with carbon-tetrachloride or similar cleaning fluid. Methylated spirits has been found successful. Acetone or lacquer thinners should be avoided, as they could possibly affect the adhesive which secures the brake lining to the shoe. An excessive amount of oil on the brake shoe may necessitate the replacement of the part.

On refitting, the brake drum must be set with its front face 1 1/32" from the front face of the motor (with motor shaft end play taken up on the ball at the rear of motor). A smear of light grease should be applied to the brake shoe bearing post, and the hole which engages the tie rod.

Remedy (b).—Where it is seen that the brake shoe is not seating correctly on the brake drum, or the brake drum is not positioned concentrically in its cut-out in the front cover panel, the four motor mounting screws should be released and the motor re-positioned correctly before re-tightening the mounting screws.

4.3 BRAKE ADJUSTMENT

When the brake solenoid is energized, the clearance between the heel of the shoe and the brake drum should be approximately .015". Adjustment of this clearance is made by bending the cranked section of the tie rod. If braking efficiency is poor and is not due to oiling up of the shoe and drum as described in Section 4.2 (a), then the direction of the braking system should be investigated. The supply motor should exhibit maximum braking in an anti-clockwise direction and the take-up motor in a clockwise direction.

The brake shoe mounting pillars are an eccentric bush type mounting so allowing the shoes to be set correctly against their brake drum to give the above desired properties.

4.4 UNRELIABILITY OR NON-RELEASE OF BRAKES

Apart from electrical faults, this trouble is usually due to the brake actuating solenoid being either overloaded or the armature assembly out of adjustment. Causes of this are:—

(a) Brake shoes opening too far, i.e., more than .015".
(b) Excessive friction in the solenoid bearings or in the linkages.
(c) The solenoid armature not sitting flat on its yoke.

4.5 TAPE OVER-RUN SWITCH

The tape over-run switch assembly consists of the following components:—

(a) Over-run switch actuating arm with in-built tape guide pin.
(b) Switch actuating link.
(c) Micro-switch.
(d) Tension spring.

The tension spring should be set with just sufficient tension to operate the micro-switch. If the actuating arm seems sluggish, it should be removed and its bearing thoroughly cleaned. To get to this point it will be necessary to remove the speed change knob, the circlip retaining the stabilising roller, and the roller itself. When removing the roller and the actuating arm take note of any shim washers in the system, so that they can be replaced correctly on re-assembly.

4.6 MALADJUSTMENT OF PRESSURE ROLLER AND ASSOCIATED MOVEMENTS

The tension of the pressure roller against the capstan is very important, as any discrepancies will result in high flutter and wow. Pressure roller tension can be readily checked in the following manner by means of a suspendable type spring balance with a full scale reading of approximately 8 lbs.

(a) With a reel of tape almost fully spooled on to the take-up spool (approximately 30 to 40 turns should remain on the supply reel), remove the pressure roller cover disc and replace the pressure roller retaining screw.

NOTE.—It will be necessary to fit a 3/16" washer under the screw when the cover disc is not present, otherwise the pressure roller will run off the spindle over the retaining screw head.

(b) Loop a short length of cord over the end of the screw and attach the spring balance.

(c) Pull on the spring balance so that the cord lies over the take-up brake drum and parallel with the top edge of the deck casting.

(d) Start the machine — preferably in the "PLAY" mode.

(e) A reading of 4½ to 5 lbs. should be reached before the pressure roller tension is reduced to the point where the tape motion becomes irregular. If the pressure roller tension is low, or high, suitable adjustment normally can be made by moving the two lock nuts which operate against the spring on the link coupling the solenoid arm to the pressure roller arm.

(f) If after this adjustment has been made the machine still shows varying pressure roller tensions, the armature in the driving solenoid should be checked, to ensure that it is sitting correctly on its yoke. If this condition is not the case, suitable adjustment should be made to the three self-locking nuts located on the armature assembly. After this adjustment has been made it will be necessary to repeat Section (e).

4.7 PRESSURE ROLLER CLEANING

Drive of tape through the machine can be affected by a dirty or greasy pressure roller surface. A brush is useful for removing dust particles, but oil, grease or wax must be removed with the aid of a cleaning fluid, preferably carbon-tetrachloride. This should be applied sparingly, using a moistened cloth. After cleaning, correct drive surface is obtained by applying a fine film of powdered graphite evenly over the pressure roller driving surface.

4.8 PRESSURE ROLLER LUBRICATION

The pressure and stabilising rollers are both fitted with self-lubricating bearings and require no attention in this respect.

4.9 MOTORS

Normally the three motors of the Tape Transport Mechanism require no attention, as the bearings are of phosphor-bronze with an oil pad reservoir. However, should unforeseen circumstances necessitate the removal of a motor from the transport, sequences as laid down in Sections 4.10, 4.11, 4.12 and 4.13 should be observed.

4.10 CAPSTAN MOTOR REMOVAL

(a) Unplug the unit from the mains supply.

(b) Unplug the "head" outlet cables and amplifier interconnecting cable from the control box on the tape transport.

(c) Remove the tape transport from the case by releasing the four socket head screws (two at each end on the front of the transport).

(d) Place the transport upside down on a bench or table with the rear of the unit facing the operator.

(e) Remove the eight screws securing the cover on the control box. Remove the control box cover.

(f) Disconnect the six motor leads which terminate on a strip which is located on the rear of the speed change switch.

(g) Unscrew the four motor mounting studs and remove the motor by withdrawing it straight back until the capstan shaft is completely clear of the main deck.

(h) Note the position of the motor in relation to the deck, because during assembly it has been placed in a position to ensure minimum inductive noise.

4.11 CAPSTAN MOTOR RE-FITTING

In re-fitting the capstan motor, the foregoing procedure is reversed. The utmost care should be taken to ensure that the capstan does not at any time foul the main deck casting or the pressure roller assembly.

4.12 SPOOLING MOTOR REMOVAL

(a) Unplug the unit from the mains supply.

(b) Unplug the "head" outlet cables and amplifier interconnecting cable from the control box on the tape transport.

(c) Remove the tape transport from the case by releasing the four socket head screws (two at each end on the front of the transport).

(d) Remove the front cover panel (follow procedure as in Section 4.1).

(e) Place the transport upside down on a bench or table with the rear of the unit facing the operator.

(f) Remove the eight screws securing the cover on the control box and remove the control box cover.

(g) Disconnect the four motor leads which terminate on a strip located at either end of the control box near the rear edge.

(h) Release brake tension spring.

(i) Unscrew the four motor mounting studs and remove the motor by withdrawing it straight back until the brake drum is completely clear of the main deck.

(j) Remove the brake drum by slackening its grub-screw sufficiently to clear the locating flat on the motor shaft. A hex key will be necessary for the operation.

4.13 SPOOLING MOTOR RE-FITTING

In re-fitting the spooling motor the foregoing procedure is reversed. The brake drum must be set to its correct height as described in Section 4.2 and the braking operation checked.

4.14 HEAD ASSEMBLY

The complete head assembly may be removed from the transport by:—

(a) Removing the speed/change switch knob, using a hex key.
(b) Removing the stabilising roller, using circlip pliers.
(c) Removing the four screws which secure the head mounting bracket.
(d) Unsoldering head leads.

4.15 INDIVIDUAL HEAD REPLACEMENT

Any of the three heads may be changed separately by:—

(a) Unsoldering leads to the appropriate head.
(b) Unscrewing the self-locking retaining nut.
(c) Releasing the azimuth screw.
(d) Rotating the head back and forth, drawing it away from its mounting bracket, so removing the head completely from its mounting.

If the old head is to be lapped and refitted, any associated shims, etc., should be replaced. If a new head is to be fitted some care should be taken to ensure that the head is free enough for azimuth adjustment without a large amount of tension needing to be applied. If tension is too great slacken the head securing nut.

4.16 CLEANING THE HEADS

Dust and ferrous powder is best removed by a stiff bristle brush. Where large accumulations occur they are usually caused by the particles adhering to smears of adhesive from cellulose tape. For this reason it is not a good policy to use other than the correct splicing tape when making joints.

Accumulations not readily removable by brushing can usually be cleared by the use of Acetone, lacquer thinners, or similar solvents on a piece of clean rag or absorbent cotton. Solvents of this nature should be used very sparingly and never in the vicinity of a naked flame or spark of any nature.

4.17 ADJUSTING TAPE GUIDES

The tape guides position should be adjusted so that a new reel of good quality tape will run through the guides without rubbing on either wall of the guide.

4.18 ADJUSTING EDIT CAM ASSEMBLY

If it becomes necessary to adjust the position of the pressure roller assembly when the edit cam is engaged it will be necessary to:—

(a) Remove the front cover panel as detailed in Section 4.1.
(b) Rotate the edit cam fully anti-clockwise.
(c) Release the locking nut on the adjustable stop which is located on the side pressure roller arm casting.
(d) Reset the stop by screwing it in or out to the desired position.
(e) Re-lock the stop securing nut.

4.19 REPLACING INDICATOR LAMPS

It will be necessary to firstly remove the machine front cover panel as set out in Section 4.1, then remove the appropriate press button assembly by removing the inner two retaining screws (do not remove the third outer screw). Replace the faulty lamp. In some units standard No. 2-6V wedge lamps are used, but in current units an equivalently rated miniature wedge lamp is used.

4.20 CLEANING STABILISING ROLLER

Build up of dirt or grease on the stabilising roller will affect the machine flutter and wow. Any foreign matter should be removed with a cloth moistened with carbon-tetrachloride. The fluid should be applied sparingly to the rubber section of the roller.

4.21 INSPECTING AND CLEANING RELAY CONTACTS

Remove the tape transport from its carry case by releasing the four socket head screws, two located at each end of the transport. By placing the unit upside down, with the rear face of the machine facing the operator, an inspection cover which will allow access to the relay contacts will be located on the right hand end of the control box assembly. By removing the two inspection plate retaining screws the cover may be removed. After inspecting the contact tension any dirty contacts may be cleaned by using a fine grade abrasive cloth such as Crocus cloth. By passing this between the dirty contacts several times any burn or pit marks should have been removed.

4.22 ADJUSTING HEAD SHIELDS

If at any time the head shields move, due to continuous operation, or an accidental knock, it will be necessary to reposition them. To make the adjustment it will be necessary to:—

(a) Remove the front cover panel as detailed in Section 4.1.
(b) Slacken the head shield or shields retaining screw or screws which are located adjacent to the head shield assembly hinges.
(c) Reposition the head shield so that it is concentric with the matching head cams. When this adjustment is satisfactory re-lock the head shield retaining screws. A hex key will be necessary for these adjustments.

4.23 PROCEDURE TO BE FOLLOWED AFTER REPLACING OSCILLATOR VALVE

(a) Simultaneously tune both the oscillator coil and bias trap for maximum bias reading on the internal meter.

(b) Adjust "NOISE-BALANCE" control to minimum bias reading on the internal meter.

(c) Adjust "Bias ADJ" control as detailed in paragraph 4.28.

(d) Place a reel of tape on the machine.

(e) Switch machine to "HIGH SPEED."

(f) Press "RECORD" button.

(g) Set A-B Monitor control to maximum "PLAY" gain.

(h) On listening tests set "NOISE BALANCE" control to minimum noise. (This should require only a minor adjustment to the "NOISE BALANCE" control.)

(i) Re-check bias setting.

4.24 PROCEDURE TO BE FOLLOWED AFTER REPLACING VALVES IN AMPLIFIER

Check the new valve current by means of the "METERING" control. If the replaced valve is in the replay pre-amplifier a noise check should be carried out on the channel by:—

(a) Placing an A.F. voltmeter across the "600 OHMS" OUTPUT (if this meter is of the high input impedance type an external 600 ohm load must be placed across the line output).

(b) Setting the "REPLAY GAIN" control to maximum.

(c) Setting the "METER/600 OHM" switch to "PLAY".

(d) The replay head plug should be withdrawn from its socket on the transport and a shorting link placed on the plug.

(e) The noise output reading under these conditions should not exceed —25 dbm.

(f) If the noise is greater than this level it may be necessary to select a valve (due to the usage of four EF86's in the record and replay pre-amplifiers a transplant of these valves would be in order before additional new valves are tried).

Apart from noise problems arising on replacing valves in the play pre-amplifier, any change of valves in the play or record channels, also in the 600 ohm line amplifier, will necessitate checking of frequency responses as described in Section 4.30.

4.25 REPLACING RECORD OR REPLAY GAIN CONTROLS

In standard production units the replay and record gain controls are standard 100K ohm C curve carbon potentiometers. In special units which are made to order 100K ohm stepped attenuators are used and should require cleaning only if they become noisy. When it becomes necessary to replace or clean the "REPLAY GAIN" control the amplifier assembly will have to be removed from the carrying case by releasing the four socket head securing screws, two of which are located at each end of the amplifier front panel.

When it becomes necessary to replace or clean the "RECORD GAIN" control the amplifier assembly will have to be removed from the carrying case as above, the amplifier bottom cover panel will also have to be taken off by releasing its four securing screws.

4.26 REPLACING A.C. MAINS OR D.C. H.T. FUSES

All fuses on the unit are cartridge types. The two 3 amp rating A.C. mains fuses are located at the rear of the machine on the top face of the control box assembly.

The D.C. 250 MA high tension fuse is located on the front panel of the amplifier assembly at the right hand end of the panel.

4.27 RE-SETTING CALIBRATION OF LEVEL METER IN V.U. POSITION

An internal pre-set potentiometer is provided for setting the V.U. Meter reading to standard. To gain access to this control the amplifier assembly will have to be removed from the carrying case by releasing the four socket head securing screws, two of which are located at each end of the amplifier front panel. Also the amplifier bottom cover panel will have to be removed by releasing its four securing screws. The pre-set potentiometer, RV7, is located at the right hand end of the amplifier. By connecting an external standard level meter across the "600 OHM OUTPUT" from the amplifier, and feeding a suitable 1 Kc/s signal into the record channel, adjust the record gain control to give a +8 dbm reading on the standard level meter. (If a high input impedance level meter is used an external 600 ohm load must be placed across its input.) Adjust the internal pre-set control to give zero V.U. reading on the internal meter.

4.28 ADJUSTING BIAS

The following procedure should be followed when:—

(a) Using tape other than that for which the machine was set up at the factory.

(b) After any components have been changed in the erase or bias sections of the circuit the adjustment procedure is as follows:—

(i) Set the "METER/600 OHM" switch to "RECORD" and feed a 400 c.p.s. signal from an oscillator to the input of the Record amplifier. Adjust the "RECORD GAIN" control to give a reading of —7 V.U. on the panel meter.

(ii) Start the machine recording at a speed of 7½ i.p.s. on the selected tape. Switch the V.U. meter to "PLAY" and set the "REPLAY GAIN" control to approximately 25 on its scale. Next, turn the "BIAS" control on the control box to its maximum anti-clockwise position. Then slowly turn the "BIAS" control clockwise until peak output is indicated on the V.U. meter. If the peak output is higher than the full scale deflection of the V.U. meter reduce the replay level by means of the "REPLAY GAIN" control. The setting which gives peak output is the correct one for the particular tape being used.

4.29 ADJUSTING BIAS TRAP

Set "METERING" switch to the "BIAS" position. Set the machine in the "RECORD" mode of operation. Tune the bias trap to give maximum reading on the meter.

4.30 SETTING OF REPLAY AND RECORD EQUALISATION

The replay frequency response must first be checked before any adjustments are carried on the record frequency response.

Replay Equalisation

To set the replay equalisation the following items will be necessary:—

A 7½ i.p.s. Standard C.C.I.R. Replay Test Tape and a 15 i.p.s. Standard C.C.I.R. Replay Test Tape.

(a) Place the 7½ i.p.s. test tape on the machine.

(b) Set the machine speed to 7½ i.p.s. and start it in the "PLAY" mode.

(c) Using the azimuth track which is provided on the test tape, align the replay head for maximum output on the internal V.U. meter which has been switched to monitor the play channel by setting the "METER/600 OHM" control to "PLAY".

(d) Using the 1 Kc/s reference tone on the tape, set the "REPLAY GAIN" control to obtain zero V.U. reading on the internal meter.

(e) Tabulate the levels against each tone of the test tape.

(f) Using the 7½ i.p.s. "SET" control located on the rear face of the amplifier and accessible through the carrying case, adjust to compensate for any departure from the desired response at the high frequency end.

(g) Place the 15 i.p.s. test tape on the machine.

(h) Set the machine speed to 15 i.p.s. and start it in "PLAY" mode.

(i) Carry out further adjustments as detailed in (c), (d), (e) and (f) of this section, reading 15 i.p.s. where 7½ i.p.s. is stated.

Record Equalisation

To set the Record equalisation the following will be necessary: An Audio Oscillator with suitable leads for its connection to the machine, a reel of tape.

(a) Place the reel of tape on the machine.

(b) Set the machine speed to 7½ i.p.s. and start it in the "RECORD" mode.

(c) Connect the oscillator to the record channel input.

(d) Set the oscillator to 15 Kc/s.

(e) Set the "RECORD GAIN" control to give —7 V.U. Record level.

(f) Azimuth the record head by placing the "METER/600 OHM" switch to the "PLAY" position and adjusting the "REPLAY GAIN" control to give zero V.U. reading.

(g) Set the record head for maximum replay output level.

(h) By keeping the record level at —7 V.U. at all input frequencies and setting the "REPLAY GAIN" to give zero V.U. replay level at 1 Kc/s overall frequency responses can be obtained.

(i) Check the overall frequency response against the machine specification. If any discrepancy exists at the high frequency end of the response it may be corrected by adjusting the pre-set trimmer, CT1.

(j) If any adjustment was necessary to CT1, the CT3 line amplifier response setting pre-set trimmer will have to be re-adjusted. This trimmer should be set to give a flat response between 30 c/s and 18 Kc/s from the record amplifier input to the 600 ohm line amplifier output (checks being made using the internal V.U. meter).

4.31 SETTING RECORD LEVEL

To set the record level the following will be necessary:—

An Audio Oscillator.

An Audio Distortion Meter with suitable interconnecting leads.

A reel of the tape for which the record level is to be changed.

(a) Place the reel of tape on the machine.

(b) Set the machine speed to 7½ i.p.s. and start it in the "RECORD" mode.

(c) Connect the oscillator to the "600 OHM/ INPUT".

(d) Set the oscillator to 1 Kc/s. Set the "METER/ 600 OHM" switch to "RECORD".

(e) Set the "RECORD GAIN" control to give a zero V.U. record level reading on the internal meter.

(f) Set the "METER/600 OHM" switch to the "PLAY" position.

(g) Set the "REPLAY GAIN" control to give zero replay level reading on the internal meter.

(h) Set the distortion meter to read 3rd harmonic distortion. (Output obtained from the 600 ohm line.)

(i) Increase the record level by means of the pre-set "RECORD LEVEL" control on the rear of the amplifier. If the unit is in its carrying case access to this control can be gained through the rear of the case.

(j) As the record level is increased it will be necessary to adjust the "REPLAY GAIN" control to give zero V.U. level at the new record level.

(k) Set the "RECORD LEVEL" pre-set control to obtain 2% distortion. At this point the replay level on the internal meter will be zero V.U. if step (j) has been carried out correctly.

(l) Now that the 2% distortion reference point has been obtained it is necessary to re-set the record level to a lower level, normally 10 db below the 2% distortion point. By making this adjustment with the internal meter showing the replay level, the desired level below the 2% distortion point can be set by adjusting the record level pre-set control to give —6 or —10 db reading on the internal V.U. meter.

SECTION 5 — AZIMUTH ADJUSTMENT

5.1 EQUIPMENT REQUIRED

(a) An Azimuth Alignment Tape.

(b) An Audio Oscillator with suitable interconnecting leads.

5.2 ADJUSTMENT PROCEDURE

Replay

(a) Place the azimuth alignment tape on the machine.

(b) Set the machine to the appropriate speed and start it in the "REPLAY" mode.

(c) Set the "METER/600 OHM" switch to "PLAY".

(d) Adjust the "REPLAY GAIN" control to give zero V.U. reading on the internal meter.

(e) Remove the head cover by releasing its two securing screws.

(f) With a small screwdriver adjust the azimuth screw of the replay head for peak meter reading.

Record

(a) Place a reel of tape on the machine.

(b) Set the machine to the appropriate speed and start it in the "RECORD" mode.

(c) Connect the audio oscillator to the record channel input.

(d) Set the "METER/600 OHM" switch to "RECORD".

(e) Set the audio oscillator to 15 Kc/s.

(f) Set the "RECORD GAIN" control to give a —7 V.U. meter reading.

(g) Set the "METER/600 OHM" switch to "PLAY".

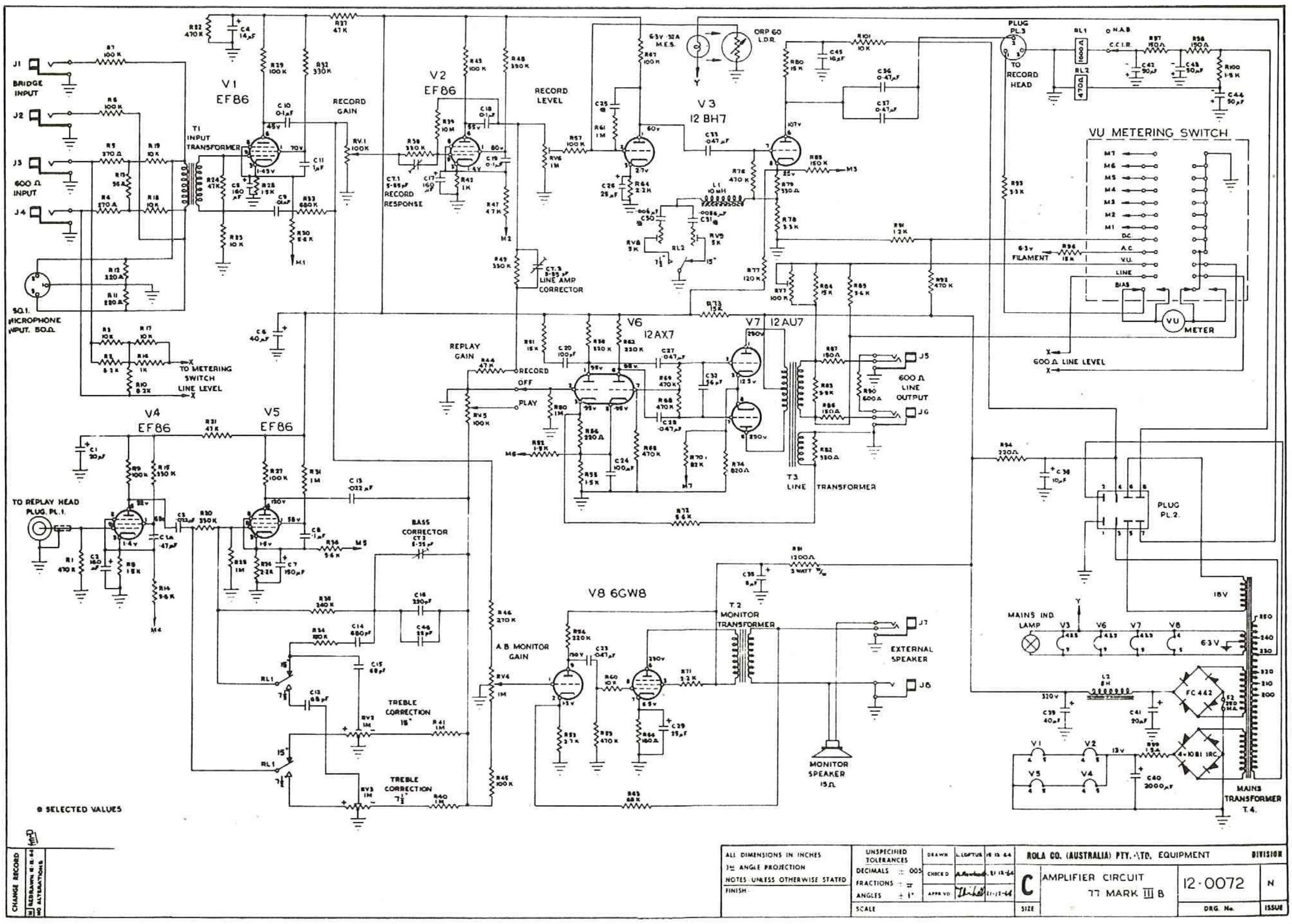
(h) Set the "REPLAY GAIN" control to give a zero V.U. meter reading.

(i) With a small screwdriver adjust the azimuth screw of the Record head for peak meter reading.

SECTION 6—TROUBLE-SHOOTING CHART

TROUBLE	POSSIBLE FAULT	REMEDY
"WOW" — the term applied to undesirable frequency deviations occurring at frequencies below 10 to 20 c.p.s.	Binding in Supply Motor.	Check bearings and securing screws.
	Brake shoe not clearing brake drum on Supply Motor.	See "Brake Servicing", Section 4.2.
	Oil on Capstan.	Clean with industrial solvent.
Wow on beginning or end of tape.	Low pressure roller tension.	Adjust as described under heading "Maladjustment of Pressure Roller and Associated Movements."
	Dirty or worn pressure roller.	Clean or replace as necessary.
"FLUTTER" — same as described under "wow" but above 20 c.p.s.		
High flutter.	Generally faulty Capstan Motor.	Return to factory for repair.
NON-OPERATION.		
Complete failure of unit.	Blown fuse on Control Box.	Replace fuse. If replacement fuse also blows, check for "shorts" inside control box and between Mains transformer and Plug PL2 on amplifier. See Section 4.21.
Amplifier only operating.	Dirty or maladjusted contacts.	Inspect and clean relay contacts.
	Faulty solenoid coil.	Replace with new unit.
	Faulty doubler condenser or reservoir condenser (C11, C12, or C20) on Circuit 12-0073.	Replace with new unit.
Deck only operating.	Blown fuse on front of amplifier.	Replace fuse. If replacement fuse fails, check for "shorts" in amplifier H.T. circuits.
Records but does not Play.	Faulty 12AX7 or 12AU7 valve or associated component.	Replace and check circuit voltages.
Plays but does not Record.	Oscillator not functioning.	
	"Play Safe" switch is set to "Safe" or broken lead at switch.	Turn key to "Record" or repair broken lead.
	Faulty 12BH7.	Replace and check circuit voltages.
	Faulty coil.	Replace with new unit.
	Relevant relay contact on RL2 not completing H.T. circuit to oscillator.	Clean and adjust. If necessary replace with new relay.
	Faulty components in oscillator circuit.	Replace and check circuit voltages.
	Faulty Record head or head wiring.	Replace and check circuit voltages.
	Faulty valve (12BH7) in amplifier.	Replace and check circuit voltages.
	Faulty components in 12BH7 circuit.	Replace and check circuit voltages.
Does not Erase.		
Complete non-erasure.	Faulty components in oscillator.	Replace valve or other faulty component and check circuit voltages.
	Faulty erase head.	Replace with new unit.
	Faulty series capacitor (C18).	Replace with new unit.

TROUBLE	POSSIBLE FAULT	REMEDY
Partial Erasure.	Oscillator component or valve failure (12BH7) on control box.	Replace faulty unit and check voltages.
	Faulty erase head.	Replace with new unit.
	Faulty series capacitor (C18).	Replace with new unit.
	Imperfect tape contact.	Clean head of oxide deposits.
Tape Over-run Switch.		
Does not operate.	Mechanical.	Check linkage to micro-switch. See Section 4.5.
	Electrical.	Check micro-switch.
Operates too readily.	Return spring tension too heavy.	Slacken off and if necessary reduce operation pressure on micro-switch.
	Supply motor torque too low.	Check that motor runs freely in its bearings.
Tape wraps round pressure roller when machine is started.	Brake solenoid not operating.	Unreliable or non-release of brakes. See Section 4.2.
	Dirty or maladjusted contacts on Relays RL1 to RL4.	Clean and adjust contacts.
	Faulty take-up motor.	Replace with new unit.
Inadequate pressure roller tension on Capstan.	Tape lift arm sticking.	Remove and clean.
	Slackness in mechanical linkages.	Readjust or replace faulty component.
	Solenoid frame has rotated slightly.	Reposition and lock in place.
	Armature fixing screws loosened.	Tighten screws and lock them.
	Capstan motor bearing housings have slackened, allowing Capstan to move sideways.	Return motor to factory for repair.
	Dirty pressure roller or Capstan.	Clean unit with carbon-tetrachloride.
	Worn pressure roller.	Replace with new unit.
Does not play L.P. tapes.	Worn pressure roller.	Replace with new unit.


J1 BRIDGE INPUT
J2
J3 600 Ω INPUT
J4
SO.1. MICROPHONE INPUT. 50Ω.
T1 INPUT TRANSFORMER
V1 EF86
RECORD GAIN
V2 EF86
RECORD LEVEL
CT.1 RECORD RESPONSE
CT.5 LINE AMP CORRECTOR
V3 12 BH7
ORP 60 L.D.R.
PLUG PL.3
TO RECORD HEAD
VU METERING SWITCH
VU METER
600 Ω LINE LEVEL
TO METERING SWITCH LINE LEVEL
REPLAY GAIN
RECORD
OFF
PLAY
V6 12AX7
V7 12AU7
600 Ω LINE OUTPUT
T3 LINE TRANSFORMER
V4 EF86
V5 EF86
TO REPLAY HEAD PLUG PL.1.
BASS CORRECTOR
TREBLE CORRECTION
V8 6GW8
A.B. MONITOR GAIN
T2 MONITOR TRANSFORMER
EXTERNAL SPEAKER
MONITOR SPEAKER 15Ω
PLUG PL.2.
MAINS IND. LAMP
MAINS TRANSFORMER T.4.
⊗ SELECTED VALUES
ALL DIMENSIONS IN INCHES
NOTES: UNLESS OTHERWISE STATED
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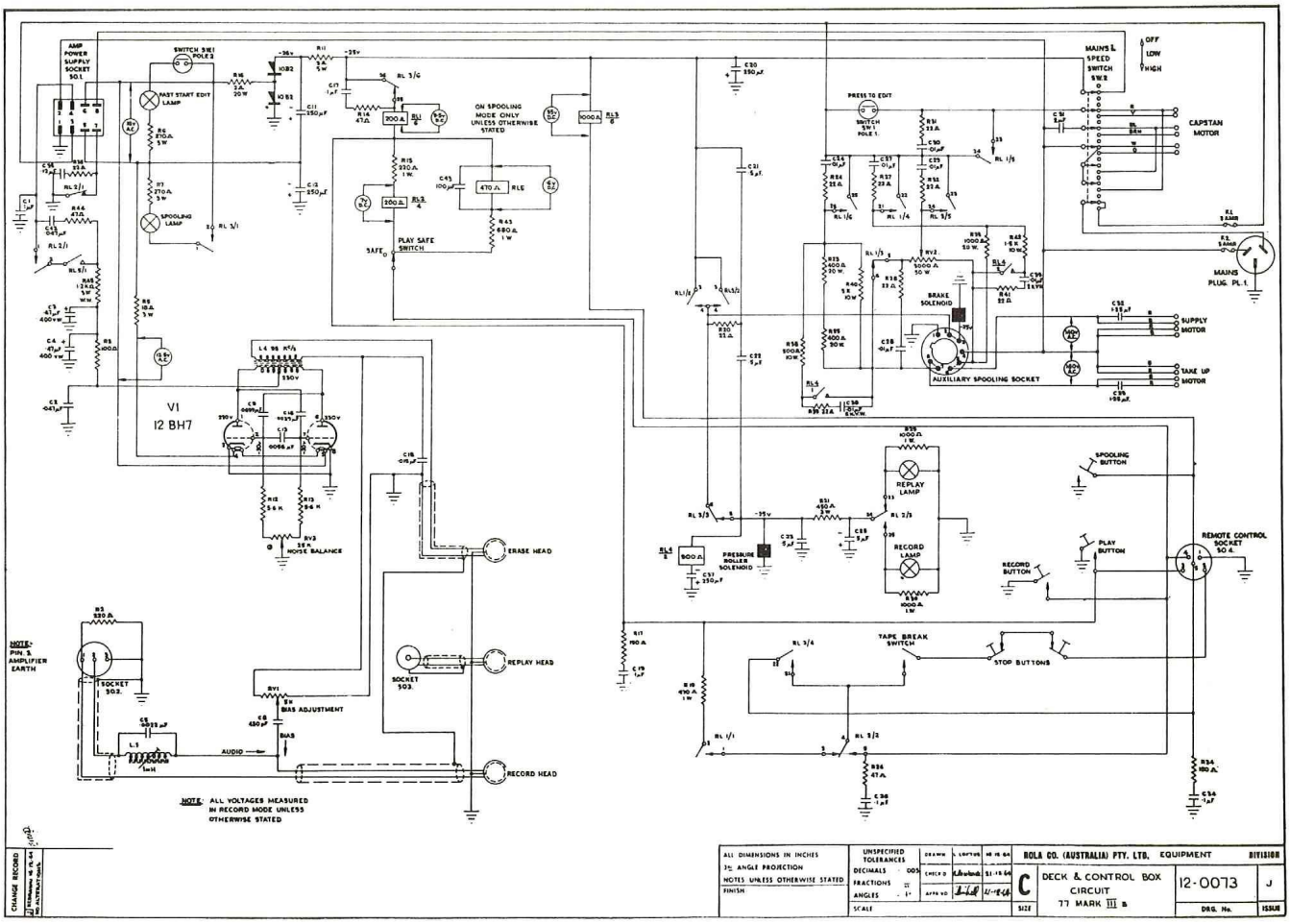

ALL DIMENSIONS IN INCHES 3rd ANGLE PROJECTION NOTES UNLESS OTHERWISE STATED FINISH	UNSPECIFIED TOLERANCES DECIMALS .005 FRACTIONS ± ANGLES 1°	DRAWN L. LOFTUS 16.10.64 CHECKED 21.10.64 APPROVED 4-11-64	SCALE	SIZE C	ROLA CO. (AUSTRALIA) PTY. LTD. EQUIPMENT DIVISION DECK & CONTROL BOX CIRCUIT 77 MARK III B DRG. No. 12-0073 ISSUE J

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J ALTERATIONS 16.10.64
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