# TAPE RECORDING

Service Manual

## magnetophon M 10 A

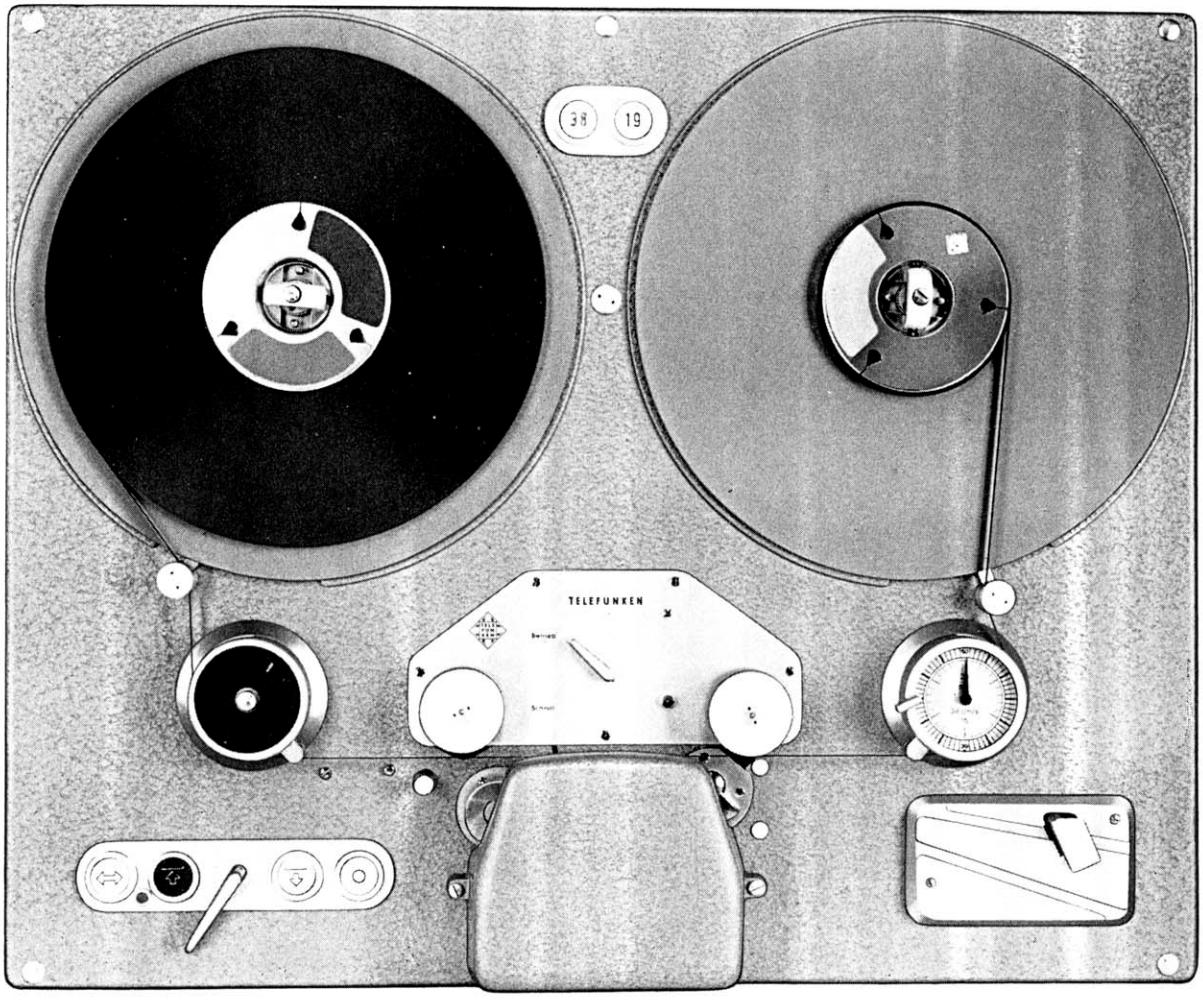


TABLE OF CONTENTS

# 1. GENERAL

These service instructions are valid for the following types of design:

$\frac{1}{4}$ inch, emulsion inside or outside;
$\frac{1}{2}$ inch, emulsion inside;
and 1 inch, emulsion inside.

## 1.1. Spare parts

Spare parts can be ordered with the help of the spare parts list M 10 A.

All ball and sintered bearings must be stored under dust-protection until fitted and should not be allowed to come into contact with absorbent material.

## 1.2. Special tools

For maintenance and adjustment, a box of tools with the following contents can be supplied against special order:

| | |
|---|---|
| Spring force meter up to 0.2 kg | 9098-1B |
| Spring force meter up to 1 kg | 9098-2A |
| Spring force meter up to 5 kg | 9098-2B |
| Tape tension meter up to 1 kg | Sk 58-30.030-00 |
| Contact spring balance up to 100 g | |
| Demagnetising choke | 9001 |
| Measuring jack 100 mm | 3086 |
| Screwdriver 150 x 8 mm | |
| Screwdriver 100 x 4.5 mm | |
| Screwdriver 75 x 3 mm | |
| Fork spanner | Sk 58-30.000-02 |
| Fork spanner | Sk 58-30.000-03 |
| Double ring spanner 5 x 5.5 mm, cranked | |
| Twin-lock socket screw wrench | 12.101.00 |
| Fixed spanner 4 x 6 mm | |
| Fixed spanner 5 x 5 mm | |
| Fixed spanner 14 mm | |
| Hexagonal spanner 5.5 mm | |
| Box spanner inserts 5.5; 7; 9; 10; 14 | |
| Angle grip with joint | |
| Allen keys 1.5; 2; 2.5; 3; 4; 5; 6 | |
| Two-pin disc | Sk 58-30.010-00 |
| Head-adjusting tool | Sk 58-30.015-00 |
| Head-adjusting tool | Sk 58-30.020-00 |
| Feeler gauge | |
| Setting pin | Sk 58-30.000.04 |
| Economic lubricator | |
| Hexagonal box spanner 5.5 x 6 | |

Each tool can be supplied as an individual accessory. A universal tape tension meter No. 58. 4003. 000-00 for tape widths up to 1 inch is available, which together with the holder 58. 4003. 200-00 can be threaded in the fixing holes for the head-assembly. The tension meter can also be used without hands and without holder for the tape tensions before the filter spindle and behind the capstan.

It is advisable to use only expanding ring spanners with stop.

1. 3.
Packing

For storage and despatch, polythene bags are recommended as dust and rust protection because these can be welded airtight. For reducing the moisture within the bag, a packet containing silica gel may be introduced into it.

# TECHNICAL DATA

| | | | |
|---|---|---|---|
| Drive: | Three-motor tape transport with a pole-changing synchronous motor (external rotor) and two special reel motors | | |
| Tape velocity: | 38.1 and 19.05 cm/sec. (15 ips and 7½ ips) | | |
| Wow and flutter: | ≦ 0.08% at 38 cm/s ) measured with EMT 420, ) weighted in accordance ≦ 0.12% at 19 cm/s ) with DIN 45507 | | |
| Slip: | ≦ 0.2% | | |
| Tape width: | ¼" | ½" | 1" |
| Tape length: | 1000 m (3300 ft) | 750 m (2475 ft) | 500 m normal tape (1650 ft) |
| Coated side: | outside or inside | inside | inside |
| Spool mounting: | hub as per DIN 45515 with 100 mm diameter (with turntable for self-supporting tape packs) or spool according to DIN 45515 with 60 mm core diameter | | only in case of ¼ inch model |
| | or | | |
| | spool or hub as per NAB with 144 mm core diameter (with adapter and turntable) | | |
| Mechanical run-up time: | approximately 0.2 sec. | | |
| Starting time: | ≦ 1 second up to reaching the permissible wow and flutter | | |
| Rewind time | ≦ 2.5 minutes for 100 m tape ¼ inch<br>≦ 2 minutes for 750 m tape ½ inch<br>≦ 1.5 minutes for 500 m tape 1 inch | | |
| Stopping time: | ≦ 4 seconds | | from the fastest rewind |
| Stopping time with counter drive applied: | ≦ 1.7 seconds | | |
| Stopping time on reaching the tape end: | ≦ 2 seconds | | |
| Tape tension peak: | ≦ 750 grams force (¼ inch) | | |

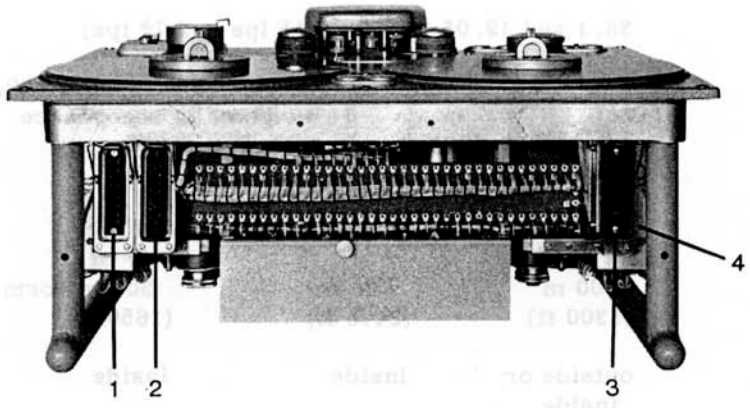



Fig. 1 Connections to the tape transport

# 3. SETTING UP

For setting up, the matching plug with the necessary bridges (see 3. 1) is to be inserted into the socket strip (Fig. 1 item 2).

The tumbler switches S12 and S13 on the reel motors must point towards the outside.

While assembling the tape transport, care is to be taken to see that no extraneous items such as tools etc. remain under the equipment. The lower soldering-tag strips will otherwise be damaged.

## 3. 1. Electrical connections

On the complete installation all connections are labelled and are mounted either on the front or back, depending on the type or model.

On the tape transport, item 1 represents the connection for the mains cable (16-pole Tuchel socket strip)
item 2 represents the connection for remote control (30-pole Tuchel socket strip) and
item 3 the head cable connection (16-pole Tuchel socket strip).

For the head connections on $\frac{1}{2}$ inch and 1 inch models, instead of a Tuchel socket strip item 3 there is one on the left-hand side of the tape transport (Item 4). 6-track units have a second socket strip in this position for tracks 5 and 6.

For direct operation, i. e., without the remote control device, brigde a2-c9 in socket item 2.
For operation without the control pedal for the right reel motor, bridge a4-b3 in the plug matching the socket item 2.

When operating without the synchronizing equipment R 91 T, each of the contact pairs c1 to c4, c2 to c3 and c5 to c6 must have a bridge, if these tape transports are prepared for operation with picture-synchronised sound (See 4. 1).

If a light indication is to occur in the speed-selector switches S7 and S8 - during operation without recording and playback amplifiers - the socket corresponding to the plug St1 must contain a bridge each from contacts 5a to 8b, and 6a to 8a.

3. 2.
Spool types and tape tension switch

Spools with the same hub diameter are to be used on both sides. This is necessary for trouble-free operation and for reaching the rated values.

The following spool types are permissible:

hub as per DIN 45515;
hub with flanges as per DIN 45514 for $\frac{1}{4}$ inch models;
hub with Order No. SV 230. 00. 00-07 for $\frac{1}{2}$ inch models and
hub with Order No. SV 260. 00. 00-07 for 1 inch models.

In the case of $\frac{1}{4}$ inch models with hub diameters up to 60 mm, the tape tension switch S9 should be in the position marked ⅄, with core diameters greater than 60 mm it should be in the position marked ⊸.

The MAGNETOPHON M 10 A is a professional unit for continuous service, incorporating all the features of present-day technology. It is designed especially with a view to operation in broadcasting stations and large recording studios. The transport features a three-motor drive, i. e. a reversible 6/12-pole hysteresis synchronous motor with external rotor as the recording motor and 2 reel motors, which have the torque characteristics of a combination of squirrel cage and wound rotor motor and therefore meet the particular requirements without any torque fluctuations. The capstan moving the tape is direct driven. A filter arrangement with an additional pressure roller, mounted before the point where the tape enters the head assembly, reduces wow and flutter to a minimum.

Balancing levers on the left and right absorb tape tension variations and peaks and moreover prevent the dropping of individual turns on stopping. The left-hand balancing lever is combined with a tape end-of-run switch, which produces rapid braking on tape run-out and thus avoids damage to the end of the tape. A tape clock with scale in minutes and seconds indicates the running time and makes it possible to maintain operating times exactly.

The right-hand balancing lever is also coupled to a switch, which actuates a braking magnet under the tape clock on reaching the end of the tape or if the tape tears, so that the clock is immediately stopped.

On the $\frac{1}{4}$ inch models stroboscope markings for 38 cm/sec. and 19 cm/sec. can be seen in the left-hand roller cap through a plexiglass disc, the stroboscope scale being illuminated by a lamp inside the roller during recording or playback.

In order to maintain constant tape tensions during rewinding, the left-hand roller underneath the base plate is equipped with an eddy current brake with permanent magnet.

Changing over the tape speed and the control of the play-back - record - rewind - stop operations is effected by push-buttons via relays. In each button there is an acknowledging lamp. The tape speed lamp is switched via the relays in the amplifiers. In this way it is immediately checked that the equalisation of the amplifiers agrees with the selected tape speed.

In addition to the rewind button there is a rewind or editing lever, by means of which it is possible to rewind the tape forward or backwards at various speeds.

The relay control of the tape transport facilitates genuine remote control. For this purpose all the contacts of the operating buttons can be actuated via the multipoint connector from a remote control desk.

During recording and playback the tape is held against the head by the two rubber pressure rollers.

During rewinding the tape is kept away from the head assembly, in order to safeguard the heads.

In the stop or rewind positions the tape can be laid on the playback head by means of a lever in front of the head assembly in order to locate particular points. A marking device, which can be mounted as an accessory in front of the playback head on $\frac{1}{4}$ inch models, makes it possible to mark the cutting point exactly on the reverse side of the tape. Cutting and splicing the tape is facilitated by the template on the tape deck, the marked position being drawn forward to the tape cutters. There is also a connection for a pedal, which makes it possible to switch off the right-hand reel motor during cutting.

A running time meter is fitted under the tape deck to indicate the running time of the capstan motor

4. 1.
Connection terminals
(see Fig. 1)

The mains connection is to the left-hand (seen from behind) multipoint connector (soldering tags 1a, 2a) in accordance with the circuit diagram. Mains current is thus applied simultaneously via the main switch, tape end-of-run switch and the mains fuses to the terminals 7a and 7b. The operating voltage for the recording amplifier is applied across the soldering tags 2b and 3b and the contact rs4 33-34. In stereo machines the second recording amplifier receives its operating voltage via the contact rs4 31-32. The connection is made to the soldering tags 4a and 4b. The amplifier relays for switching over the equalizer receive voltage via 5a and 5b at 38 cm/sec. The acknowledgment passes over 8a and 8b. If the transport is run without the amplifiers provided, the soldering tag pairs 5a, 8b and 6a, 8a must each be bridged for indicating the tape speed.

The remote control unit is connected to the socket strip (item 2). The wiring can be seen in the circuit diagram. The connection for the pedal (3b, 4a) is bridged on the plug. Even if the remote control is not used this plug must always remain in the socket strip, since otherwise the right-hand reel motor would not work. When working without the synchronizing unit R 91 T, c1 must be bridged to c4, c2 to c3, and c5 to c6. From model number 3147 a bridge must also be put across 2a and 9c.

The male multipoint connectors on the right-hand side (item 3 or item 4) serve for making the head connections.

4. 2.
Switches and push-buttons

The main switch is located together with the two main fuses (T1. 6A) on a small panel on the front of the tape transport, left-hand side. On closing the main switch, the relay Rs2 receives closed circuit current via the 24 v rectifier Gr1. If the amplifiers are connected or the contacts indicated under 4.1 bridged (5a, 8b and 6a, 8a), one of the two push-buttons for the choice of tape speed now lights up.

The selection of the tape speed can be made by means of the appropriate push-button immediately after closing the main switch. The latching relay Rs7 then receives a pulse and is held on as indicated in 4. 9. 7. Operating one of these buttons breaks the capstan motor circuit between the points 101 and 102, so that the capstan motor is switched over without current.

During recording or playback, the tape speed cannot be changed, since the relay circuit Rs7 is broken by the open contacts rs6 31-32 and rs8 31-32. This interlocking system prevents breakdowns due to accidental touching of the changeover buttons. Furthermore the circuit points 101 and 102 are bridged by the contacts rs6 38-39 and the recording motor circuit remains closed.

4. 3.
End-of-run switch

The tape end-of-run switch S3 is coupled to the left-hand filter lever and its changeover contact fulfills the following functions:

With a tape in position it switches on the capstan motor and prepares the circuits for rectifier 3, (brake-lifting magnet), rectifier 4 (pressure magnet) and for transformer Tr1 (reel motor).

When the tape runs out it cuts off the power supply to the capstan motor, to the rectifiers 3, 4 and 5 and to the transformer Tr1, i. e. the whole tape drive system is brought to a stop. In addition to the arresting brakes now acting on the reel motors two additional brakes on the reel motors are actuated by the magnets KM2 and KM3.

The tape-end relay Rs3 receives voltage via the rectifier Gr2. Through the contacts rs3 21-22 this causes the particular current-carrying relay of the push-button control to be switched off and in consequence breaks the circuit of the tape run-out brakes to rectifier Gr2. These brakes are then released and the non-operational condition is restored.

4. 4.
Brakes

Each reel motor has two mutually independent brakes:

the decelerating and arresting brake and
the tape run-out brake.

The decelerating and arresting brake is always on when the tape transport is switched off. It consists of a shoe brake acting on a graphite cylinder.

This graphite cylinder is connected with an adjustable disc brake similar to a torque clutch with the motor spindle.

If the motor is running in its proper direction, the braking moment is determined by the shoe brake, in the opposite direction by the disc brake. This ensures that the unwinding spool is braked more strongly than the winding spool by a precisely adjustable amount in order to prevent the formation of loops.

In addition to the operating brake the tape run-out brake has the function of braking the winding motors in the shortest possible time as soon as a tape has run out or broken. It is also designed as a shoe brake and acts on a steel cylinder which is rigidly attached to the motor spindle.

4. 5.
Filter lever

The function of the left-hand filter lever in combination with the tape end-of-run switch has already been explained under 4. 3. In addition to this both the left-hand and the right-hand levers are intended to take up occasional tape tension variations which can for example occur when two tape turns become stuck together at joints. The left-hand lever also serves to maintain the tape tension constant over the whole tape length. If the tape tension for example should decrease, the feeler lever swings inwards. In this way the arc of tape embrace around the tape guide of the lever is increased and in consequence the friction, which leads to an increase in the tape tension. This gives rise to a degree of correction. Natural vibration of the levers is prevented by air damping underneath the base plate. When cutting, in order to prevent a once-located cutting point from being pulled away when the turntable is released, the left-hand lever is blocked in the stop position.

4. 6.
Filter spindle

When recording or playing back the tape is pressed onto the roller body of the filter spindle by means of a second pressure roller. This eliminates disturbances which may be caused by the left-hand winding. In order to achieve rapid run-up to speed and to avoid tape elongation on starting, the flywheel is coupled in the stop position with the capstan drive by an idler wheel. It therefore starts with the correct operating speed. If the rubber pressure rollers are applied by the pull magnets, this coupling is immediately disconnected. The filter roller is then only driven by the tape. The positioning of the filter spindle is adjustable under its flywheel by means of two hexagonal nuts.

4. 7.
Head-assembly

After removing the cover and loosening the two left and right-hand screws the head-assembly can be removed. The plug and socket connection is a "Tuchel" plug, or in the case of 6-track models a 50-pole Cannon plug.

A small roller is provided for the purpose of reducing longitudinal oscillations of the tape at high frequency, caused by friction against the guides and the heads.

The recording and play-back heads can be aligned to adjust the gap direction. Furthermore, all heads can be rotated and are adjustable both in height and in angle perpendicular to the tape surface. The small stabilising roller can be aligned within narrow limits by means of the two attachment screws for the lower bearing and displaced perpendicularly to the tape (alteration of the wrap-around angle).

4.8.
Tape tension change-over switch

On the switch panel there is a switch for changing over the tape tension. In the case of spools or spool cores ≧ 100 mm diameter it must be in the position ⊸, but for 60 mm diameter in the position ⅄. The symbols denote the spool attachment. The spools used should always be in pairs of the same diameter.

By means of this switch, the mains voltage is supplied alternately to two different taps on the transformer Tr1. This gives the reel motors a small or large torque. In the position ⅄ also an additional resistor (R17) of 39 ohms is introduced into the circuit to the wiper of the editing switch S14.

This changeover system is not incorporated in ¼ inch and 1 inch models since only spool cores of 140 mm (5½ inch) diameter should be used on these.

4.9.
Sequence of functions
(see circuit diagram)

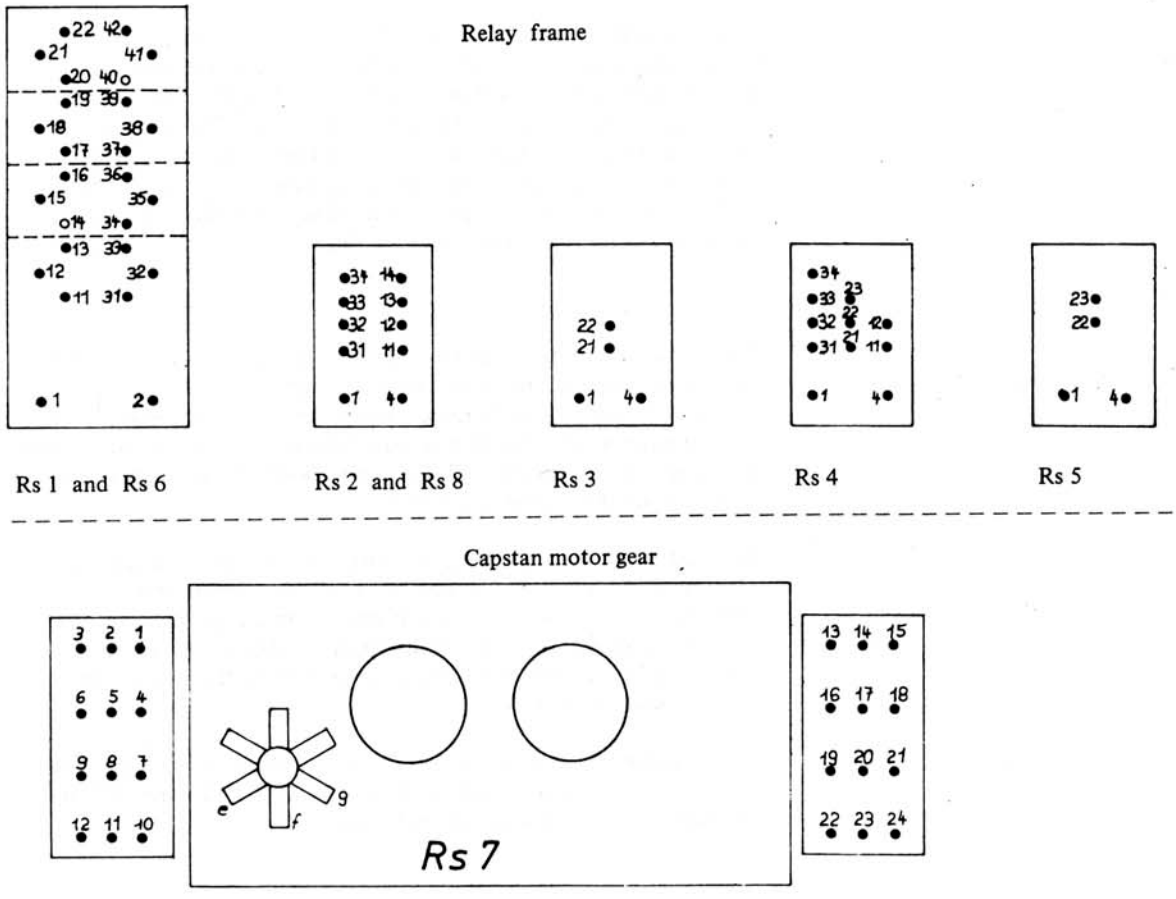
4.9.1.
Playback

Playback is obtained by pressing the playback button S6, provided that the left-hand filter lever pulled in a clockwise direction engages and is held by the tape or by the hand, so that the transport is not switched off again by S3 after pressing the playback button.

The replay relay Rs6 picks up. At the same time the lamp La6 in the playback button lights up by way of acknowledgment.

All the contacts denoted by rs6 are actuated:

| | |
|---|---|
| 31-32-33 | Closes the circuit to the playback relay in place of S6 and thus holds it in the operating position. At the same time the delay relay Rs2 is cut out. |
| 11-12 | Opens and if the machine is switched over direct to rewind, allows this to take place only after the playback relay is de-energised. |




Relay contacts as arranged in M 10 A tape transports (showing the soldering lug side)

15-16 Closes, as a preselector contact, between the tape end-of-run switch S3 and the instant stop brake KM2 and KM3 for end of tape or if the tape snaps.

17-18-19 Switches off the lamp La2 in the stop button and closes the circuit for the pull magnets KM4 and KM5 of the arresting brakes and KM8 of the left-hand filter lever. The arresting brakes lift and the filter lever is released from its locked position.

20-21-22 Closes the circuit operating the right-hand reel motor M3. In the rest position of the contact the motor is ready for rewinding.

41-42 Closes the circuit for operating the left-hand reel motor M2.

38-39 Shunts the speed selector switches S7 and S8 ahead of the capstan motor. This prevents cutting off the mains supply to the capstan motor by inadvertent operation of the switches.

35-36 Closes the circuit to the magnets KM6 and KM7 for pressing the rubber rollers on the capstan and filter spindle.

The delay relay Rs2 picks up when the mains switch S11 is switched on, and is cut off by the contact (rs6) 31-32-33 when the playback button is pressed. When the charging current of the capacitor C3 is used up, the relay in de-energised and thus actuates the following rs2 contacts:

11-12 Closes on playback without function.

31-32 Closes on playback without function.

33-34 Opens and so puts an additional portion of the resistor R14 into circuit with the right-hand reel motor. This abolishes the high starting torque necessary for starting up.

Changing over from playback to record or rewind is possible without actuating the stopbutton S2.

4. 9. 2.
Recording

Recording is started by pressing simultaneously the record button S2 and the record interlock S15.

The same conditions apply to the left-hand filter lever as under 4. 9. 1, but in relation to the record buttons.

The record relay Rs4 picks up. At the same time the lamp La4 in the record button lights up by way of acknowledgment.

All the contacts denoted by rs4 are actuated:

| | |
|---|---|
| 11-12 | Closes the circuit to the record relay in place of S4 and S15 and therefore maintains it in the operating position. |
| 33-34 | Closes and puts into operation the recording amplifier Channel 1. |
| 31-32 | Closes and puts into operation the recording amplifier Channel 2. |
| 21-22-23 | Breaks the circuit to the playback lamp La6 and switches over to the playback relay Rs6. The playback relay picks up and its contacts take over the functions for tape drive described under 4. 9. 1. This also actuates the delay relay Rs6, the contacts of which have the same functions as during playback. |

The changeover from record to rewind is possible without actuating the stop button S2. The changeover from record to playback must be done by going through the stop button. The tape must actually stop between these two operations.

4. 9. 3.
Rewind

Rewinding is started by means of the rewind button S1.

The same conditions apply to the left-hand filter lever as under 4. 9. 1., but in relation to the rewind button.

The rewind relay Rs1 picks up. At the same time the lamp La1 in the rewind button lights up by way of acknowledgment.

All contacts denoted by rs1 are actuated:

| | |
|---|---|
| 41-42 | Closes the circuit to the rewind relay in place of S1 and thus maintains it in the operating position. |
| 37-38 | Opens and breaks the circuit for the lamp La24 which signals in the remote control record button S24. |
| 34-35 | Opens and breaks the circuit to the lamp La26 which signals in the remote control playback button S26 and at the same time breaks the circuit to the lamp La6 in the playback button S6 of the unit. |
| 21-22 | Closes and prepares the reel motors M3 and M4 for operation with the editing switch S14. |
| 17-18-19 | Switches the lamp La2 in the stop button off and closes the circuit for the tension magnets KM4 and KM5 of the stationary brakes and KM8 of the left-hand filter lever. The stationary brakes lift and the filter lever is released from its locked position. |

15-16 Closes as a preselector contact between the tape end-of-run switch S3 and the instant stop brake KM2 and KM3 for end of tape or if the tape snaps.

11-12-13 Prepares the tape clock brake KM9, switches off the circuit for the playback relay Rs6, the record relay Rs4 and the delay relay Rs2.

The tape tension relay Rs5 picks up and the contact
(rs5) 22-23 closes and switches on the winding motors M2 and M3 to tension the tape to equal tensile torques (in series with the resistor R16) until this condition is ended by the delay relay Rs2.

The delay relay Rs2 which is switched off by the contact (rs1) 11-12-13 as described above, is de-energised after the charging current from the capacitor C3 is used up and then actuates all the contacts denoted by rs2:

31-32 Closes and makes connection to the editing switch S14.

Working together with the contact...

11-12 Which shunts the resistor R16, the tensions created by the tape tension relay Rs5 are lifted and determined by the editing switch.

33-34 Opens on rewinding without function.

The changeover from rewind to playback or record can only take place via the stop button S2. The tape must first come to a standstill.

4.9.4.
Stop

This condition is brought about by means of the stop button S2. It breaks the current supply.

to the playback relay Rs6
to the record relay Rs4
to the rewind relay Rs1
and to the tape tension relay Rs5

At the same time the Lamp La2 in the stop button lights up, if the capstan motor remains in circuit through the tape end-of-run switch S3.

All the contacts of the above-mentioned relays revert to their rest position and the delay relay Rs2 picks up so that the transport is prepared for the next tape start.

Somewhat later than the rewind relay Rs1 the tape tension relay Rs5 is de-energised in association with the capacitor C25 and the resistor R25 when changing over from rewind to stop and maintains the condition described under 4.9.3 until the stationary brakes have been positively applied. This avoids a brief looseness of the tape.

4.9.5.
End of tape

The tape-end relay Rs3 is actuated if the tape breaks or the end of the tape is reached, together with the instant stop brake, by switch S3, and the contact

(rs3) 21-22 immediately takes over the function of the stop button S2.

4.9.6.
Remote start

The remote start relay Rs8 is necessary for operation with the synchronizing unit R91 T. (Available in $\frac{1}{4}$ inch from model No. 3027 onwards, and in $\frac{1}{2}$ inch and 1 inch for all transports).

This relay can be switched on or switched off by the B-relay in the R91 T (b - contact)

With previously chosen remote start the B-relay is actuated directly by a sound pulse from a built in pre-amplifier or by a contact. When the remote start relay engages, all contacts denoted rs8 are actuated.

31-32 Opens and breaks the supply of current to the delay relay Rs2. With the pre-selection of record or playback, the contact took over the supply of current for this relay, since the contact (rs6) 31-32-33 had already switched over to the playback relay Rs6. When the charging current from the capacitor C3 has been used up, the delay relay and its contacts function as described under 4.9.1.

33-34 Closes and establishes the connection from the mains to the transformer Tr1, so that the winding motors receive their operating current.

13-14 Closes and establishes the connection from the mains to the rectifier Gr4 for the pressure magnets KM6 and KM7.

If the plug St2 has a shunt from contact c5 to contact c6, the remote start relay Rs8 immediately picks up on closing S11, so that all the switching operations described in the paragraphs 4.9.1 and 4.9.2 occur and are maintained.

(rs8) 31-32 opens in this case without function.

4. 9. 7.
Changing over the tape speed

The changeover of the tape speed is effected by the selector switches S7 for 38 cm/s or S8 for 19 cm/s. At the same time the lamp in the button which has been pressed lights up by way of acknowledgment.

If no amplifier is connected, the signal lamp in the selector buttons will only acknowledge if the socket Bu1 has a bridge each from contact a5 to b8 and a6 to a8.

The changeover facility is excluded during record or playback by means of the contact (Rs6) 31-32-33. since then the current supply to the changeover relay Rs7 is absent, in order that unintentional operating of controls does not influence the functioning of the equipment.

The changeover relay Rs7 has one solenoid each for the two tape speeds which are held in the particular working position by additional permanent magnets. On pressing the non-illuminated selector button the changeover relay picks up and all the contacts denoted by rs7 are actuated:

| | |
|---|---|
| 1-2 )<br>10-11 )<br>7-8-9 )<br>4-5-6 )<br>13-14-15 ) | switch the capstan motor winding to the desired tape speed |
| 16-17 )<br>19-20 ) | switch the capstan motor adjusting elements to the desired tape speed |
| 22-23-24 | switches the relays in the amplifiers to the desired equalization |

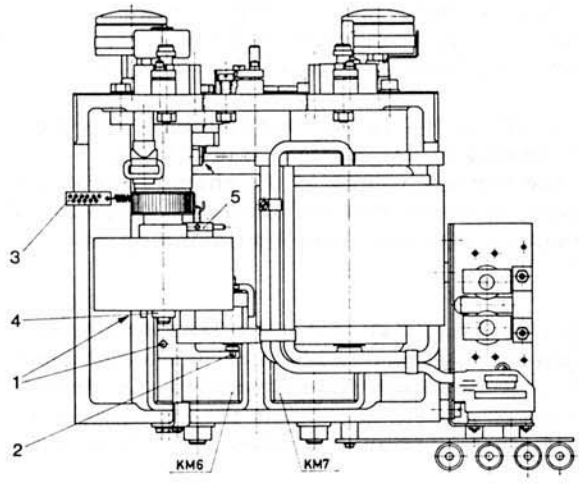



Fig. 2 Gear unit

5. 1.
Machine condition

All the adjustments and measured values given in the following are - unless otherwise stated - with reference to the machine when it is warmed up in operation after approximately two hours of continuous running with tape. The measuring voltage is 220 V/50 Hz.

5. 2.
Adjustment of the idler wheel (see Fig. 2)

When actuated by means of the pressure magnets KM6 for the filter spindle, the stroke of the idler wheel in the gear unit should amount to 2-3 mm. Adjustment can be made after loosening the hexagonal nut, item 1. The idler wheel pressure, which is measured operationally on the pin, item 2, must have a value of 110 to 140 grams. For this adjustment the spring plate (item 3) is provided.

A deviation of maximum 50 grams from the adjusted value may occur in the opposite direction. During playback or recording, the idler wheel must not touch the capstan motor or the filter spindle.

5. 3.
Rubber pressure on the capstan (spring force meter 9098 - 2B)

A loop of cord is placed around the spindle underneath the roller. With a suspended spring force meter the roller is pulled from the capstan. With the magnet drawn away, the pressure roller should not be lifted by more than 2-3 mm from the capstan because otherwise the spring would be overloaded.

Adjustment values:

| $\frac{1}{4}''$ | $\frac{1}{2}''$ | $1''$ |
|---|---|---|
| 1200 ± 50 grams | 1600 ± 50 grams | 1600 ± 50 grams |

These values are required at the point where the pressure roller is just about to pull free of the capstan.

For adjustment on the KM7, the magnet armature can be turned upwards or downwards on the threaded stud, after loosening the flat nut by means of the setting pin Sk 58-30. 000-04. For recording or playback, the magnet must pull right up to the stop.

A difference of 50 grams maximum may occur between the tightening and pulling up of the roller by means of the spring balance.

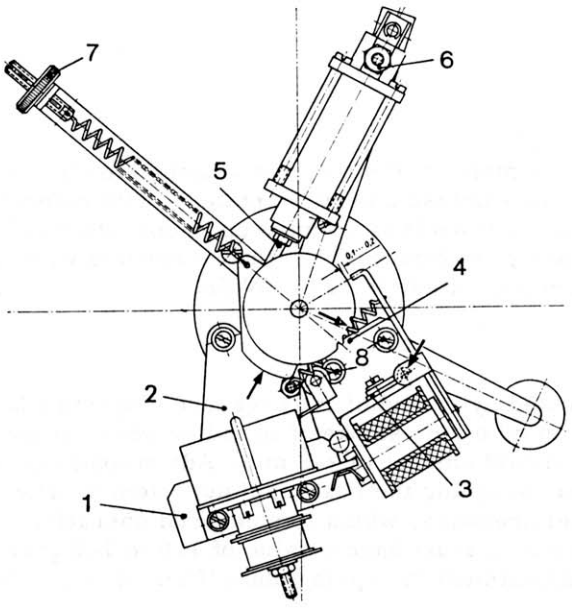



Fig. 3 Filter lever, left

5. 4
Rubber pressure on the filter spindle (spring force meter 9098-2a)

The measuring method and adjustment point with reference to the filter spindle are the same as described for 5. 3.

Adjustment values:

| ¼" | ½" | 1" |
|---|---|---|
| 200 - 250 grams | 400 - 500 grams | 400 - 500 grams |

The adjustment can be done on KM6 in the same way as described for KM7 (see 5. 3).

A difference of maximum 50 grams may occur between the tightening and pulling up of the roller.

In the "cutting" position, the eccentric on the intermediate lever for the pressure roller should be adjusted such that the tape then just touches the gap on the playback head.

In the rest position, the clearance between the roller body and the tensioned tape amounts to 0. 5 - 1. 5 mm. An eccentric serves as the stop for the intermediate lever, and can be adjusted in order to attain these values.

To ensure a firm seating for the synthetic-rubber eccentrics, the eccentrics should be glued fast after adjustment. For this it is advisable to lift the rubber slightly from its mating surface at two positions and to let the adhesive run underneath. Sicomet 85 made by Sichel-Werke GmbH can be used as adhesive.

5. 5.
Stopping time of the filter spindle

The tape transport should be switched to the 38 cm/s speed and run without tape. The left-hand filter lever must be put into the outer setting and fixed there, so that the tape end-of-run switch S3 remains switched on. Now the time from pressing the playback button until the filter spindle stops under the rubber pressure can be measured.

Adjustment values:

| ¼" | ½" | 1" |
|---|---|---|
| 12. 5 s - 1 s | Adjusted along with the tape tension (according to section 5. 10) | |

For adjustment purposes, two hexagonal lock nuts (Fig 2, item 4) M8 metric fine thread, are provided underneath the flywheel on the filter spindle.

5. 6.
Adjustment of the left-hand filter lever

When the filter lever has a spacing of 1. 5 to 3 mm from the inner stop pin, the tape end-of-run switch (position 1) should switch off. The adjustment for this can be made on the switch plate (Fig. 3, item 2).

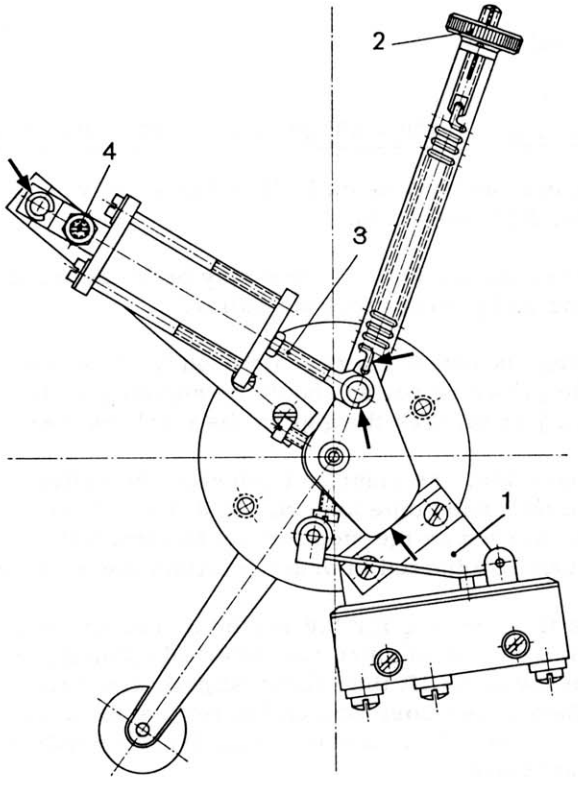



Fig. 4 Filter lever, right

The bearing bracket (item 3) should be so adjusted that the armature in its attracted position lies parallel to the face of the solenoid core. The armature clip should then be at a distance of 0.1 - 0.2 mm from the stop disc.

By shifting the support (item 4) the appropriate value can be reached. When making this adjustment, care must be taken to see that the armature clip springs into the first notch only after the tape end-of-run switch is switched on. When both these conditions have been fulfilled, the fixing screws (item 8) can be tightened. This adjustment should then once more be checked.

The restoring force of the filter lever, when measured on the tungsten carbide steel roller at an angle of 90° to the lever, in the outer stop position, should be as follows:

| for ¼" | for ⅜" | for 1" |
|---|---|---|
| 45-50 grams | 60-70 grams | 45-50 grams |

(spring force meter 9098-1b)

For adjustment, a milled nut (item 7) is provided.

With the filter lever in the rest position the air-damping plunger should be at a distance of 0.5-1.0 mm from the end of the cylinder. After releasing the lock nut, the desired setting can be obtained by rotating the plunger on the threaded rod (item 5).

A valve (item 6) is provided for re-adjusting the time of return of the lever from the outer to inner stop; the set values are:

| ¼" | ⅜" | 1" |
|---|---|---|
| 0.8-1.0 sec. | 0.5-0.7 sec. | 0.5-0.7 sec. |

5.7.
Adjustment of the right-hand filter lever (see Fig. 4)

With a spacing between the filter lever and the inner stop pin of 1-2 mm, the switch should actuate the footage counter brake (only during "rewind"). The adjustment can be done on the switch panel (item 1).

When measured on the tungsten carbide guide roller, at an angle of 90° to the lever, the restoring force of the filter level in its position on the outer stop should be as follows:

| ¼" | ⅜" | 1" |
|---|---|---|
| 40-50 grams | 90-100 grams | 90-100 grams |

(spring force meter 9098-1b)

The milled nut, (item 2) is used for the adjustment.

In its rest position the air-damping plunger should be at a distance of 0.5 - 1.0 mm from the end of the cylinder. After loosening the lock nut, its position can be adjusted by turning the plunger on the threaded rod (item 3).

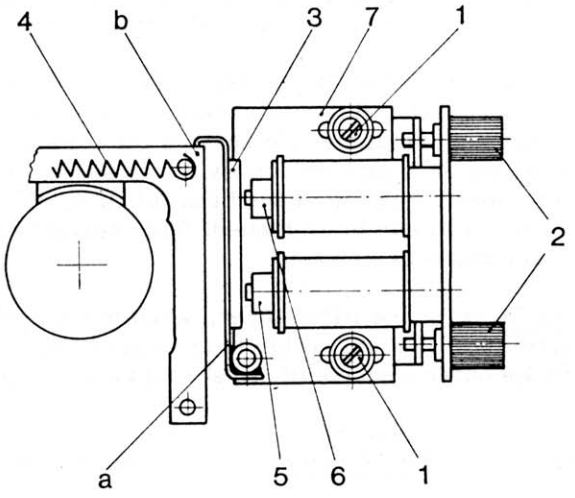



Fig. 5 Magnet holder

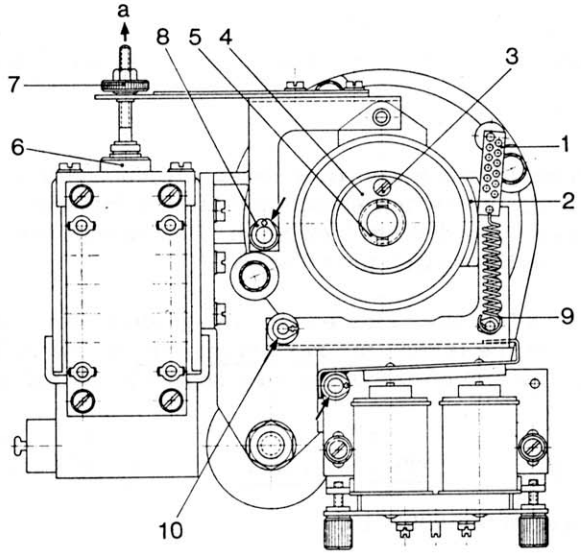



Fig. 6 Brake arrangement

For re-adjusting the time of return of the lever from the outer to inner stop, a valve (item 4) is provided; the set values are:

| $\frac{1}{4}$" | $\frac{1}{2}$" | 1" |
|---|---|---|
| 0. 1-0. 2 sec. | 0. 3-0. 5 sec. | 0. 3-0. 5 sec. |

5. 8.
Adjustment of the brakes
(see Fig. 5)

The adjustments described in this section are only necessary if parts of the brake arrangement have to be dismantled or renewed for the purpose of repairs.

As a basic adjustment, the fixing screws (item 1) may be tightened only slightly, so that it is possible to move the plate (item 7) by means of the knurled-head screw (item 2). For adjustment of the armature (item 3), the tensioning spring (item 4) can be temporarily hooked out. If now the armature (item 3), is drawn back until it lies lightly on the magnet core (item 5), there should be a spacing of 0.7 ±0.1 mm between the armature and the other core (item 6). This value can be obtained by bending the armature at point "a".

For adjustment of the brake-lever clearance the tensioning spring (item 4) must be hooked back again. If the armature touches the brake lever at the point "b" without lifting the brake lever, then the distance between item 3 and item 6 should amount to $1^{+0.1}$ mm.

This adjustment can now be made by means of the two knurled-head screws (item 2).

After this the screws (item 1) can be finally tightened. Then this adjustment should once more be checked.

When changing the cork liner, sandpapering is necessary to ensure correct seating of the brake shoes on the brake disc. For this, a strip of emery cloth (Grain size 320) approximately 20 mm wide can be laid around the brake disc in question with the emery surface towards the cork lining, and secured there.

By turning the brake disc in the direction of opening, the liner is sandpapered down. In order to avoid marking the brake disc during operation, all emery dust must be removed by carefully wiping the brake liner and the disc with a dry cloth. Thereafter the brake surface should not be touched with bare hands.

Brake moments (see Fig. 6) (measuring lever 3086, spring 3086, spring force meter 9098-1b).

In the direction of opening, i. e. looking towards the turntable, in the case of the left-hand reel motor clockwise and in the case of the right-hand reel motor anti-clockwise, the moments should be as follows:

| for ¼" | for ½" | for 1" |
|---|---|---|
| 400 ± 20 cm-grams | 500 ± 20 cm-grams | 500 ± 20 cm-grams |

For final adjustment the spring plate (item 1) is fastened as required.

In the direction of closing the brake shoe (item 2) fixes the graphite disc in such a way that it must glide between two felt discs. The pressure of the felt discs determines the braking moment which should be as follows:

| for ¼" | for ½" | for 1" |
|---|---|---|
| 1500 ± 50 cm-grams | 2000 ± 50 cm-grams | 2000 ± 50 cm-grams |

After unscrewing the screw (item 3), the milled nut (item 4) can be turned on the threaded tube (item 5) for adjustment.

The braking time, after the above adjustment, must be as

| for ¼" | for ½" | for 1" |
|---|---|---|
| 1000 m tape | 750 m tape | 500 m tape |
| ≦ 4 s | ≦ 4 s | ≦ 4 s |

With a 350 m tape on a flanged spool with 60 mm diameter core, in the case of ¼" models, the braking time must not exceed 1.5 s (changeover on S9).

The tape over-run after pressing the stop button during recording or playback should be

for 38 cm/s ≦10 cm
19 cm/s ≦ 5 cm

For this measurement, a small piece of adhesive tape can be stuck to the tape backing, so that the push button can be pressed when the position so marked passes a definite point on the tape deck, (timed as exactly as possible). Then the length from the stop point to the position of the piece of adhesive tape can be measured (measurement can be repeated).

The tape run-out brakes on the left and on the right should have the following moments in the direction of closing:

| for ¼" | for ½" | for 1" |
|---|---|---|
| 5000 - 5500 | 5500 - 6000 | 5500 - 6000 |
| cm-grams | cm-grams | cm-grams |

including the moments of the stationary brake from item 2. For measurement, the magnet core (item 6) must be pressed up to the stop in the direction of the arrow "a".

The milled nut (item 7) is provided for adjustment. For measurement purposes the connection points 235 and 236 on the relay rack can be connected together. The tape runout brakes can then be operated by the left-hand filter lever (measuring lever 3086, spring force meter 9098-2a).

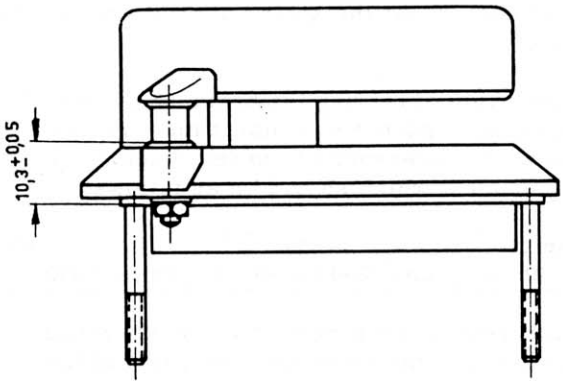



Fig. 7 Right-hand cover cap

The run-out time should amount to ≦2.0 seconds if the tape end-of-run switch (left-hand filter lever) switches off on rewind. ($\frac{1}{4}$ inch at 1000 m, $\frac{1}{2}$ inch at 750 m and 1 inch at 500 m tape).

Squeaking cork linings can be cleaned with methyl alcohol or, as described in this section (adjustment of brakes), carefully touched up with emery cloth.

The tape tension peaks need be checked only in case of $\frac{1}{4}$ inch models and should not exceed 750 grams for the following kinds of operation:

| | |
|---|---|
| I | 50 m tape, 10 mm winding core, in the event of quick changeover from reverse to forward. |
| II | Tape and core as above. Starting rewind at full speed. (correction possible on the resistor R16). |
| III | Tape and core as above. Start of recording or playback. |
| IV | 1000 m tape, 100mm winding core, changeover from playback to full rewind speed. (tape tension meter Sk 58-30.030-00 or 58-4003.000-00). |

5.9.
Tape run (see Fig. 7)

Adjustment of the tape run is facilitated by using the adjustment gauge L 4285, which can be supplied against order.

The device consists essentially of a measuring plate with openings for mounting a dial indicator. Using this dial indicator the height setting of the drive discs, the feeler levers, the tape guides at the roller caps and in front of the filter spindle and the head carrier mounting points can be checked.

The reference level is the lower surface of the tape deck base plate. The device has three feet. To fit it, remove the twin slot screw between the turntables, the face plate of the push-buttons and the tape cutter. Then, at these three points, flat materials can be seen which are screwed direct against the lower surface of the base plate. The adjustment device is placed with its three feet on these flat materials.

In order to obtain a reference point, the right-hand roller cap must be screwed off and adjusted before setting up the measuring device. The roller cap carries a tape guide. The upper edge of the tungsten carbide steel disc should have a spacing of 10.3 ± 0.05 mm for the mounting recess of the cap (Fig. 7).

When the adjustment is completed the cap is placed on the tape transport again. A gauge with a ground surface is available for the tape guide of this cap.

There are various gauges belonging to the measuring device for the several tape guides. For the turntable two measuring rings and for the head carrier mounting points a gauge plate are supplied with the machine. The individual measuring points - as listed above - are checked starting with the tape guide of the right-hand cap.

Here, the tape guide of the right-hand cap constitutes the reference level, and all other tape running parts are lined up with this height. Permissible tolerances are for the drive disc ±0.1 mm, for the feeler lever, the tape guides of the left-hand roller and ahead of the filter roller ±0.05 mm, and for the head assembly mounting points ±0.02 mm.

In the $\frac{1}{2}$inch and 1 inch models the drive discs are adjusted 0.3 - 0.5 mm lower than on the $\frac{1}{4}$ inch models.

For checking the gauge, the measuring device includes a spacer ring, a spacer gauge plate and various bushes. Using these spacer parts, it is possible to check the measuring device on a plane ground surface. The spacer parts are thus intended to act, as to dimensions, for the missing transport base plate.

The height adjustment of the pressure rollers can be effected, after aligning the tape run of the tape transport parts mentioned, using an actual tape. For this purpose, it is necessary that the points of the brass eccentrics in the rollers point in one direction. The alignment of the rollers is thus set at a neutral point. After screwing off the twin slot plate nut and the cover disc (with the socket wrench 12 101 00) the eccentric is revealed. The centre screw can also be removed with this socket wrench, so that the eccentric can be adjusted. By bringing the roller lightly up to the tensioned tape it is possible to see whether the running surfaces of the rollers correctly project symmetrically over the tape width above and below. It is possible to achieve this by means of adjustment discs between the lower roller bearing and the seating on the roller spindle.

The roller can be removed from the spindle in order to adjust its height.

(Socket wrench 12 101 00, fork spanner Sk 58.30.000-02, fork spanner Sk 58.30.000-03).

5.9.1.
The alignment of the right-hand pressure roller

The adjustment is effected with a tape on the machine while running on playback without the head carrier, the left-hand pressure roller and without a tape guide in front of the filter spindle. (The magnet for the left-hand pressure roller should be unsoldered on one side.) Before making this alignment, the height adjustment of the pressure roller mentioned in paragraph 5.9, should be observed.

For the aligning, there are two eccentric brass sleeves in the roller, which become visible after removing the twin slot p'ate nut (twin slot socket wrench 12 101 00) and the cover plate. The eccentrics are attached by means of a centre screw which can also be loosened with the same socket wrench.

The points on the faces of the eccentric sleeves superimposed on each other indicate the zero position. After loosening the centre screw the rubber pressure roller can be moved in either direction by rotating the eccentrics in opposite senses by means of the fork spanners Sk 58-30.000-02 and Sk 58-30.000-03.

The adjustment must be done in such a way that the tape on the recording spindle in the playback position runs exactly in the middle of the running surface of the rubber pressure roller and does not change its height by more that ± 1 mm under the following operating conditions:

Increase in tape tension
Varying reel diameters
After changing the tape speed
Starting playback.

On $\frac{1}{2}$ inch and 1 inch models the right-hand cover cap (with dial) can be removed to facilitate coarse adjustment.

After final adjustment, i.e. when the above-mentioned conditions are fulfilled and the pressure roller is parallel to the recording spindle, the centre screw must be tightened up again.
Note: The eccentric sleeves must not turn while doing this. Subsequent adjustment may possibly be necessary.

5.9.2.
The alignment of the left-hand pressure roller

The adjustment must be carried out as in the case of the right-hand pressure roller, so that the values obtained there remain constant. (Resolder the magnet). The right-hand rubber pressure roller will be working during this adjustment, since it is responsible for drawing the tape through.

The spacing of the tape wiper on the capstan should be adjusted to 0.05 - 0.1 mm.

5.10
Tape tensions

Tape tensions (for tape tension peaks see 5.8). (Tape tension meter Sk 58-30.030-00 or tape tension meter 58.4003.000-00).

The tape tensions between the filter spindle and the recording spindle should be as follows at both speeds:

| for ¼ inch | for ½ inch | for 1 inch |
|---|---|---|
| 1000 m tape | 750 m tape | 500 m tape |
| 75-160 grams | 150-220 grams | 150-220 grams |

The adjustment can be made on the resistor R15.

On the ½ inch and 1 inch models 50-70 grams of the above-mentioned values should be produced by the filter spindle.

On the ¼ inch models with 350 m tape on a flanged spool with a core of 60 mm diameter, the tape tension after switching over S9 should also be 75-160 grams.

The tape tensions behind the capstan should be:

| for ¼ inch | for ½ inch | for 1 inch |
|---|---|---|
| 1000 m tape | 750 m tape | 500 m tape |
| 180-60 grams | 250-110 grams | 250-110 grams |

Adjustment on R14 (tape with yellow lead).

For the rewind tape tension, which is only measured running forward, the following values are necessary to obtain tight winding:

| for ¼ inch | for ½ inch | for 1 inch |
|---|---|---|
| 100 m tape | 750 m tape | 500 m tape |
| ≧ 100 grams | ≧180 grams | ≧180 grams |

The adjustment can be made by altering the plunge depth of the eddy current brake magnet underneath the left-hand guide roller.

5.11
Rewind time

The rewind time should not exceed the following values in both directions:

| for ¼ inch | for ½ inch | for 1 inch |
|---|---|---|
| 1000 m tape | 750 m tape | 500 m tape |
| 150 s | 120 s | 90 s |

On the ¼ inch models with 350 m tape and a flanged spool with a core of 60 mm diameter the rewind time after switching over S9 should be ≦100 s.

5.12
Stroboscope indication
(only on ¼ inch models)

At 38 cm/sec the graduation 49 appears, at 19 cm/sec the graduation 98 appears.

The speed deviation can be calculated from

$$n = \frac{49}{t} \quad \text{in \% for 38 cm/sec}$$

$$n = \frac{98}{t} \quad \text{in \% for 19 cm/sec}$$

where "t" is the time for an apparent revolution of the stroboscope graduation in seconds

The permissible deviation is ±0.3 %. Any stroboscopic oscillation is caused by the stroboscopic disc and is not a consequence of wow and flutter.

## 5. 13. Tape clock

### 5. 13. 1. Accuracy of the tape clock

The deviation of a mains-synchronised clock must not exceed 0.3% (1.8 seconds after 10 minutes of running time). For comparison purposes, a synchronous clock should be connected to the same mains supply as the machine itself.

### 5. 13. 2 Drift of the tape clock (on ¼ inch models)

After running forward once and in reverse once on a 1000 m tape and braking four times during forward or reverse running the deviation on the tape clock may amount to 4 seconds, if a mark made on the tape previously is brought back again to the starting point.

In the case of ¼ inch models the value relates to a 750 m tape and in the case of 1 inch models to a 500 m tape.

### 5. 13. 3 Tape clock brake

The tape clock brake under the right-hand guide roller should best be so adjusted that the armature is approximately 0. 3 mm in front of its stop in the magnet housing when the plunger touches the end of the guide roller. The magnet can be shifted in its holder after loosening the clamping screw.

After adjustment the free movement of the guide roller should be checked.

The overrun of the tape clock in the event of tape run-out, should, on rewinding from full speed, be

| for ¼ inch | for ⅛ inch | for 1 inch |
|---|---|---|
| ≦ 4 sec | ≦6 sec | ≦6 sec |

measured in rewind position.

When a tape is fed in from left to right, the clock is set at 0 = zero, when the beginning of the tape is at the same level as the guide roller of the right-hand filter lever - looking in the direction of tape run. The tape is then attached to the right-hand winding core and the drive unit set to forward rewind. After approximately 3-4 tape clock minutes on the 38 scale, a changeover should be made to full return speed. When the tape has run out, the run-out time can be read off on the clock as a deviation from the zero position.

The brake magnet should have a time constant of 0. 4 to 0. 6 seconds. If the value is less than this, the capacitor C26 is probably faulty.

## 5. 14. Relays

### 5. 14. 1. Relay d. c. voltage

The d. c. voltage for the relay supply should be $24^{+2.5}_{-1.0}$ V measured at the connection points 69 (+) and 60(-) of the power supply, (with one playback amplifier V87 and a recording amplifier V 86) at 38 cm/sec playback.

### 5. 14. 2. Delay times

The delay times should be:

| | |
|---|---|
| for the delay relay Rs2 | 0. 2-0. 4 seconds |
| for the tape tensioning relay Rs5 | 0. 8-1. 5 seconds |
| for the tape end relay Rs3 | 1. 0-1. 5 seconds |

## 5. 15. Current consumption

For 220 V alternating current the current consumption without amplifier in the 38 cm/sec position with tape inserted is:

| | |
|---|---|
| for full speed rewind | ≦1. 32 A |
| for recording | ≦1. 04 A |
| and for stop | ≦0. 44 A |

## 5. 16. Capstan Motor

### 5. 16. 1. Capstan motor adjustment

The capacitors C21, C22, C23 and C24 connected together with the wire resistor R25 are provided for adjustment of the capstan motor in 6 and 12 pole operation.

All switching elements are mounted on the gear unit.

The three current values should not differ from each other by more than ±5%. The values printed on the outer rotor of the recording motor refer to no-load running and do not have to agree with the values applicable to playback.

For measurement purposes it is possible to open, at plug St6
the connections 1-3-5 for 19 cm/sec = 12 pole
or the connections 6-7-9 for 38 cm/sec = 6 pole
so that the ammeters (multimeters) can be connected in between them. The measurement is made in the 300 A range, and the run-up of the capstan motor in the next highest range. In order to be able to make the adjustment under operating conditions, the tape transport must be switched to playback.

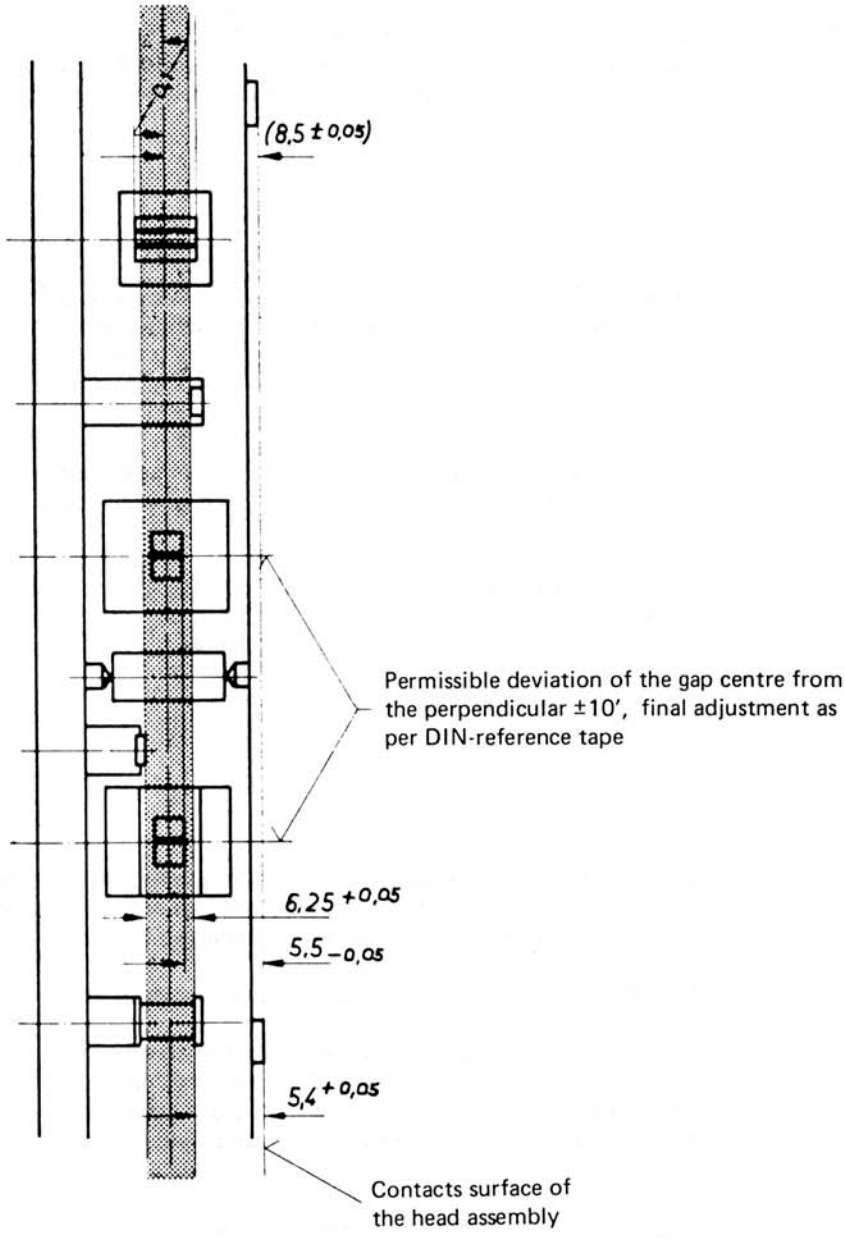



Fig. 8 1/4" full-track head assembly

5. 16. 2.
Capstan motor run-up time

The run-up time of the recording motor including the filter spindle until synchronised running is reached should be as follows without pressure from the rubber roller:

| | |
|---|---|
| at 19 cm/sec | ≦ 4 seconds |
| at 38 cm/sec | ≦ 8 seconds |

For measurement with a mains synchromesh flash stroboscope lamp, the flash can be directed at the outer casing of the capstan motor. If the lettering or three evenly spaced marks on the circumference of the outer casing are at an apparent standstill, the capstan motor has run up to speed. The capstan motor can be switched on by means of the left-hand filter spindle.

5. 17.
Capstan wobble

Measured at 19 cm/sec with pressure from the rubber roller, the capstan wobble should not exceed 2 µm at tape level. In making this measurement it is important that only dial gauges with a spherical nylon pivot and with a static error ≦ 2 µm be used.

5. 18.
Filter spindle wobble

The filter spindle wobble can be measured in the same way as the capstan wobble but can amount to 10 pm. (If necessary rotate the spindle and upper part towards each other and tighten the fixing screw again. The upper part rests with a cone on the spindle and can be drawn upwards with the fixing screw and in this way loosened). (Pin wrench 12 101 00).

5. 19.
Head-assembly adjustment

An adjustment gauge L 4336 can be supplied for optical height adjustment of the head assembly. This head-assembly adjusting device consists of a part to receive the head-assembly, a replica each of the capstan and filter spindles, and an optical system with scale.

The replica of the filter spindle has a horizontal line which represents the middle of the tape-run. The centre of the scale = 0 is checked for height against this line. Graduations run perpendicular to this scale centre line upwards and downwards at distances of 0. 05 mm to each other, up to a maximum of 3. 5 mm.

The tape-run adjustment of the heads and tape guides can be carried out with the assistance of the data sheets (Figs. 8 to 12), starting from the scale center, the height deviation of which from the head-assembly supports is 8. 5 ± 0. 05 mm. Since the data sheets, with the exception of stereo and two-track heads, refer to tape or head core edges, the individual values must be converted to refer to the scale centre.

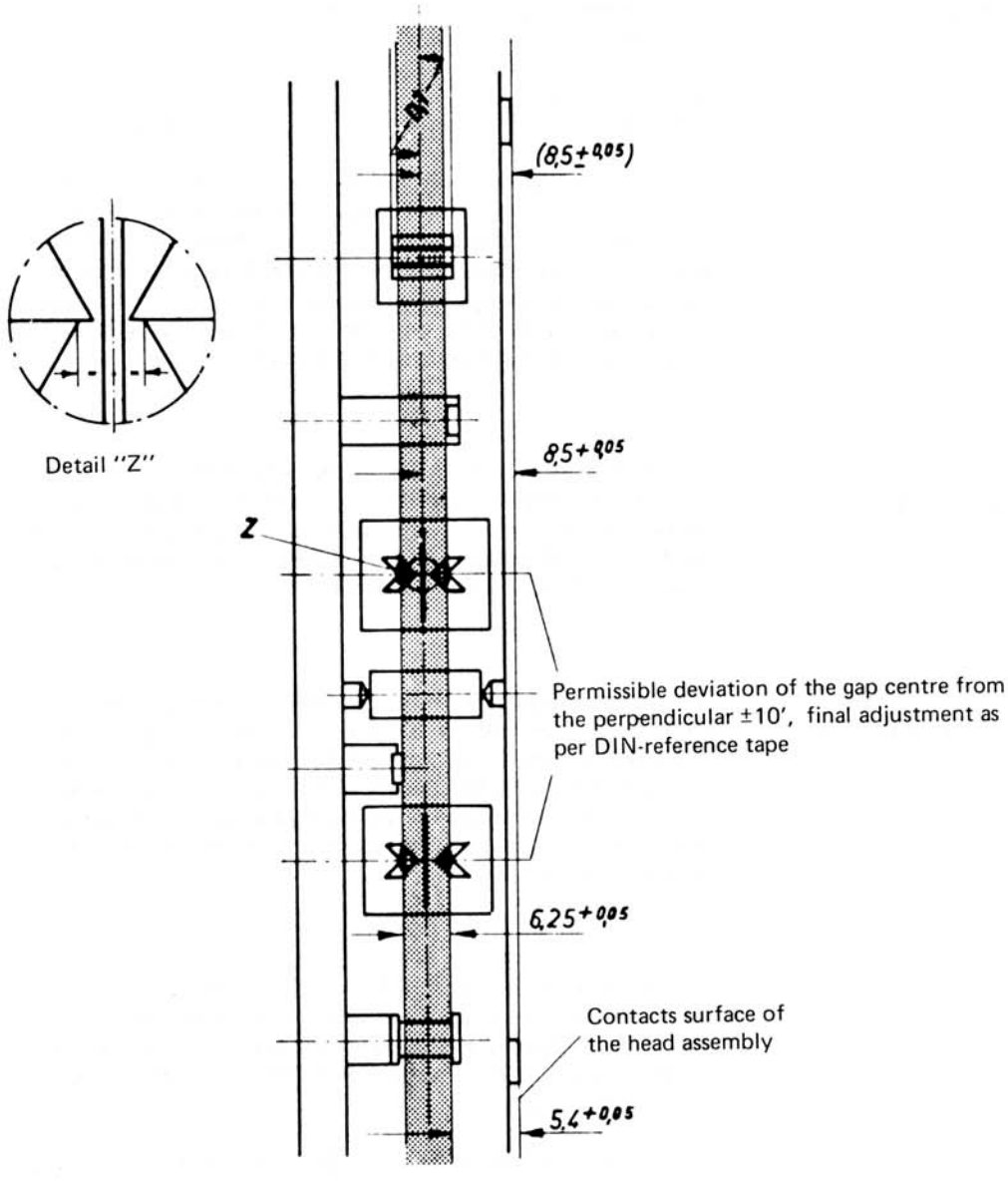



Fig. 9 1/4" stereo head assembly

Example: Data sheet Fig. 8, playback head

| | | |
|---|---|---|
| Scale centre (zero) | 8. 5 mm | |
| Less head-carrier mounting to underside of head core | $5.5_{-0.05}$ | mm |
| = Adjustment value as per scale | $3.0^{+0.05}$ | mm |

Stereo and two-track heads should be adjusted in such a way that the points of the V-shaped cores are symmetrical with respect to the scale centre. Under certain circumstances the "detail Z" must be given attention in this connection (see data sheet Fig. 9).

For the upper tape guide a tape can be run through (on playback) to assist with the $\frac{1}{2}$ inch and 1 inch head-assemblies, if the tape transport has been adjusted as per 5. 9 and 5. 9. 1 and the heads and lower tape guides have been aligned as per data sheet Fig. 10 or Fig. 11. The upper tape guides are adjusted by means of adjustment discs so that they just touch the upper edge of the tape. The tape must never be kinked at this point. If necessary check the entire adjustment of the tape transport and head assembly.

For changing the heads see also Section 6. 1.

5. 19. 1.
Adjustment of the pilot head

Particular attention must be paid to the exact height adjustment of the recording head, i.e. the tracking must be central on the tape.

The tape embrace of the pilot head should have a length of 1. 8 ± 0. 2 mm. To check this the head surface can be marked with a very soft coloured pencil. If a piece of tape is then run through on playback (if possible not a reference tape) the colouring is rubbed off after a short period of running so that the contact surface on the polished head can be discerned. The adjustment can be made directly on the head attachment. After loosening the M3 hexagonal nut the head can be moved in the longitudinal hole of its mounting and the head gap can be adjusted to the centre of the loop. All other adjustments can be seen in data sheet Fig. 12.

For adjusting the pilot head on $\frac{1}{4}$ inch tape transports for transverse recording a reference tape with description is obtainable. The electrical calibration of the HF pilot head-carrier is described in a separate instruction manual.

A combined head-current measuring lead for the pilot head and the erase head can also be supplied.

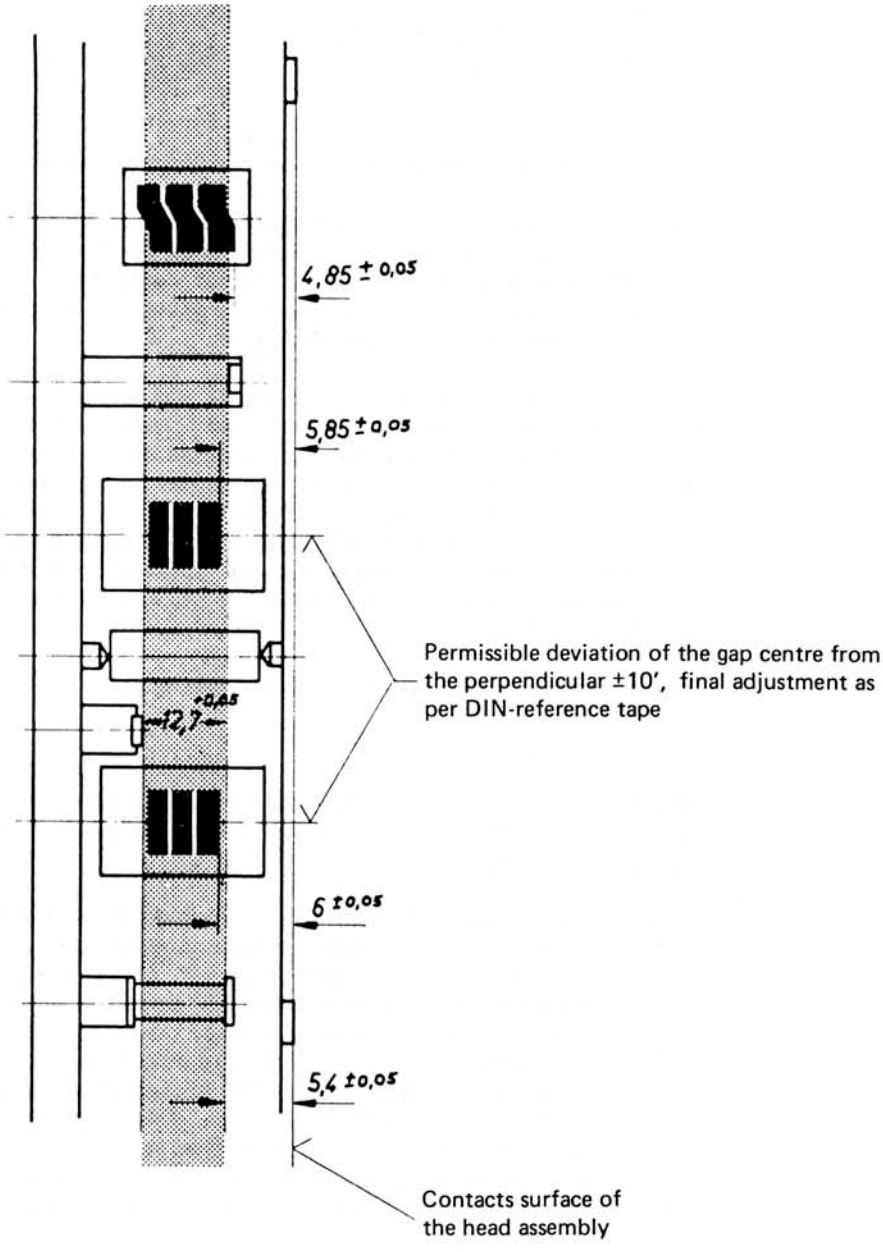



Fig. 10 1/2" 3-track head assembly

5. 19. 2.
Alignment of the heads

For alignment of the heads, which in the case of M10 A transports are only supplied as long-life heads (LL heads), a hexagonal nut with a copper coloured spacing washer is provided on the surface of the head-assembly for the recording head and the playback head. These nuts can be seen after removing the cover-cap.

The tape should lie against both halves of the head face over the same width, i. e. the head-gap must lie exactly in the middle of the head loop. (In the case of the erase head, both gaps should be symmetrical around the centre).

If a piece of tape is then run through on playback (if possible not a reference tape) the colouring is rubbed off after a short period of running so that the contact surface on the head face can be discerned. The adjustment can be made after loosening the central fixing screw, which is visible through a hole over the head in question, if the head is turned. Final alignment can only be carried out with the special gauging tapes.

The leaf springs should only be stressed sufficiently to avoid their lying on the bed of the recess while permitting $\pm 1^{\circ}$ tilting of the particular head-gap.

The stabilising roller of the head-assembly can be adjusted to the smallest bearing play by means of the adjustment screw; easy-running i. e. without sticking, must nevertheless be guaranteed.

5. 20.
Wow and flutter

The wow and flutter, measured with the frequency variation measuring instrument EMT 420, weighted to DIN 45 507 should be as follows:

at 38 cm/sec = ± 0.08%
and at 19 cm/sec = ± 0.12%

The reading is taken on the right-hand instrument. It can, however, also be pen-recorded by using in addition a level recording instrument which can be connected to the EMT 420 measuring instrument.

The calibration of the level recorder is best carried out in the "weighted" position with the permissible wow and flutter values of ± 0.08% at 38 cm/sec and ± 0.12% at 19 cm/sec.

The above mentioned values refer to the playback of a 3 kHz tone, previously recorded with the same transport unit. The measurement does not have to extend over the whole tape, but can be restricted to the start of the tape, the middle and the end of the tape. On $\frac{1}{4}$ inch models with 350 m tape and a flanged spool with 60 mm diameter core, the following values must not be exceeded after switching over S9:

for 38 cm/sec $\leqq \pm 0.08\%$
and for 19 cm/sec $\leqq \pm 0.12\%$

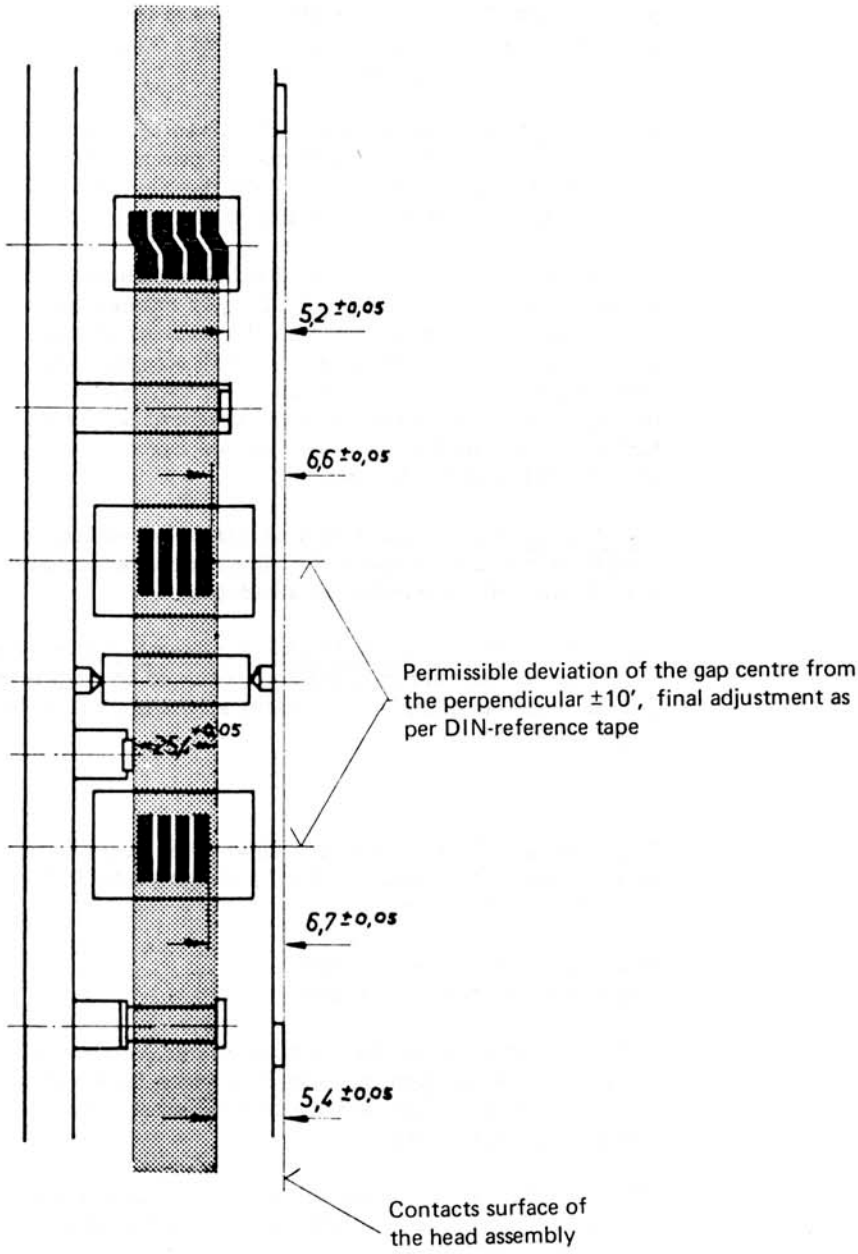



Fig. 11 1" 4-track head assembly

In order to obtain reliable measurement values, it is recommended that the selector button should be pressed during changeover of tape speed long enough for the capstan motor to come to a standstill and start up again.

5. 21.
Run-up time

The run-up time, i. e. the time from the start of a tape until the permissible wow-and-flutter value is reached should not exceed the following values:

| for $\frac{1}{4}$ inch | for $\frac{1}{2}$ inch | for 1 inch |
|---|---|---|
| 1 second | 1. 5 seconds | 1. 5 seconds |

The values can be plotted exactly by means of a level recorder connected to the EMT 420 measuring instrument. The calibration should be carried out as described in Section 5. 20. If on playback a tape on which a 3 kHz tone has previously been recorded is started and at the same time the level recorder operated, the run-up time can be seen on the oscillogram. The measurement can be restricted to the beginning, middle and end of the tape.

5. 22.
Slip

The slip, i. e. the tape speed variation between the beginning and end of tape must not exceed 0.2 % on

1000 m tapes for the $\frac{1}{4}$ inch model
750 m tapes for the $\frac{1}{2}$ inch model and
500 m tapes for the 1 inch model

For $\frac{1}{4}$ inch models with 350 m tape and a flanged spool with a 60 mm diameter core, this value should likewise not be exceeded after changing over S9.

With the slip measuring apparatus J54. a 50 Hz tone can be recorded at the start of a full length tape. If the tape reel is now changed over for the purpose of measurement so that what was the beginning of the tape is now the end, on subsequent playback the slip can be read on the instrument of the slipmeter. The needle swings. and the maximum swing can be read off as the slip. The same measurement can also be done with the measuring apparatus for frequency variations, i. e. the EMT 420, in the "slip" setting. The procedure is as described for the slip measuring apparatus J54. but 3 kHz are recorded and then played back. The indication is given on the left-hand instrument, the needle of which shows the slip as a deviation from the mid-position.

Since in the case of multi-track equipment changing the tape reel for playback changes the position of the track compared with recording, the following possibilities arise :

Stereo and two-track equipment: ($\frac{1}{4}$ inch)
a) recording track 1... playback track 2,
or vice-versa

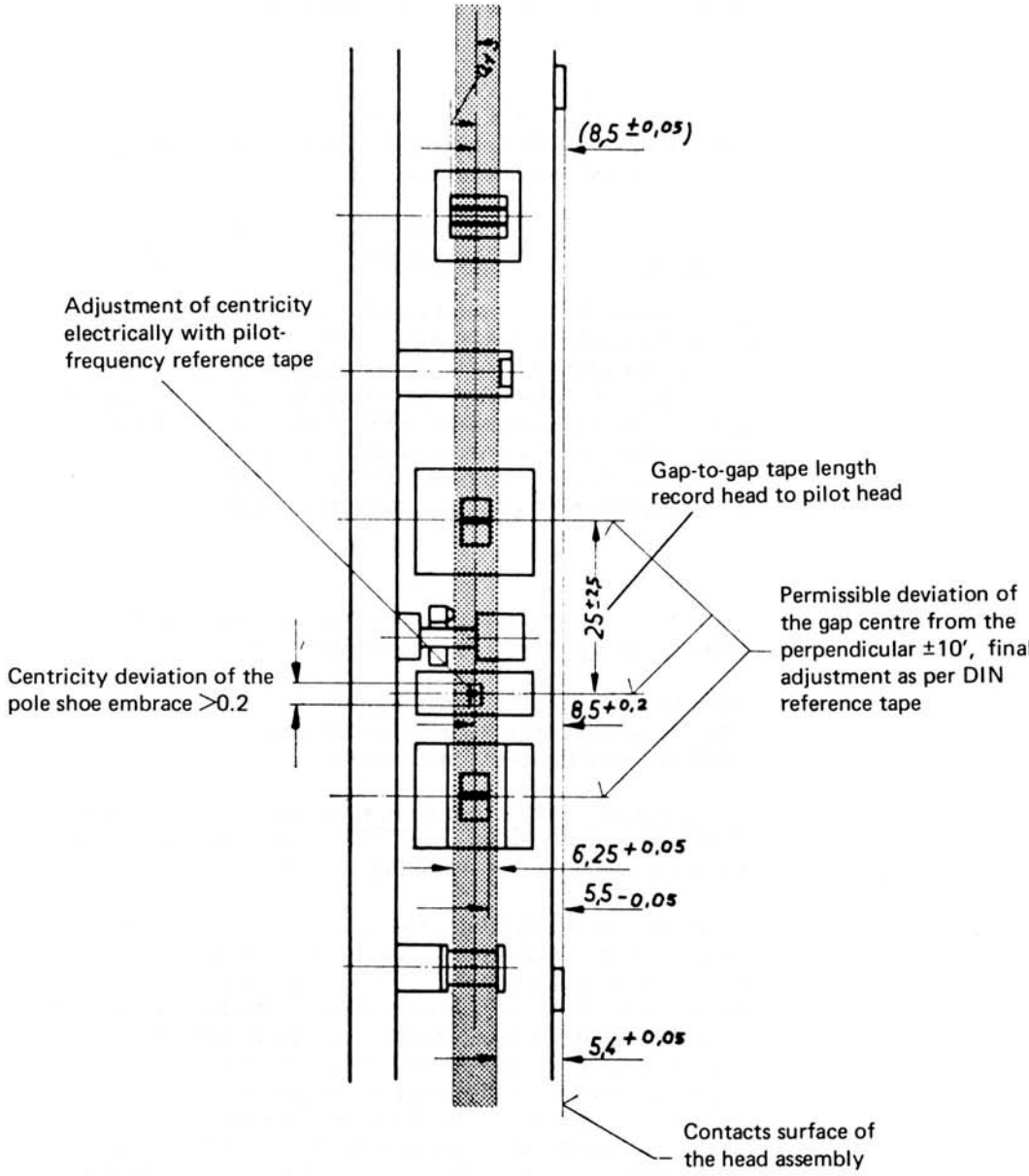



Fig. 12 1/4" pilot head assembly

Three-track equipment: ($\frac{1}{8}$ inch)
a) recording track 1... playback track 3, or vice-versa
b) recording track 2... playback track 2.

Four-track equipment: (1 inch)
a) recording track 1... playback track 4, or vice-versa
b) recording track 2... playback track 3, or vice-versa

Six-track equipment (1 inch)
a) recording track 1... playback track 6, or vice-versa
b) recording track 2... playback track 5, or vice-versa
c) recording track 3... playback track 4, or vice-versa

5. 23.
Marking device

For mounting the marking device No. 58. 2102. 510-00 in the case of $\frac{1}{4}$ inch models, a rivetted pin with flat head and a threaded hole M3 are provided in front of the playback head.

The swivelling forked piece on the underside of the device is pushed under the rivet head, so that the above-mentioned threaded hole and the slotted hole on the reverse side of the marking device coincide. The slotted hole allows the adjustment described below.

The marking device should be so mounted in front of the playback head that with the stamp full projecting the raised part - an oblique stroke - will just leave a neat mark on the reverse side of the tape. The stamp is then caught by the inner stop, thus preventing any damage to the playback head.

The rubber stamp is held rigidly in a cylindrical hole, so that it can be withdrawn easily from the marking device for the purpose of inking.

For this purpose the rubber stamp is best placed in a small container which is filled up with a stamping ink until the stamp is covered. Then the stamp is pressed down two to three times with a cylindrical rod of approximately 10 mm diameter. The stamp becomes filled up like a sponge. After wiping off any excess ink, it can then be replaced in the marking device by means of a pair of tweezers.

A stamping ink which does not dry out for several months, so that the stamp can be used for a long time without re-impregnation. can be supplied under the designation NCR NON-STOP.

5. 24.
Echo-erase head

For mounting an echo-erase head No. 26. 515. 00, threaded holes are provided on the tape transport platform between the left guide roller and the filter spindle. As occasion demands, the head can be swung on to the magnetic tape and is then held in position by means of a ball catch (on $\frac{1}{4}$ inch models)

The echo-erase is performed by a $\frac{1}{2}$ inch tape magnetised by an alternating field. The transfer attenuation gain is from 6 to 8 dB, while the signal level at 1 kHz is attenuated by only 0. 1 dB and at 10 kHz only by 0. 4 dB.

The ready-magnetised echo-erase tape can be supplied later from the works and should be so mounted that the tape backing lies on the outside, i. e. for echo erasure the recording tape glides with its coated side on the backing of the echo-erase tape.

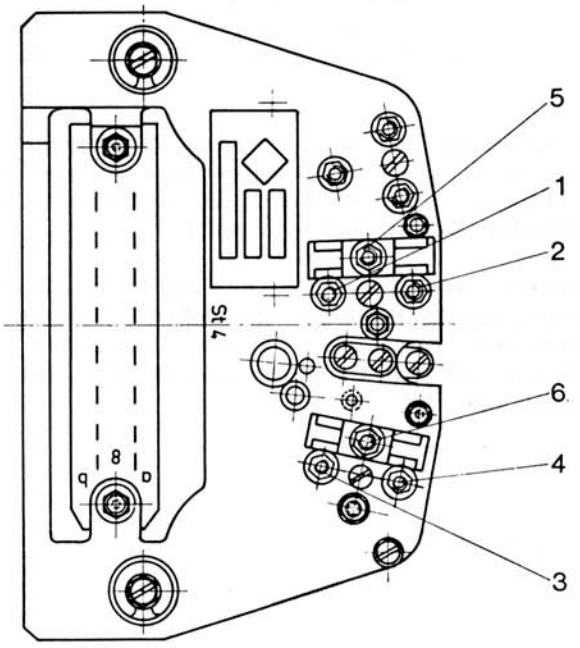



Fig. 13 Head assembly

Certain parts of the drive unit have to be changed after long periods of operation. Their working life is influenced by the mode of operation, etc., and hence cannot be predicted (for special tool kit, see 1.2).

## 6.1. Heads (see Fig. 13)

If the head face is damaged, or if it is not possible to adjust the frequency characteristics with the tolerances laid down despite reliable equalisers, the playback and (or) recording heads must be changed. In the case of the erase head, the precise moment is determined by reduced erase attenuation.

The heads are dismantled by loosening the central fixing screw on each of them, the connections on the multi-point connector having been unsoldered. Refitting the heads is carried out in the reverse order. In this connection, the following points should be observed:

The heads, which are rotatable around the fixing screws, are adjusted so that the head-gap halves the tape embrace. Since it is often the case that the tools used in the works are not available, the following methods can be used:

A thin line is marked on the face of the head with a very soft coloured pencil. When a magnetic tape is run through the machine in the playback position, this colouring is rubbed off at the embrace. The brightened surfaces on the left and right of the head-gap must be equal in width. After attachment, the head must be cleaned again.

The head can be adjusted in height and in a front to back direction of movement by means of the screws (Fig. 13, items 1 and 2, or 3 and 4) after loosening the lock nuts.

It should be adjusted so that the face is perpendicular to the transport plate or parallel to the tape surface. The tape must run symmetrically with respect to the upper and lower edge of the core-block. In this connection, by means of the nuts (Fig. 8, items 5 & 6), the plate springs should be tensioned just far enough to allow a movement of 1 mm to facilitate alignment of the head gap.

After soldering, the heads should be demagnetised.

For optical height adjustment, see 5.19.
For alignment of the heads, see 5.19.2.

6.2
Filter spindle

The filter spindle turns in contact with the caoted side of the tape. Despite its hard chromium plated surface, it will be pitted by the tape coating, although only after a very long period of time. Replacement is simple and consists of changing the upper roller body.

Dismantling and replacement, see 5.18.

6.3.
Pressure rollers

The cover is removed with the special spanner 12.101.00. The centering screw underneath it is unscrewed with the same spanner. The roller can then be easily removed from the spindle. When fitting a new roller adjustment may be necessary. Under the cover-plate, two bushes with slits will be seen, shaped as eccentrics.

For adjustment, see 5.9, 5.9.1, 5.9.2.

6.4.
Tape run-out brakes

The securing ring (Fig. 6, item 8) is removed. Then the knurled nut (Fig. 6, item 7) is unscrewed from the threaded pin with the plate-spring. The lever can now be replaced with a new one and the unit carefully reassembled.

For adjustment, see 5.8.

6.5.
Decelerating and arresting brakes

The tensioning spring (Fig. 6, item 9) is unhooked and the securing ring (Fig. 6, item 10) is removed. Then the lever can be taken off. The cork lining on the new brake lever must be bedded in the installed position.

For adjustment, see 5.8.

6.6.
Signal lamps

Access to the lamps is possible after removing the changeover lever and the cover-plate. The lamps have a rated voltage of 24 V, and the stop-lamp 60V.

6.7.
Front panel

The transport plate is covered by a panel. To take off the front panel, the following must first be removed:

the turntable,
the head-assembly,
the covers for the guide rollers (including tape clock),
the filter roller body and the tape guiding,
the dust cover for the capstan,
the coverings for the push-buttons,
the tape cutter with splicing template,
the special screws in the middle of the front panel,
the plate with the trade-mark and the cutter lever,
the filter levers (first, mark "right" and "left")

Press the rubber rollers on the recording and filter rollers, but do not dismantle.

After unscrewing the nuts on the six attachment screws, the front panel can be removed.

# 7. MAINTENANCE AND LUBRICATION PLAN

## 7. 1. Removal of tape dust

For satisfactory operation of the equipment, apart from normal servicing, regular cleaning is necessary of all parts which come into contact with the tape to remove tape dust, deposits of which can cause many faults.

So, clean regularly, without waiting for deterioration, the heads, the pressure rollers and the tape guiding parts with a soft spirit-soaked cloth. Particular attention must be given to the rubber covering of the left- and right-hand guide rollers, because dust deposit prevents proper entrainment of the rollers.

## 7. 2. Greasing and oiling

Lubrication plan - see Figs. 14 to 18, Section 7. 3.

The following parts are to be kept free of all grease and oily substances:

a) bearings of the brake discs
b) brake surfaces
c) magnet armature
d) plunger of the pneumatic dampers (air damping)
e) running surfaces

Contamination by grease or oil can be removed with spirits.

## 7. 2. 1. Sintered bearings

The damping roller for the head-assembly should, when required, be lubricated with Tellus-oil: all other sintered bearings need no lubrication.

## 7. 2. 2. Tape clock

The tape clock is provided with instrument grease by the supplier. During overhaul, it should be oiled lightly with resin-free bone oil (Tellus).

## 7. 2. 3. Editing switch

The contacts of this switch must be lubricated with Siemens selector grease (Siemenswählerfett) during overhaul of the drive unit.

7. 2. 4.
Tape transport

When overhauling the tape transport, the points indicated in the lubricating chart should be lubricated with "Esso Aviation Beacon 325".

7. 2. 5.
Capstan motor

The capstan motor must be removed and dismantled for oiling. The felt retainers between the two bearing bushes of the capstan motor must be filled with 2 cc of Teresso 43 (Esso) every 2000 operating hours.

The pressure balls should be lubricated with a drop of Hypoid 90 (Esso) after 1000 operating hours.

The running time meter indicates the running time of the recording motor.

7. 3.
Lubrication charts

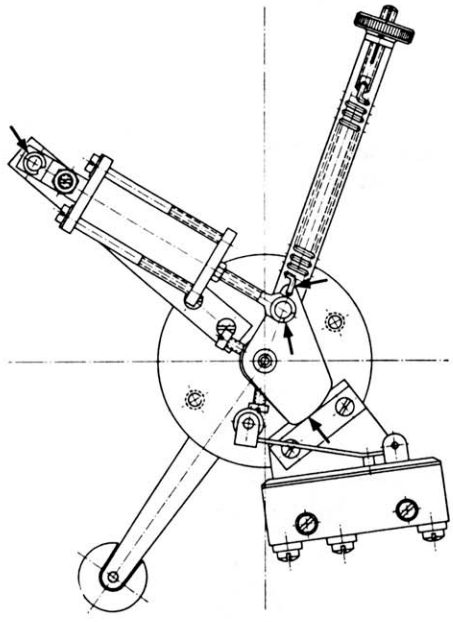


Fig. 14 Right-hand filter lever
Grease with Esso Aviation Beacon 325
(lubrication points indicated)

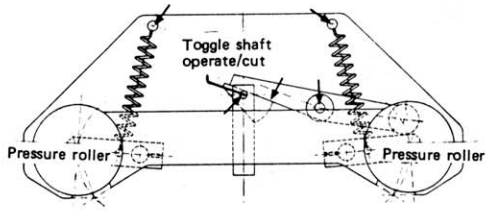



Fig. 15 Operating/cutting switch
(with label and toggle removed)
Grease with Esso Aviation Beacon 325
(Lubrication points indicated)

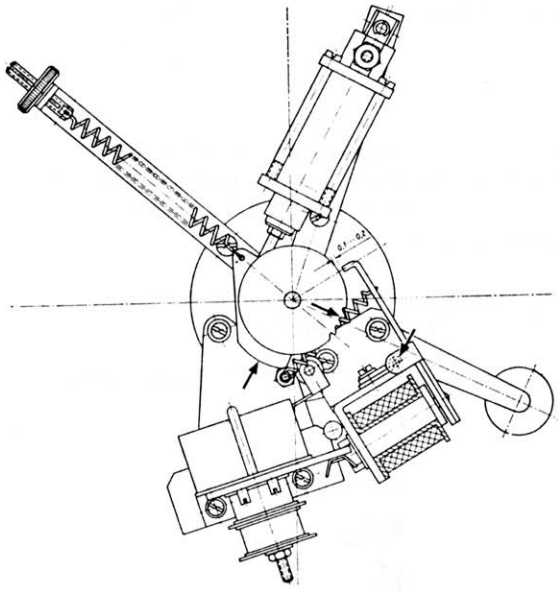


Fig. 16 Filter lever, left
Grease with Esso Aviation Beacon 325
(Lubrication points indicated. Other points as in Fig. 14)

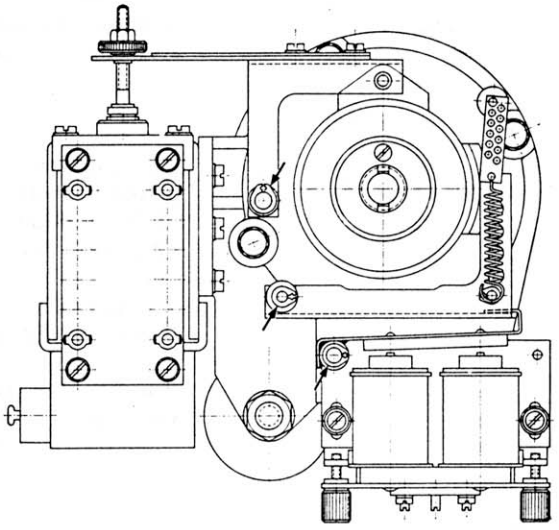


Fig. 18 Brake lever at right and left reel motor
Grease with Esso Aviation Beacon 325
(Lubrication points indicated)

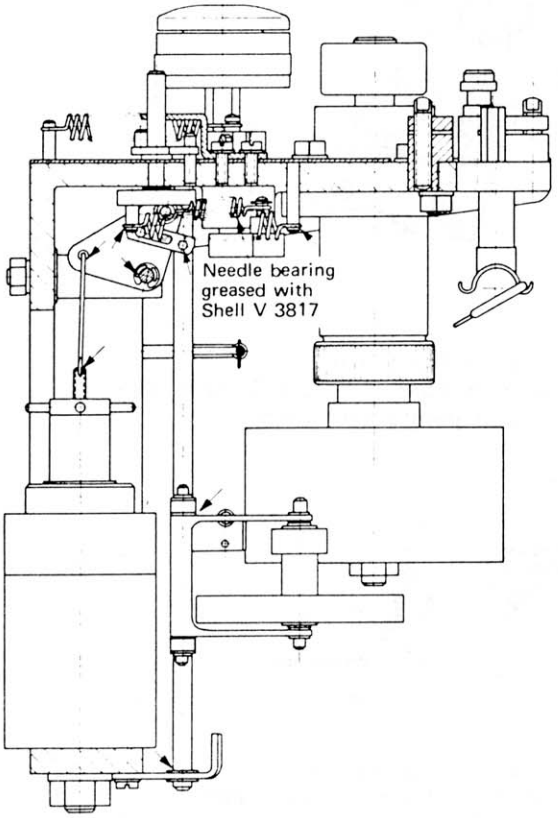
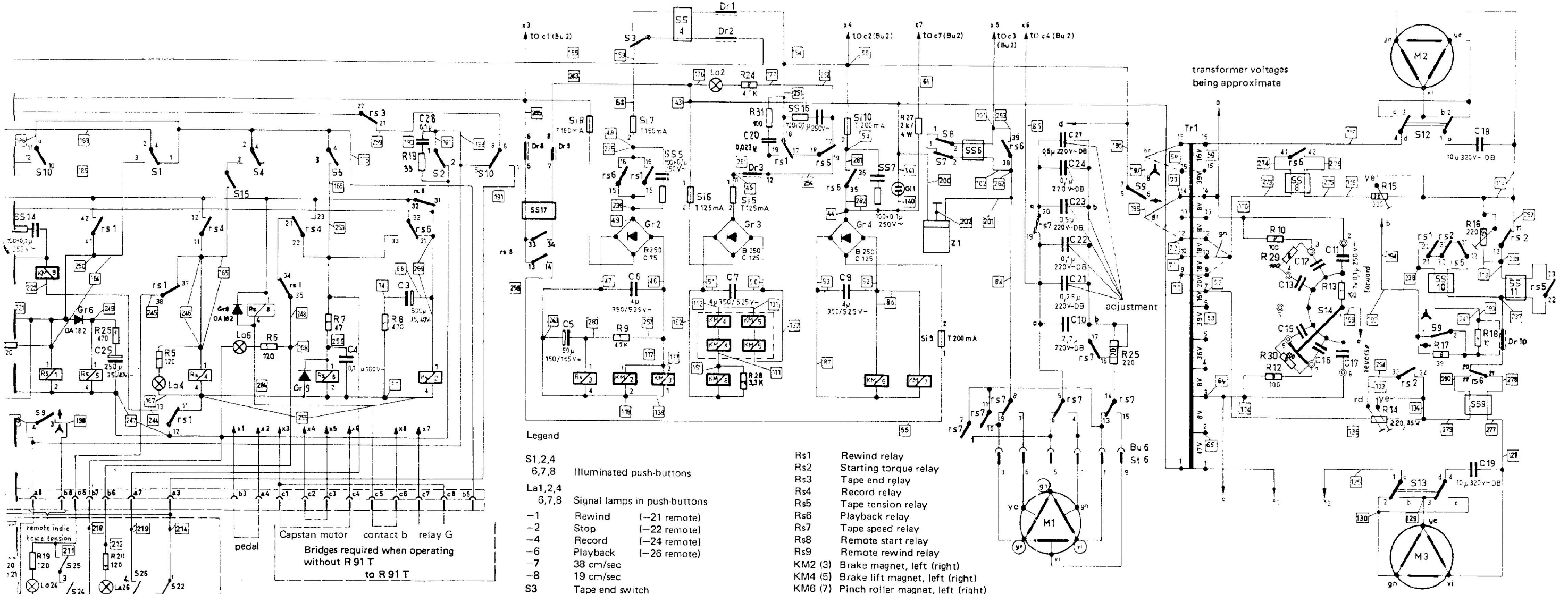



Fig. 17 Capstan motor gear
Grease with Esso Aviation Beacon 325
(Lubrication points indicated)

# 8. CIRCUIT DIAGRAMS

## 8.1. Circuit diagram for 1/4" models




Legend

S1,2,4
6,7,8 Illuminated push-buttons

La1,2,4
6,7,8 Signal lamps in push-buttons

| | | |
|---|---|---|
| –1 | Rewind | (–21 remote) |
| –2 | Stop | (–22 remote) |
| –4 | Record | (–24 remote) |
| –6 | Playback | (–26 remote) |
| –7 | 38 cm/sec | |
| –8 | 19 cm/sec | |

| | |
|---|---|
| S3 | Tape end switch |
| S9 | Tape tension changeover switch |
| S10 | Remote control switch |
| S11 | Mains switch |
| S12 | Changeover switch M2 ┐ |
| S13 | Changeover switch M3 ┘ for brake adjust |
| S14 | Editing switch |
| S15 | Record interlocking |
| S16 | Tape clock brake switch |
| S20 | Changeover forward/reverse, remote |
| S25 | Record interlocking, remote |

| | |
|---|---|
| Rs1 | Rewind relay |
| Rs2 | Starting torque relay |
| Rs3 | Tape end relay |
| Rs4 | Record relay |
| Rs5 | Tape tension relay |
| Rs6 | Playback relay |
| Rs7 | Tape speed relay |
| Rs8 | Remote start relay |
| Rs9 | Remote rewind relay |
| KM2 (3) | Brake magnet, left (right) |
| KM4 (5) | Brake lift magnet, left (right) |
| KM6 (7) | Pinch roller magnet, left (right) |
| KM8 | Holding magnet, left filter lever |
| KM9 | Tape clock brake magnet |
| La10 | Signal lamp, remote control 'on' |
| Gl1 | Stroboscope glow lamp |
| Z1 | Time meter |
| M1 | Capstan motor |
| M2 (3) | Reel motor, left (right) |

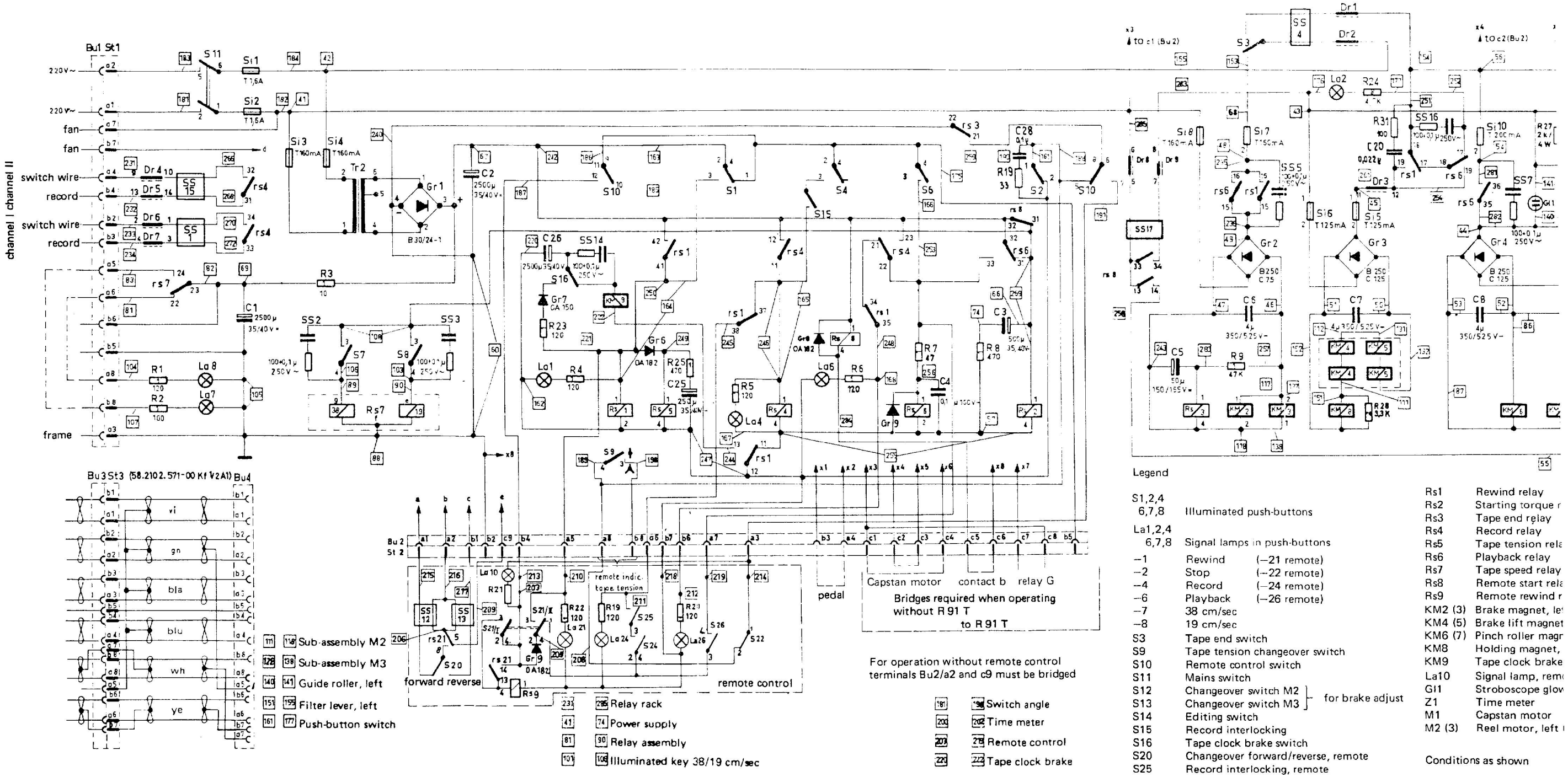
Conditions as shown

1. All relays not excited
2. M1: 12-pole, 19 cm/sec
3. S3 and S16: position without tape
4. S9: position ⊸, for hub 100 mm dia.
5. S10: remote control 'off'

For operation without remote control terminals Bu2/a2 and c9 must be bridged

| | | | |
|---|---|---|---|
| 181 | 198 | Switch angle | |
| 200 | 202 | Time meter | |
| 273 | 276 | Remote control | |
| 220 | 222 | Tape clock brake | |

| | |
|---|---|
| 295 | Relay rack |
| 74 | Power supply |
| 90 | Relay assembly |
| 109 | Illuminated key 38/19 cm/sec |




Sub-assembly M2
Sub-assembly M3
Guide roller, left
Filter lever, left
Push-button switch

Relay rack
Power supply
Relay assembly
Illuminated key 38/19 cm/sec

Switch angle
Time meter
Remote control
Tape clock brake

For operation without remote control terminals Bu2/a2 and c9 must be bridged

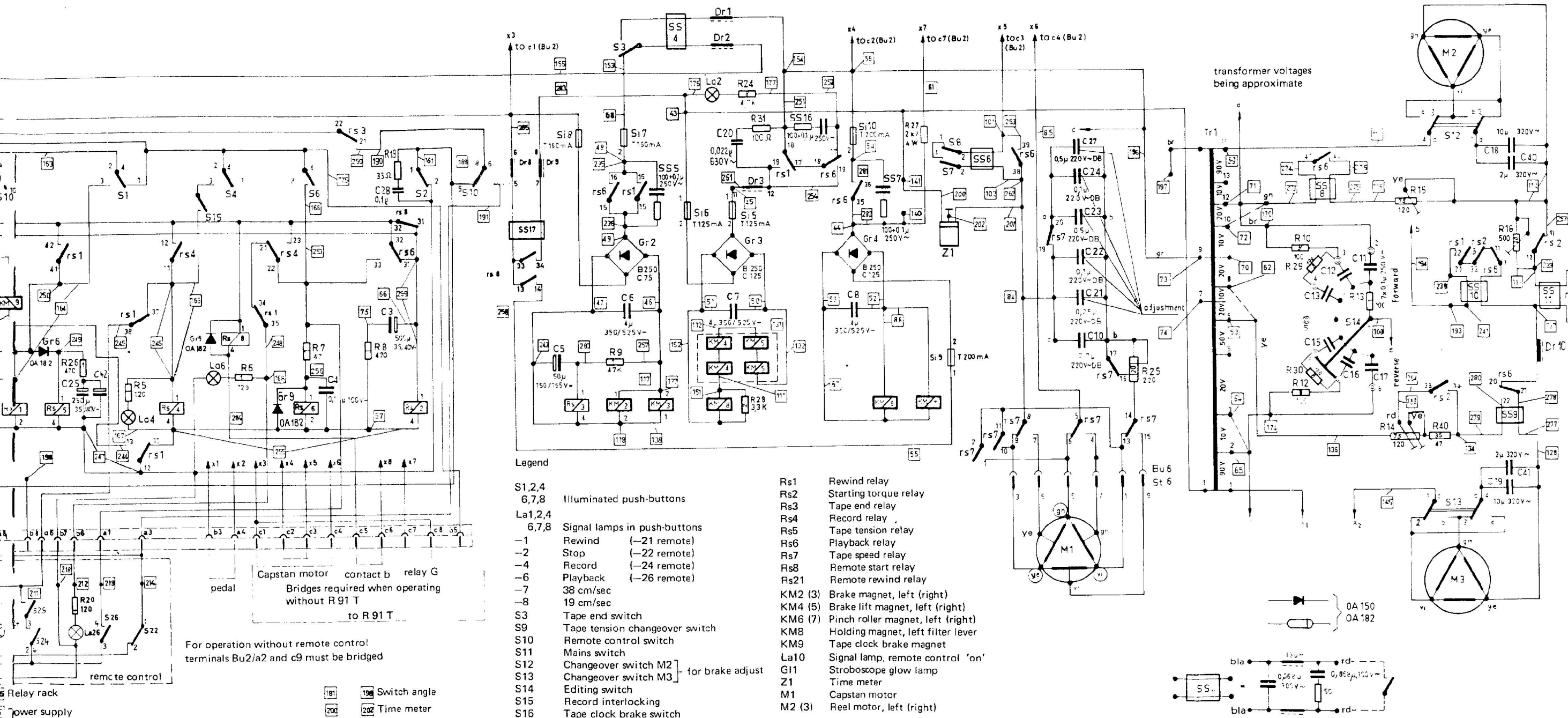
Legend

| | | |
|---|---|---|
| S1,2,4 6,7,8 | Illuminated push-buttons | |
| La1,2,4 6,7,8 | Signal lamps in push-buttons | |
| –1 | Rewind | (–21 remote) |
| –2 | Stop | (–22 remote) |
| –4 | Record | (–24 remote) |
| –6 | Playback | (–26 remote) |
| –7 | 38 cm/sec | |
| –8 | 19 cm/sec | |
| S3 | Tape end switch | |
| S9 | Tape tension changeover switch | |
| S10 | Remote control switch | |
| S11 | Mains switch | |
| S12 | Changeover switch M2 | for brake adjust |
| S13 | Changeover switch M3 | for brake adjust |
| S14 | Editing switch | |
| S15 | Record interlocking | |
| S16 | Tape clock brake switch | |
| S20 | Changeover forward/reverse, remote | |
| S25 | Record interlocking, remote | |

| | |
|---|---|
| Rs1 | Rewind relay |
| Rs2 | Starting torque r |
| Rs3 | Tape end relay |
| Rs4 | Record relay |
| Rs5 | Tape tension rela |
| Rs6 | Playback relay |
| Rs7 | Tape speed relay |
| Rs8 | Remote start rela |
| Rs9 | Remote rewind r |
| KM2 (3) | Brake magnet, le |
| KM4 (5) | Brake lift magnet |
| KM6 (7) | Pinch roller magr |
| KM8 | Holding magnet, |
| KM9 | Tape clock brake |
| La10 | Signal lamp, rem |
| Gl1 | Stroboscope glow |
| Z1 | Time meter |
| M1 | Capstan motor |
| M2 (3) | Reel motor, left |

Conditions as shown

1. All relays not excited
2. M1: 12-pole, 19 cm/sec
3. S3 and S16: position wi
4. S9: position ⊸, for
5. S10: remote control 'off




For operation without remote control terminals Bu2/a2 and c9 must be bridged

Relay rack
Power supply
Relay assembly
Illuminated key 38/19 cm/sec

181 Switch angle
196 Time meter
200 Remote control
202 Remote control
210 Tape clock brake
220

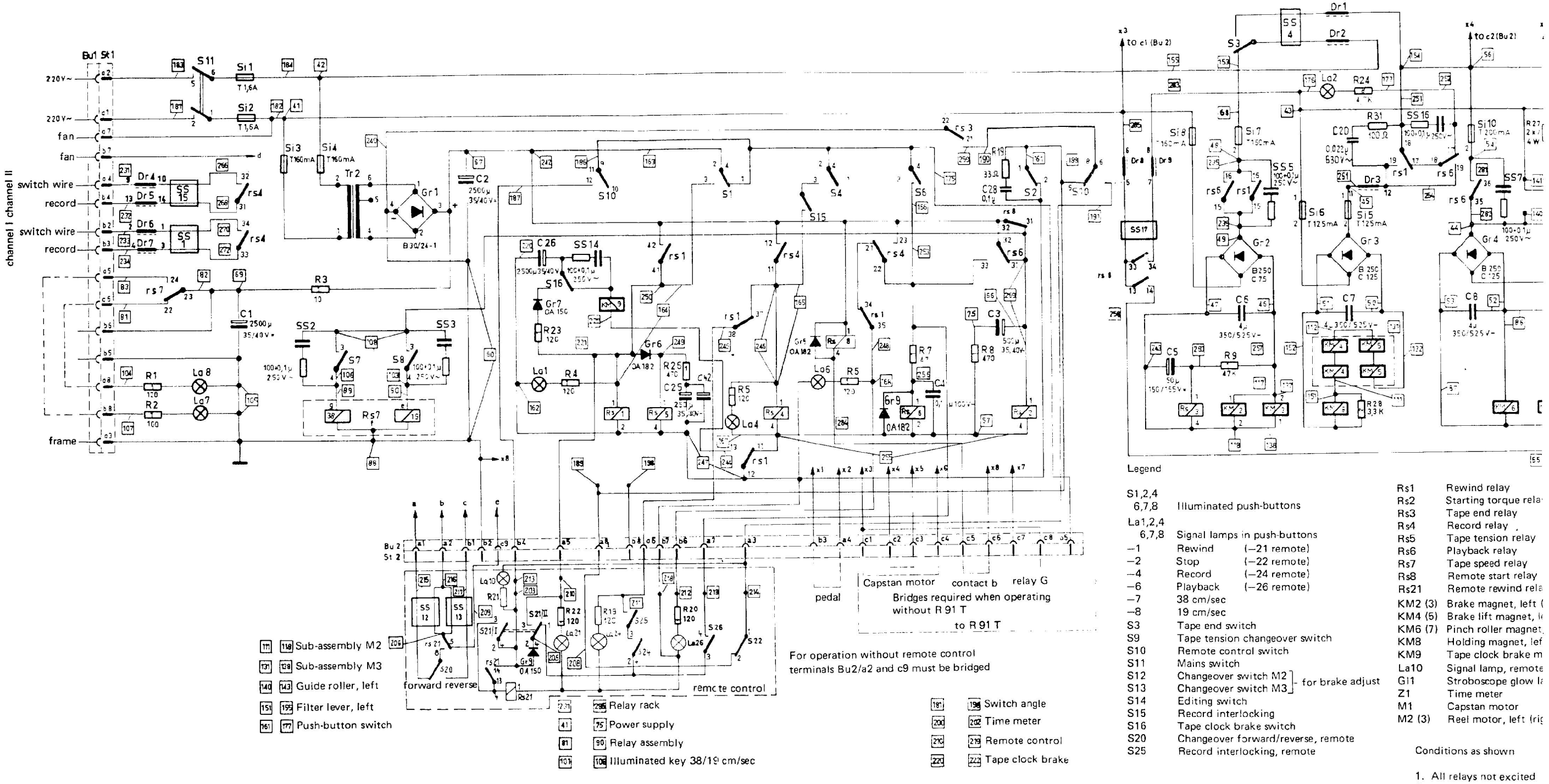
Legend

| | |
|---|---|
| S1,2,4 6,7,8 | Illuminated push-buttons |
| La1,2,4 6,7,8 | Signal lamps in push-buttons |
| –1 | Rewind (–21 remote) |
| –2 | Stop (–22 remote) |
| –4 | Record (–24 remote) |
| –6 | Playback (–26 remote) |
| –7 | 38 cm/sec |
| –8 | 19 cm/sec |
| S3 | Tape end switch |
| S9 | Tape tension changeover switch |
| S10 | Remote control switch |
| S11 | Mains switch |
| S12 | Changeover switch M2 ] - for brake adjust |
| S13 | Changeover switch M3 ] |
| S14 | Editing switch |
| S15 | Record interlocking |
| S16 | Tape clock brake switch |
| S20 | Changeover forward/reverse, remote |
| S25 | Record interlocking, remote |

| | |
|---|---|
| Rs1 | Rewind relay |
| Rs2 | Starting torque relay |
| Rs3 | Tape end relay |
| Rs4 | Record relay |
| Rs5 | Tape tension relay |
| Rs6 | Playback relay |
| Rs7 | Tape speed relay |
| Rs8 | Remote start relay |
| Rs21 | Remote rewind relay |
| KM2 (3) | Brake magnet, left (right) |
| KM4 (5) | Brake lift magnet, left (right) |
| KM6 (7) | Pinch roller magnet, left (right) |
| KM8 | Holding magnet, left filter lever |
| KM9 | Tape clock brake magnet |
| La10 | Signal lamp, remote control 'on' |
| Gl1 | Stroboscope glow lamp |
| Z1 | Time meter |
| M1 | Capstan motor |
| M2 (3) | Reel motor, left (right) |

Conditions as shown

1. All relays not excited
2. M1: 12-pole, 19 cm/sec
3. S3 and S16: position without tape
4. S10: remote control 'off'




For operation without remote control terminals Bu2/a2 and c9 must be bridged

111 118 Sub-assembly M2
131 138 Sub-assembly M3
140 143 Guide roller, left
151 155 Filter lever, left
161 177 Push-button switch

231 295 Relay rack
41 75 Power supply
91 90 Relay assembly
101 108 Illuminated key 38/19 cm/sec

181 196 Switch angle
200 202 Time meter
210 219 Remote control
220 222 Tape clock brake

Legend

S1,2,4 6,7,8 Illuminated push-buttons
La1,2,4 6,7,8 Signal lamps in push-buttons
–1 Rewind (–21 remote)
–2 Stop (–22 remote)
–4 Record (–24 remote)
–6 Playback (–26 remote)
–7 38 cm/sec
–8 19 cm/sec
S3 Tape end switch
S9 Tape tension changeover switch
S10 Remote control switch
S11 Mains switch
S12 Changeover switch M2 ] for brake adjust
S13 Changeover switch M3 ]
S14 Editing switch
S15 Record interlocking
S16 Tape clock brake switch
S20 Changeover forward/reverse, remote
S25 Record interlocking, remote

Rs1 Rewind relay
Rs2 Starting torque rela
Rs3 Tape end relay
Rs4 Record relay
Rs5 Tape tension relay
Rs6 Playback relay
Rs7 Tape speed relay
Rs8 Remote start relay
Rs21 Remote rewind rela
KM2 (3) Brake magnet, left (
KM4 (5) Brake lift magnet, l
KM6 (7) Pinch roller magnet
KM8 Holding magnet, lef
KM9 Tape clock brake m
La10 Signal lamp, remote
Gl1 Stroboscope glow l
Z1 Time meter
M1 Capstan motor
M2 (3) Reel motor, left (rig

Conditions as shown

1. All relays not excited
2. M1: 12-pole, 19 cm/se
3. S3 and S16: position w
4. S10: remote control 'o