

NAGRA[®]

**Transistorized Self-Contained
Tape Recorder with Electronically
Controlled Direct Drive Motor**

KUDELSKI

6, chemin de l'Etang Paudex-Lausanne Switzerland

*Put Into Service
4.6.64*

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BEHREND CINE CORP.
161 E. Grand Avenue
Chicago 11, Ill.
Michigan 2-2281

NAGRA[®]

The Nagra is not a new-comer to the professional field. It is being used extensively by most important radio net-works in Europe, and by many in other continents. The Nagra is well known the world over in many different fields of endeavour, from news reporting to ethnomusicology. It is used with similar success in motion picture production, in automotive research, aviation, ornithology, missionary work, linguistic research, radio photo facsimile recording, the production of records, and in general, whenever it is important to bring studio-quality sound recording outdoors, and whenever excellent speed stability is indispensable. This unique performance is not a miracle. It is the result of very meticulous study of the problems encountered by the user, and very advanced technology and production methods.



Front cover: Mr. Simon of Cinema Sound Inc. New York, on location at Idlewild airport.

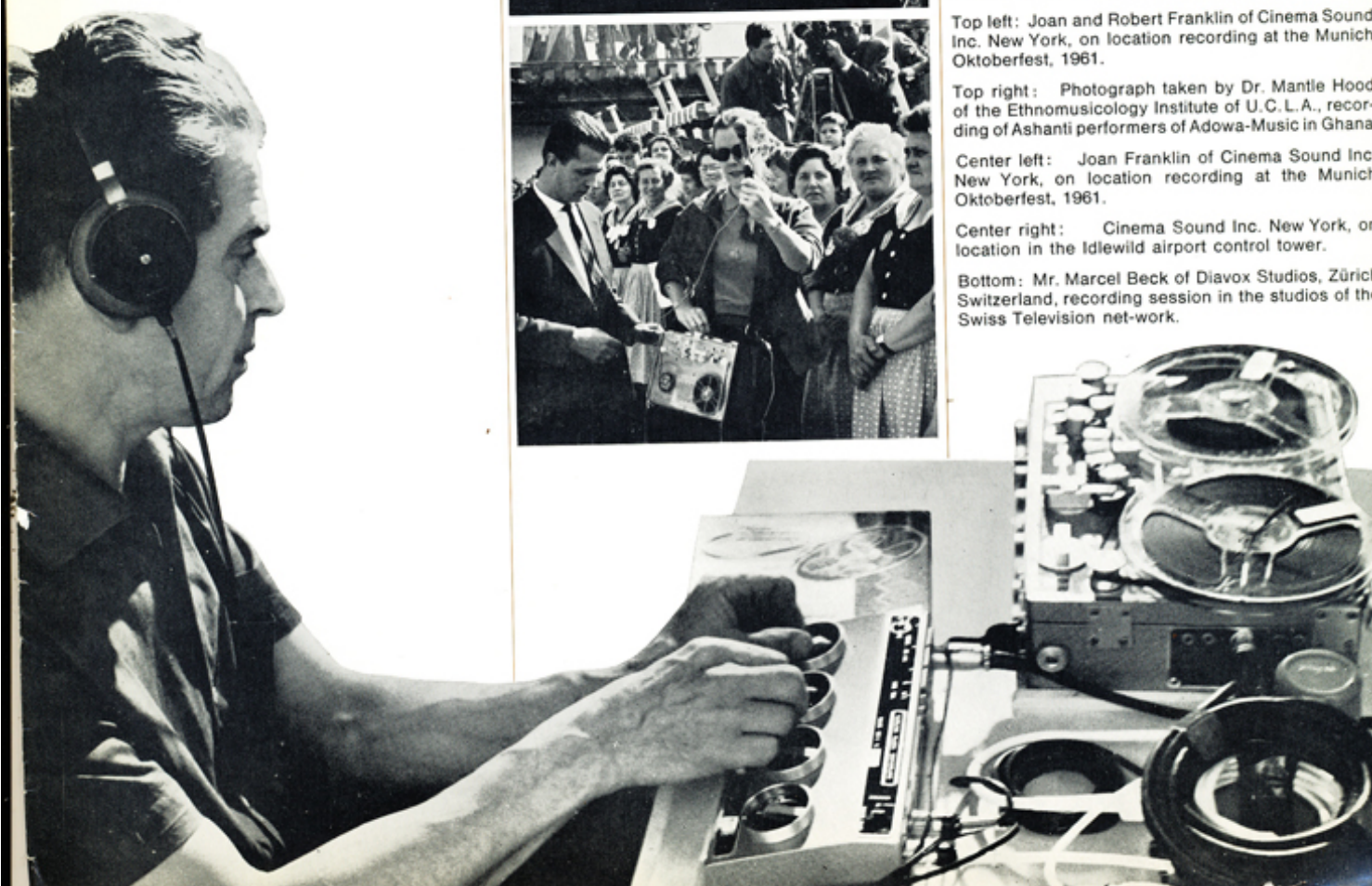
Top left: Joan and Robert Franklin of Cinema Sound Inc. New York, on location recording at the Munich Oktoberfest, 1961.

Top right: Photograph taken by Dr. Mantle Hood of the Ethnomusicology Institute of U.C.L.A., recording of Ashanti performers of Adowa-Music in Ghana.

Center left: Joan Franklin of Cinema Sound Inc. New York, on location recording at the Munich Oktoberfest, 1961.

Center right: Cinema Sound Inc. New York, on location in the Idlewild airport control tower.

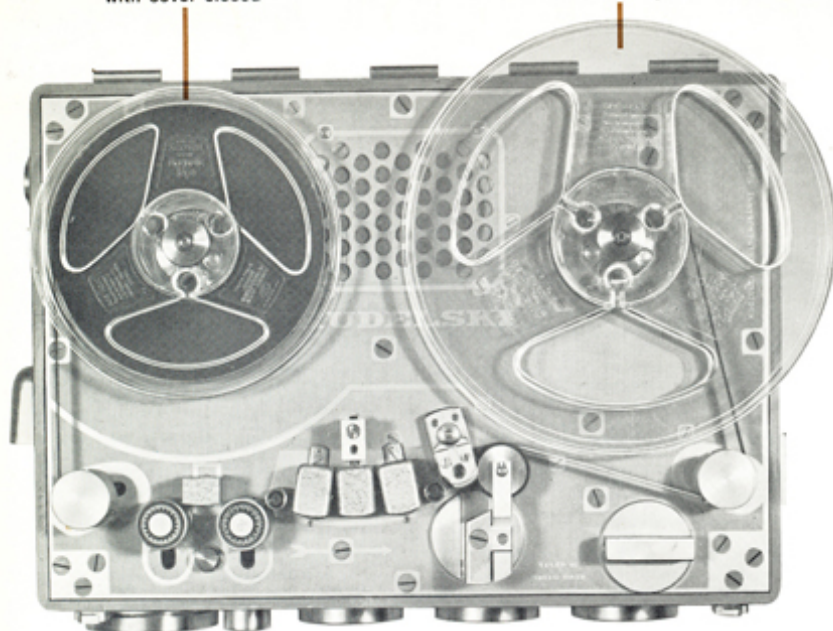
Bottom: Mr. Marcel Beck of Diavox Studios, Zürich Switzerland, recording session in the studios of the Swiss Television net-work.



Up to 5" reels
with cover closed

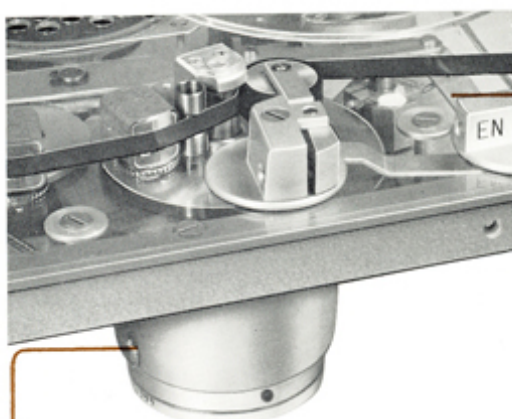
or

Up to 7" reels
with cover open



Transistorized Self-Contained Tape Recorder with Electronically Controlled Direct Drive Motor

The capstan is a part of the motor shaft. We have developed this motor specially for the Nagra III. A wheel, with 400 highly accurate cogs, on its circumference, is mounted on the same shaft. When this wheel turns, it induces an alternating current in an adjacent magnetic head. The signal thus produced, is rigorously proportional to the capstan's angular speed, and consequently, to the linear speed of tape. A servo mechanism, maintains this speed constant and equal to a previously chosen value. We can select the speed, simply by switching a condenser in the frequency meter circuit. We can also modify this speed by a correcting signal, originating at an outside source. This feature, facilitates the construction of simple and efficient accessories, for lip-synchronization in motion picture production, and for stabilization of speed with crystal oscillators.



Motor Servo
Amplifier

Frequency
Meter

Tachymetrical
Amplifier

Accessory Socket

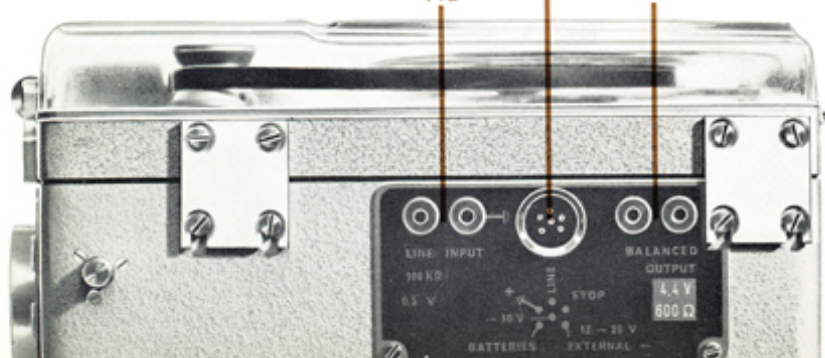
Line Input

Balanced Output

14a

14b

14c



Speed and
equalization
Select. Switch

Shoulder
Strap Button

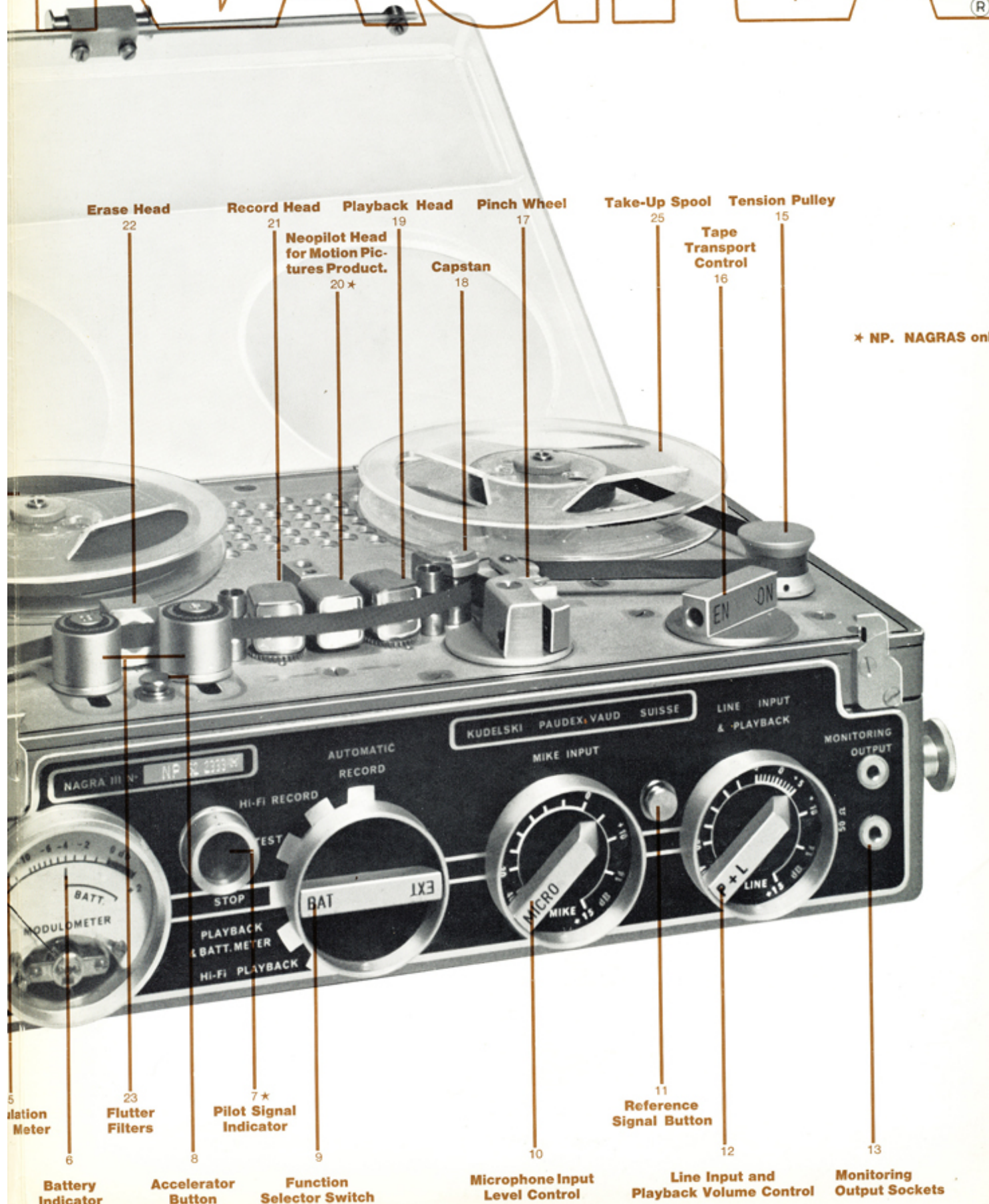
Mod
Leve

24

3

2

NAGRA[®]



★ NP. NAGRAS only

INTRODUCTION

We would like to take this opportunity of presenting you with the description of the NAGRA III portable tape recorder, and let you browse through our old files, and thus get an idea, how and why this machine was developed and put into production.

When we first started the development of the NAGRA III, our intention was to construct a self-contained recorder, meaning: powered by batteries which are incorporated in it, having a recording quality that is sufficient for the recording of music, and as rugged as can be, as this sort of recorders often has to be used under very unfavourable conditions.

As transistors achieved at that time an acceptable quality level, their use brought about solutions, which were not possible with tubes. The major problem was the control of tape speed. The classic solution to this problem consisted of a high speed motor, stabilized by a centrifugal regulator and connected to the capstan by a reduction transmission. (A capstan having a high speed rotation must evidently be of a very small diameter, this in turn makes it rather difficult to obtain a decent flutter value.) Frankly speaking, this solution did not please us at all. We have been producing for several years a tape recorder with a centrifugal stabilizer, (the Nagra I and II), and we have been thoroughly disillusioned by the infinite source of troubles coming from this stabilizer and the associated reduction transmission. Moreover, a high speed motor is noisy, and silent operation is one of the first requirements from a self-contained portable tape recorder.

Another idea, which we have been playing with, is the employment of an AC motor driven by a transistorized DC-AC converter. However, the low efficiency of such motors, especially the slow ones, eliminated this idea.

Then, the only rational solution left, was the employment of a moving-coil motor, the efficiency of which can be excellent, and control its speed with the aid of a servo-mechanism. This solution made it possible to put the capstan directly on the motor shaft, and give it a real size diameter (almost a half inch in the Nagra III). By placing a phonic wheel on the same shaft and by measuring the frequency it produces, we have a means of detecting instantaneously any variations in speed, and correcting them electronically. This solution seemed rather complicated; we were quite afraid to tackle it at the beginning, but after thorough study of the problems involved in such realization, and thanks to the possibilities of transistorized circuits, we managed to solve the problem and finally realize this speed control system in a manner simple enough to be incorporated in a portable tape machine.

We have been manufacturing the Nagra III for several years now, and we can safely say that the results obtained in the field passed our most optimistic hopes. The obtained quality of recording is superior to that of most studio, mains operated tape machines. This is quite surprising, but on closer examination it becomes evident; not being able to utilize a conventional speed stability system, we found a new one. This new system proved to be so much better than our actual requirements at the time. The Nagra III, which was destined to be a tape recorder for use by a news reporter or eventually by the roving ethnologist, is now being used extensively in the recording industry, not so much because of its portability, but due to its remarkably low modulation noise and wow and flutter values.

The success of the Nagra III was such, that in a matter of several years our facilities of production were increased ten times. The recorders are now produced in large quantities, utilizing highly modern automatized equipment, which gives us the possibility of employing very hard stainless steels.

Our modern production techniques assure a good interchangeability of parts and a precision not attainable otherwise. The procedures of final measurements and quality control are likewise perfected; a recorder will not leave our premises without being thoroughly checked and measured by several electronic engineers. A report of final measurements, with the original recordings of response curves and other pertinent characteristics is attached to each recorder and serves as a performance proof. We have gone a long way on this road, and it is with great satisfaction that we can say today that our passage to production in large quantities did not diminish our technical standards. Quite the contrary, a steady progress is immediately evident.

GENERAL DESCRIPTION

1. The quality of recordings obtained.

It is not necessary to elaborate on this point. The technical specifications found in the following pages are sufficiently eloquent. From a practical point of view, it is the tape itself which limits the performance, and it is difficult to go any further, if one wants to stay within the limits of accepted conventions. Experience shows that the tape speed stability does not decrease in any considerable manner with time, contrary to what is evident with conventional tape recorders.

2. Reliability.

What we actually mean by this term is that there is a low probability of failures of mechanisms or circuits. This is one of the most important aspects of the Nagra III, and we dare say, it has already achieved a world-wide reputation. We would like to say that we have done all that was possible in order to attain this degree of reliability.

Size was kept within reasonable limits. Rather than subminiaturize, the electronic components are of normal size.

The resistance to corrosion is excellent as we use high-quality metals and especially stainless steels. As mentioned before, these steels are very difficult to machine, but prove worthy of the trouble when the recorder is employed in unfavorable climates.

Knowing what kind of shocks a portable recorder, may be exposed to, we have constructed the box in such a manner that gives it a very rigid resistance to mechanical damage. The battery compartment serves like a longitudinal truss, which proves to add a great deal of strength to the box. This compartment, by the way, is closed so that damage that may be caused by leaking or swelling of defective batteries is limited to the box itself. Defective batteries are easily removed.

The cover is made of a special acrylic material that withstood very severe mechanical tests.

3. Convenience of use.

As the Nagra was designed to operate in very unfavorable conditions by people who are not technically inclined, it was very important to make its use as easy and as convenient as possible. After several hours of familiarization, it is already possible to make recordings with a quality sufficient for broadcast or the manufacture of records. All controls are positioned in places where they can be manipulated easily when the recorder is carried on the shoulder or placed on a table. A wide range of accessories is available that gives a very versatile use of the recorder for many different purposes: the recording of actual events for broadcast use, recording of motion picture sound tracks with very accurate lip-sync., recording in the studio, recording of instrumentation data, recording of photo facsimile signals and many more.

TECHNICAL CHARACTERISTICS OF THE NAGRA III

I. DIMENSIONS:

Dimension of casing 12.5" × 8.7" × 4.3" (318 × 222 × 112 mm).
Overall dimensions 14" × 9.5" × 4.3" (354 × 240 × 112 mm).
(See technical drawing page.)
Weight of the recorder without batteries 13 lb 13 oz (6.250 kg).
Weight of the recorder with batteries, microphone D 24, Everready leather case, and microphone cable: 18 lb 11 oz (8.615 kg).
Weight of the recorder with export airfreight packing:
(normal choice of accessories) Approx. 22 lb.
Volume of packing: Approx. 1.25 cubic feet.

II. REELS TO BE USED ARE STANDARD TAPE REELS

Up to 7" diameter (1200 feet length with regular tapes like the Scotch 111) with the cover open.

Up to 5" (600 feet Scotch 111) with the cover closed.

Thus, with the cover closed, and at the speed of 7.5"/sec, it is possible to record during 15 minutes with Scotch 111 tape, and during 30 minutes with Scotch 200 tape. With the cover opened, recording time is 30 minutes with Scotch 111 tape and 1 hour with Scotch 200 tape.

III. POWER SUPPLY:

- a) The recorder can be run off its own batteries. A set of 12 cells size D is required. One can use for instance these types:

U. S. A.	Ever-ready 950 D, R. C. A. VS. 036 Ray-O-Vac 2 LP, Burgess 2 D, Usalite 879 etc. Vidor V 0002, Berec U 2
England	Titania 2211
Germany	Wonder « Marin » 1602, Mayda (Cipel) RGT 1, 5 V
France	Hellesens 211
Spain	Leclanché 300 ou 300 S
Switzerland	Alladin 1, 5 V cell
Pakistan	Ever-ready 1, 5 V
India	Pile Elephant 1, 5 V
China	Kai-it 360
Hongkong	

- b) It is likewise possible to power the recorder with incorporated hermetic alcalin accumulators like the following:

Switzerland	Leclanché 32 A 60
Germany	DEAC 2,5 Ah
U. S. A.	Gould 2,5 Ah

These accumulators can be recharged in 16 hours by the ATN and PAR recharger (see accessories list).

- c) By an external source of DC current. The tension must be within the range of 12 V to 25 V. The positive is earth. At the lower tension range (12 V), the recorder still functions perfectly, and only the fast rewind is much slower than as with 25 V. Certain condensers in the recorder circuit may fail, if the external tension is higher than 25 V, especially when the operating temperature of the recorder is over 25° C.

The ATN mains power supply (and also the old ATU and ATUP), will supply the Nagra III with the required DC current. It can be powered by mains current from 110 V to 250 V, 50 or 60 c/s.

Power consumption and cell life.

In the TEST mode	85 mA.
In play back mode	175 mA.
In recording mode	205 mA.

During play back, when an H power amplifier is installed in the Nagra, the consumption depends on the volume, and would be around 300 to 350 mA.

Life of regular flash light batteries, or 2,5 Ah accumulators, is therefore, about 15 hours. The capacity of batteries will increase if the recorder is used for short periods (for instance, 15 minutes of operation per hour). The batteries actually recuperate during the periods of rest. On the contrary, the capacity of the rechargeable accumulators, do not depend on their manner of use. Generally speaking, accumulators will prove very economic to those who may use the Nagra, more than 1 hour a day, and may have an access to a mains power supply for the purpose of recharging. The conservation time of normal quality batteries (such as may be acquired at any drug store, any where in the world), is from 6 to 12 months. In warm climates, this will decrease.

IV. RECORDING STANDARDS

The Nagra III uses standard $\frac{1}{4}$ tape, of any thickness available on the market. The very efficient regulation of tape tension of the Nagra III, permits even the use of « Quadruple play » tape. At the speed of 3.75", and using a 7" reel 4 hours of recording time may be obtained. Of course, the high print-through effect of such tape, prohibits the use of it, when sound quality is required.

Single track recording is used, which employs the full width of the tape. Recorders destined for the U.S.A. will be adjusted to record according to the Ampex standards at the 15" speed. Recorders destined for other countries, are adjusted to record according to the CCIR standard at the 15" speed. At any rate, the difference between the two standards at the 15" speed, is very small. At the 7.5" speed, both Ampex and CCIR standards are provided.

The bias is adjusted at the factory, using Scotch 111 tape. This gives optimum results, with practically all tapes, currently available on the market. Upon request, we may adjust your Nagra, for use with any specific tape. This service may be granted free of charge, if we will receive in advance, a sample of the tape to be used. It must be well remembered though, that in the case of inferior tapes, we could not guarantee the normal performance of the Nagra.

The Nagra III is equipped with separate recording and play back heads. Each of the heads is constructed so as to give optimum performance in its respective function. Play back and recording can be made simultaneously, which gives the possibility of monitoring the recording with earphones.

V. SPEEDS

The Nagra III has three operating speeds: 15", 7.5" and $3\frac{3}{4}$ ". The speed is changed by a commutating switch (N° 1) easily manipulated with the aid of a small coin.

Upon request, the Nagra III may be supplied with the additional speed of $1\frac{7}{8}$ ". Actually any speed between $\frac{15}{16}$ " to 30" is available, whether it is a multiple of 30" or not. It is well to note that in order to work with a speed of 30", a power supply of 24 V is required. Speed stability and wow & flutter values will not be very good at the low speeds, but this becomes evident only below 7.5".

VI. INPUTS:

There are two mixable inputs in the Nagra III, with two separate sensitivity control potentiometers.

Input N° 1 (N° 3): here one can connect normally an electrodynamic microphone with 50 or 200 ohms impedance.

Sensitivity: 0.2 to 10 mV with 200 ohms microphone;
0.1 to 5 mV with 50 ohms microphone;

To change from 50 to 200 ohms, one lead has to be rewired internally.

Input N° 2 (N° 14 a):

Here one can connect:

- a) A line signal from 0,5 to 10 V with input impedance of 100 Kohms (N° 14 a).
- b) A line signal from 10 mV to 1 V with input impedance of 2,5 Kohms (N° 14 b).

With this combination of inputs, one can connect an electrodynamic microphone to input N° 1 (left side) and our condenser Nagrastatic microphone to input N° 2 (right side).

Other accessories that may be connected to this input (N° 14 a) are:

- a) ATN (or old ATU and ATUP) mains power supply.
- b) The BS microphone preamplifier, permitting the connection of a second electrodynamic microphone to this input. The input of this preamplifier is identical with that of input N° 1 (left side) of the NAGRA.
- c) An AM3 power supply-preamplifier, permitting the connection of a Neumann (or Telefunken) KM series condenser mike, or a Schoeps microphone with modified plug wiring.
- d) A BM small mixer, permitting the connection of 3 electrodynamic mikes and a line, or a condenser KM microphone (with AM 3). The ATN power supply can be connected to the mixer, permitting thus the operation of all the accessories connected in this manner, on mains power.

Neopilot input:

The Neopilot Nagra III NP, for use in motion pictures production, will also carry a special input for the Neopilot signal, for synchronization with the filmed image (see motion pictures equipment section).

VII. OUTPUTS:

Balanced line output: (N° 14 c). This line output is symmetrical. That is, not connected to The earth of the unit. This permits the elimination of parasite induction when connecting the Nagra to other instruments. The characteristics are marked on the label:

With a load not less than 600 ohms — 4,4 volts (+ 15 db) or on request, with a load not less than 100 ohms — 1,55 volts (+ 6 db).

We can supply recorders with other values of output tensions, within the limits of the available power (32 mW or + 15 dbm at 0 db level).

At this socket the following signals will be found:

During testing and recording, the signal applied to the recording head.

During play back with incorporated speaker (8 o'clock position of the main function selector switch) the signal feeding the loud speaker with attenuated low frequencies and reduced output voltage. Do not use this mode for high quality sound transfer to another recorder or a power amplifier.

During Hi Fi play back (7 o'clock position of the main function selector switch), the normal line output signal, e. g., the signal from the play back head, and from the microphone input, combined. Thus commentaries can be added to the retransmission of the recording, or the recorder can be used as a reporting amplifier.

Monitoring output sockets: (N° 13) these sockets are suitable for headphones, with an optimum impedance value of 50 ohms. The normal output level without load is about 0,3 V.

The use of earphones with a different impedance value, will result in a reduced level. It is preferable to use electrodynamical earphones of high quality.

In operation, this input is taken from:

The recording amplifier, when in the TESTING mode.

The play back amplifier when in the RECORD, AUTOMATIC RECORD, and PLAY BACK & BATT METER modes.

VIII. ADJUSTMENT OF THE RECORDING LEVEL:

Normally this will be done manually, with the aid of the two input level control potentiometers (N° 10 & 12). A visual check of the recorded signal or the signal sent to the line output, is provided by means of a modulometer (N° 5). This is a level meter, having a 10 msec. integration time.

A modulometer is preferable to a regular volume unit meter, as it permits the measurements of very short sounds, which may be very important in the recording of music containing a dominant percussion section, or in the recording of noises. The 0 db mark of the modulometer, corresponds to the maximum recording level, whether the signal is continuous or transitory. On demand, we can supply the Nagra with a regular V. U. meter.

The recording level may also be controlled automatically by a limiter having a response time of about 1 msec. In using this feature (12 o'clock of the main function selector switch), low frequencies will be attenuated, and the recording obtained may be of a quality which is sufficient for speech, but not for music. The automatic facility only affects the microphone input (N° 3).

IX. INCORPORATED LOUD-SPEAKER:

The Nagra III has a small speaker incorporated in it. The available sound power, is quite low, as this speaker is connected to the line amplifier, the power of which has been limited to the necessary minimum, in order to reduce the power consumption.

Those who may need a higher sound level for play back, when a recording is to be played back to a large group of people, an additional power amplifier may be incorporated in the Nagra. This amplifier, designated H, is intended strictly for the driving of the small internal speaker. As the sound quality required, is not as high as the line output, as in any case, the speaker cannot conserve it, the H amplifier is a class B amplifier, that is, it consumes current only when power is demanded from it. This is the reason that the Nagra III BH or III NPH, will drain more current on play back (see power consumption section). The power output of the H amplifier, is about 1 to 2 W.

Those who may need even higher sound level, may obtain it with the aid of the DH self contained speaker-amplifier (see respective section).

X. FAST REWIND:

The Nagra III features fast electrical rewinding and forward running of tape.

XI. THE NAGRA III MAY FUNCTION IN ANY POSITION.

XII. TEMPERATURE RANGE: - 20° C to + 50° C.

In low temperatures, the batteries do not give sufficient energy, and as the lubricants become very viscous, the power demand from the batteries, is higher. The optimal speed for operation in low temperatures, will be then, 7.5"/sec.

In high temperature operation, a motor thermal runaway may be expected due to thermic currents in the motor speed control system transistors. From the point of view of reliability of operation, it is not advised to operate the recorder at temperatures higher than 50° C. However, if it is necessary to expose the recorder to higher temperatures, it will be then required to limit the supply tension. The ideal tension will be in such a case: 12-14 V at the speed of 15", and 11-13 V at 7.5".

SPECIFICATIONS

Note: The asterisk next to a figure, indicates the minimum guaranteed performance.

The Nagra III gives recording with sound quality similar to that of the best studio console tape recorders. From certain points of view, it is even better. The modulation noise, and the conservation of speed stability with the use of the recorder, are particularly remarkable. In other words, the performance of the recorder, exceeds the standards, set by international conventions and the big radio networks.

1. FREQUENCY RESPONSE CURVE:

With certain tapes, the performance is even better than indicated below.

Recording at a level of -20 db.

Signal is fed into the line input, and is read at the line output (no load), in the « Hi Fi play back » mode.

Attention: if the measurement is made by reading the played back signal during recording at the monitoring output sockets, the full performance will not be obtained, as the signal found at these sockets, is not completely corrected in the very low frequencies range.

Attention: By recording at a level higher than -20 db, the tape may be saturated in the high frequency range due to the preaccentuation of the highs, required by standards used in broadcasting.

At $15''/\text{sec} - 30$ c/s to 18.000 c/s ± 1 db (30 c/s to 16.000 c/s ± 1.5 db *).

At $7.5''/\text{sec} - 40$ c/s to 15.000 c/s ± 1 db (50 c/s to 12.000 c/s ± 1.5 db *).

When the Nagra is intended for use in a laboratory at $15''/\text{sec}$, we can provide it with frequency response up to 30.000 c/s. For electro-acoustical purposes, we prefer to limit the response at 18.000 c/s.

2. DISTORTION:

The distortion of the recorder is negligible, as compared to that of the tape itself. In the complete circuit of recording and play back we have 2% of 3rd harmonic, and 0.5% of 2nd harmonic distortion.

3. SIGNAL TO NOISE RATIO:

Attention: it is absolutely necessary to measure the background noise with a voltmeter, having filters which limits its frequency response curve to the range of the recorder frequency response curve. Otherwise, one will measure the noise of the amplifiers not only in the 30 c/s to 16.000 c/s region, but also in infrasonic ranges up to several hundred Kc.

The use of regular voltmeters for the measurement of background noise, will give a completely false result, as such a method is only practical with recorders, where the output amplifier itself, limits the frequency response curve.

Best results can be obtained by use of special filters made for this purpose, and choose those which were designed for the measurement of very low noise levels. We use the ASA A filter, which is very close to the DIN 3.

The play back circuit gives at $7.5''$ and $15''$ at least 70 db * of signal to noise ratio.

The recording-play-back performance depends essentially on the tape used. We obtain normally 62.5 db.

The noise level of the microphone preamplifier is measured at about -125 dbm (dbm = db below 1 mW), ASA A filter.

4. ERASE:

We record a 1 kc signal at a 0 db level (maximum). This recording is erased with both input potentiometers closed. Then the tape is played back while the residual signal is detected with the aid of a selective voltmeter. This residual signal is normally about -80 db (-75 db *).

5. SPEED STABILITY:

a) **Absolute speed:** This speed is adjusted at the factory at $\pm 0.1\%$ for the 15" and 7.5" speeds. The speed variation with the change of position, and the change of batteries tension, in the normal operating range, is less than $\pm 0.05\%$ ($\pm 0.1\%$ *). The speed variation between the beginning and the end of a 7" reel is $\pm 0.1\%$ ($\pm 0.2\%$ *).

b) **Wow and flutter:** Measured following the DIN 45507 standard, weighted.

Peak value with weighing filter:

4 c/s = 0 db;

0,4 c/s = -15 db;

40 c/s = -10.4 db.

The variations measured according to this standard, and compared to similar standards will be as follows:

	Peak to peak Din 45507	RMS 2-200 c/s	1-200 c/s Peak to peak
15"	$\pm 0.08\%$ ($\pm 0.1\%$ *)	$\pm 0.06\%$ ($\pm 0.08\%$ *)	$\pm 0.07\%$ ($\pm 0.14\%$ *)
7,5"	$\pm 0.12\%$ ($\pm 0.15\%$ *)	$\pm 0.08\%$ ($\pm 0.1\%$ *)	$\pm 0.12\%$ ($\pm 0.24\%$ *)

These values correspond to the most unfavourable case, where the periodic faults of the play back, are added to those of the recording. In practice, these values are much better.

Upon request, we can supply accessories permitting the regulation of speed during play back, by a recorded pilot signal. A stability of reproduction of recording-playback frequency, in the order of $\pm 10^{-5}$ or better, can be achieved without difficulty.

This in particular, permits the recording on tape of a facsimile radio photograph signal.

DESCRIPTION OF CONTROLS

1. Speed and Equalization Selector

This switch may be operated by a coin in the slot. It simultaneously changes speed and equalization, both for recording and playback. The following combinations are available:

38,1 cm/sec. = 15"/sec. (CCIR or Ampex on request)

This speed is normally used in broadcasting studios. The use of it, insures the best quality; the azimuth adjustment is not very critical, while the response curve is always excellent and varies little from tape to tape. At this speed, the tape is little affected by repeated playbacks. Another advantage is that editing is easy, and that a suitable machine operating at this speed can usually be found in studios for playback of recordings.

19,05 cm/sec. = 7.5"/sec. CCIR Equalization Standard

This is the normal speed for the general uses of the Nagra in studios working with the CCIR standards.

19,05 cm/sec. = 7.5"/sec. Ampex Equalization Standard

For use in the U. S. A.

9,525 cm/sec. = 3.75"/sec.

This speed is for use where high quality is not required and tape economy is important. One hour and a half recording time can be obtained with the use of 5" reels and using triple play tape, or three hours with 7" reels.

2. Tension Pulley

This pulley is movable and operates a brake on the feed spool.

3. Microphone Input

The microphone used should have an impedance of 50 or 200 ohms. The input socket on the Nagra is Cannon type XLR-3-42. The plug on the microphone cable is Cannon type XLR-3-11C. Contact N° 1 is earth and contacts 2 and 3 are the microphone connections. The input is symmetrical (there is no connection between primary and earth).

4. Shoulder Strap Button

For the attachment of a shoulder strap or « Ever-ready » case, a small set screw is fitted for safety in the nut. (A 0.050" (1.27 mm.) key is provided.)

5. Modulation Level Meter

The upper scale on the meter is for measuring the recording level (on Test or Record), and the output level to the line, on Hi-Fi playback.

6. Battery-Indicator

The lower scale of the meter is intended for checking the state of the batteries. The meter is connected to the batteries when the function selector switch indicates « Playback & Batt. Meter ». The pointer should lie in the marked segment when the batteries are in working condition. This indication leaves a safety margin when on 7 1/2" or 3 3/4"/sec.

Audible battery warning:

When recording or playing back at the 15" speed, an audible alarm signal will be heard in the monitoring earphones, whenever the batteries go down below 11 volts. This is, of course, an independent circuit that does not interfere with either the recording or playback circuits.

7. Neopilot Signal Indicator

This is an indicator on which a white cross will appear when the Nagra is receiving the Neopilot signal.

8. Accelerator Button

By pressing this button, the motor is made to run at maximum speed. This can be done during playback for fast forward running.

9. Function Selector Switch

This switch controls the functioning of the Nagra. It has two sets of six positions. One set is for working on internal batteries when the end of the switch knob marked « bat » is used as an indicator, and one set is for working with an external power supply, when the other end of the knob, marked « ext », is used as an indicator.

The positions are as follows:

STOP in the center (9 o'clock position).

TESTING to the right (10 o'clock position).

In this position the amplifiers are connected but not the motor so that the incoming signal to be recorded can be checked. The monitoring earphones are connected to the recording amplifier.

HI-FI RECORD = Normal recording position, (11 o'clock position). The earphones are connected to the playback amplifier, so that the actual recording is monitored. Incoming signals can be mixed from both microphone and line inputs. The level of each of these signals can be adjusted by the appropriate volume control.

AUTOMATIC RECORD, (12 o'clock position), = Recording with automatic control of level and attenuation of low frequencies. The quality of recording in this position is acceptable for speech but not for music. The automatic facility only affects the microphone input and not the line input.

PLAYBACK & BATT. METER, to the left (8 o'clock position), = Playback on the internal loudspeaker. In this position the meter indicates the battery voltage. The playback level is varied by the line input and playback volume control (N° 12). The headphones are fed directly from the playback amplifier at a fixed level. The quality through the loudspeaker or at the line output is limited. The monitoring output for headphones is always fed with a high quality signal.

HI-FI PLAYBACK, (7 o'clock position), = Normal high quality playback. The loudspeaker is cut out of the circuit and the signal output is fed at low level for headphones at the monitoring output and at high level to the line output sockets. The signal, fed into the line, is measured by the meter. This output consists not only of the signal, played back from the tape, but also of a signal from the microphone input that can be added for commentary.

10. Microphone Input Level Control

This control varies the modulation level of the signal, which is fed into the microphone input.

11. Zero Level Reference Signal Push Button

This push button, sends a whistle through the line input while the motor is running. It is useful to record this whistle before recording sound at a zero level, that is to say, the modulator needle should point to zero on the scale. This signal is highly useful for the regulation of the chain of sound transfer. It is as well to leave at least two complete turns of the tape between the signal and the sound track so as to avoid the possibility that it might be superimposed on the sound track during the transfer process.

12. Line Input and Playback Volume Control

This control has two purposes:

- a) During Hi-Fi recording it varies the modulation level of the signal fed into the line input.
- b) During playback it varies the output signal.

13. Monitoring Output Sockets

14. a) Line Input

b) Accessory Socket

c) Balanced Output

15. Tension Pulley

This pulley is movable and controls the take-up spool clutch.

16. Tape Transport Control

Turning this control, which is marked on one side « En-On », clockwise, brings the pinch wheel into contact with the capstan. Turning it counterclockwise disengages it, and starts rapid tape rewinding. This occurs when the Selector Switch (N° 9) is turned to either of the playback positions. If rewinding is required when the switch is at « Testing », this can be obtained by depressing the accelerator button (N° 8). As a safety feature, the tape cannot be rewound in any of the recording modes.

17. Pinch Wheel

This rubber roller presses the tape against the capstan to drive the tape. It is operated by the control mentioned above (N° 16). The pressure of the pinch wheel can be adjusted by means of a screw on the assembly.

18. Capstan

This drives the tape at a constant speed.

19. Playback Head

20. Neopilot Head for Motion Pictures Production

21. Record Head

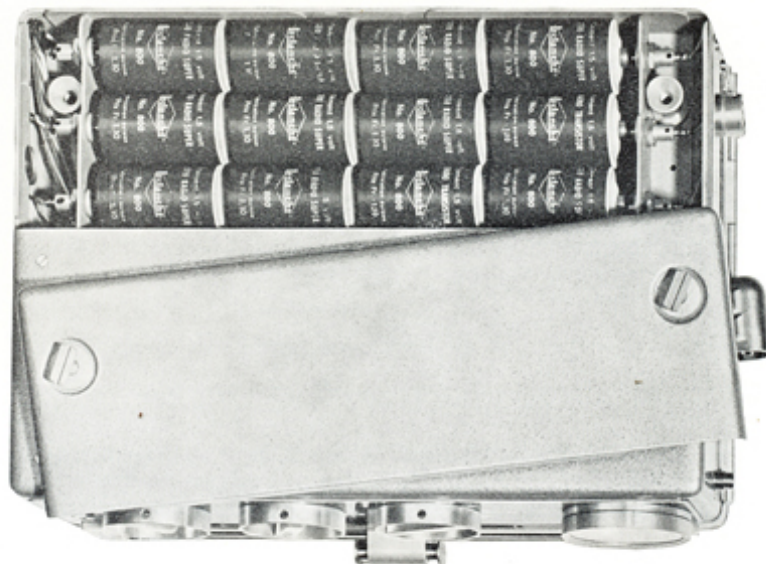
22. Erase Head

23. Flutter Filters

These carry markings which enable the tape speed to be checked stroboscopically. The speeds are set at the factory by comparison with a standard generator driven by a Quartz crystal clock.

24. Feed Spool

25. Take-Up Spool



The Battery Box

The Battery box compartment is accessible from the bottom of the instrument. A normal set of batteries consists of 12 1.5 volt flash-light cells.

MOTION PICTURES EQUIPMENT

THE NAGRA III NP (NEOPILOT)

GENERAL

So far as the recording and reproduction sections of the models are concerned, the Nagra III NP is exactly identical to the Nagra III B. The Nagra III NP, however, differs from the Nagra III B by virtue of the Neopilot head and by additional electronic circuits, which give it the additional capacity of synchronizing sound with the photographed image (« lip-synchronization », used in films and TV).

For reasons of its ease of use, sprocket tape or sprocket film is universally used for the editing of the sound on cinema films. But it is much more convenient, while shooting, to record the sound track on regular $\frac{1}{4}$ inch magnetic tape and to utilize a system of pilotage to ensure the proper synchronization.

Therefore, the sound is recorded on magnetic tape (e. g. on the Nagra III NP) together with a pilot signal, which comes from the camera, and which constitutes a form of invisible perforation. Both sound and pilot signals are, of course, recorded on two distinctly separate recording channels, which do not interfere with each other; the recording, thus obtained, is later transferred to sprocket film. Sound transfer procedures, which will be examined below, render it possible to obtain the sound track on sprocket film exactly as if a sprocket tape recorder was used at the site of shooting. Because of the portability of the Nagra, and due to the fact that it does not require a three phase power supply, this procedure offers a great many advantages.

PILOTAGE PROCEDURES

There are an infinite number of possible pilotage procedures. In practice, however, all the existing systems record a pilot signal of 50 or 60 cycles, originating at the power supply of a synchronous motor driven camera. When the camera operates on batteries, these systems incorporate a « Piloton generator » in the camera that produces a similar signal (50 cycles per 24 frames in European cinema, 50 cycles per 25 frames in European TV and 60 cycles per 24 frames in the United States).

Of its own nature, the choice of the number of cycles, or the number of frames is arbitrary; it is simply necessary that the sprocket tape recorder, on which the transfer is made, is compatible. For example, in the United States a speed of 24 frames per second is used, while the mains power supply is of 60 cycles per second; the sprocket tape recorder's have been designed for these values accordingly. Therefore, the pilot equipment must be for 60 cycles per 24 frames if the copy (or transfer) is to be made in the United States. The Nagra III NP functions well with any standard as it is possible to record either a 50 or a 60 cycles pilot signal. The SLP synchronizer is equally multi-standard.

The essential difference between the various systems in use, is the method employed in obtaining the second channel (the pilot signal channel).

Some systems use stereophonic machines for this purpose, but half of the tape is wasted on the pilot signal only. This brings about an exaggerated reduction of the signal-to-noise ratio. Other systems use two or three tracks with a very narrow track for the pilot signal, which is already an improvement. A form of carrier frequency is also used, which enables the use of conventional machines. But this method demands meticulous care and attention, as the recording of high frequencies must be perfect. We have adopted the system that has become standard practice in Germany and in many other countries, namely, the Piloton system. Here, the pilot signal was recorded across the tape.

The Piloton system originally presented many difficulties, but on account of its many advantages, it rapidly became standardized. The obvious faults of the system were acceptable at the time (the quality of 1/4 inch tape recorders being something then, that we cannot accept today), but they became unfortunately highly exaggerated when compared with the performance of the Nagra III. For this reason we undertook the study of the system, and as a result produced the head, which was named, NEOPILOT. The Neopilot is compatible with the original Piloton in that the Neopilot can be played back with the normal Piloton equipment and vice versa. But the inadequate channel separation in the old Piloton system, which permitted the passage of the pilot signal to the sound channel and the irregularities in the level of the recorded pilot signal, even its absence, have been completely eliminated.

SHOOTING

If the camera is driven by a synchronous motor supplied by the mains or by a very stable convertor, there is no problem. The pilot signal is taken directly from the ATUP or ATN power supply, which can supply the necessary signal, (1 volt at low impedance, less than 10 ohms) with the regular power for the Nagra. Note that it is desirable that the convertor will produce the 50 cycles (60 cycles in the U. S. A.) at a $\pm 1\%$ tolerance.

Unfortunately, the synchronous motor has one disadvantage; it is big, but more than that, the accumulators and the rotary convertor are heavy and cumbersome. It is, therefore, much more convenient in a great many cases to use a motor that works directly on the batteries, in which case it is possible to incorporate in the camera a piloton generator that will supply the Nagra with the necessary signal. When the camera turns at exactly 24 frames per second (25 for TV), the generator will produce exactly a 50 cycles signal (60 in the U.S.A.). The pilot signal is thus tied to the speed of the camera, and everything takes place as if the camera were driven by a synchronous motor powered by a rotary convertor. Note that the motor should turn at a constant speed. A tolerance of $\pm 1\%$ is highly desirable. There are many motors with centrifugal speed stabilization that are nearly satisfactory, but it is obvious that an electronic stabilization system is preferable.

For some years now, it has been possible to secure from several camera manufacturers delivery of cameras, equipped on demand with a piloton generator.

THE AUTOMATIC STARTMARK

In the traditional film production this is done by means of a claquette, which is a wooden board, on which are inscribed the name of the film and other relevant indications. Onto the bottom of this board is hinged another small board. When the two boards are knocked one against the other, a short dry sound is produced that corresponds to the frame on which the two pieces of wood are seen to come in contact.

This procedure is perfectly normal, but under certain circumstances, such as news films, or filming of actual events, it can become quite annoying and troublesome.

It was necessary, therefore, to find another means of marking the start, which will be more discrete. The most widely used method consists of a lamp incorporated in the camera that masks a short section of the film before the sequence with light, while an audible signal is recorded on the tape.

In the Nagra III NP, which we are now producing (N° 62-1710 and onwards), a 1 kc/s oscillator has been incorporated. By supplying a positive tension of 4 to 10 volts, (in practice 6 volts) on lead number 6, this oscillator will be actuated and the signal will record. This is evidently designed with the Arri cameras in mind.

THE PRACTICAL FUNCTIONING OF SOUND TRANSFER EQUIPMENT — THEORY

Let us suppose that we use a synchronous motor driven camera. It is powered by a rotary convertor that gives, for example, 50.1 c/s. The speed of the film is then 0.1/50 or 0.2 % faster. The 50.1 c/s will then be recorded on the pilot signal track.

Back in the studio, the sound is transferred from the 1/4 inch tape recorder to a sprocket tape recorder. But instead of the sprocket tape being driven off the mains, the pilot signal (50.1 c/s in our case) is taken from the 1/4 inch tape recorder, amplified and used to drive the synchronous motor of the sprocket tape recorder, which then turns at 0.1/50 or 0.2 % faster. Thus the same results are obtained as if the sound had been recorded directly on the sprocket tape recorder, powered by the same rotary convertor as the camera. If this procedure is examined more closely, it will be observed that it also corrects variations in the speed of the 1/4 inch tape

recorder, changes in tape length, etc. It will ensure synchronization even where the speeds of the camera and that of the $\frac{1}{4}$ inch tape recorder are highly disparate. It was highly necessary at the time it was developed, as the recorders were driven by spring-motors that had a speed precision far from acceptable norms today. In this method, there is always a slight discrepancy between the played-back pilot signal and the mains frequency ; as it is not possible to avoid completely parasitic induction, interference may be produced in the playback head and the pilot amplifier, which could result in wow.

In order to avoid this danger, it is equally possible to perform the exact opposite in order to ensure synchronized transfer. The sprocket tape recorder is driven off the mains, and the speed of the playback equipment is so modified that the played-back pilot signal, synchronizes with the mains. In principle the result is the same, but in practice, the quality of sound and synchronization is much higher and this method is therefore preferable.

When the playback equipment is of conventional construction this second method is very complicated and consequently expensive. With the Nagra, which is driven by a servo-motor, it was found possible to make a transfer synchronizer that was particularly simple and economic. This instrument, namely the SLP synchronizer, receives from the Nagra the played-back pilot signal and is also connected to the mains. The SLP compares the phase between the pilot signal and the mains, and if one of these signals shows a tendency to be faster than the other, the SLP modifies automatically the speed of the Nagra in order to eliminate any phase difference between the two signals.

However, the SLP was conceived to work with high quality equipment and its margin of speed correction is limited to $\pm 1.5\%$. It is possible though, to transfer recordings even where the speed error is higher than 1.5% , but this necessitates manual preadjustment of the Nagra. It must be remembered that the lock between the picture and the sound, made by the SLP, stays very rigid, and if the rotary convertor used for the camera drive produces wow, the sound will wow by the same amount.

GENERAL REMARKS

1. It is possible to use the Neopilot system with any of the speeds of the Nagra. If, however, you do not make the transfer yourself, make sure that a Nagra is available at the place where the transfer is made. Otherwise, use only the speed of 7.5", as conventional sound transfer installations cannot utilise any other speed.
2. It is very easy to add a Neopilot play-back to any existing installation. We can furnish these heads on request. We would like to point out, that the conventional Pilot head is quite adequate. The Neopilot head eliminated many of the faults in recording of the conventional pilot heads, but playing back on the latter poses no problem. More over, their mounting is a much simpler matter, as the Neopilot head requires a balancing electronic circuit.

THE S.L.P. SYNCHRONIZER

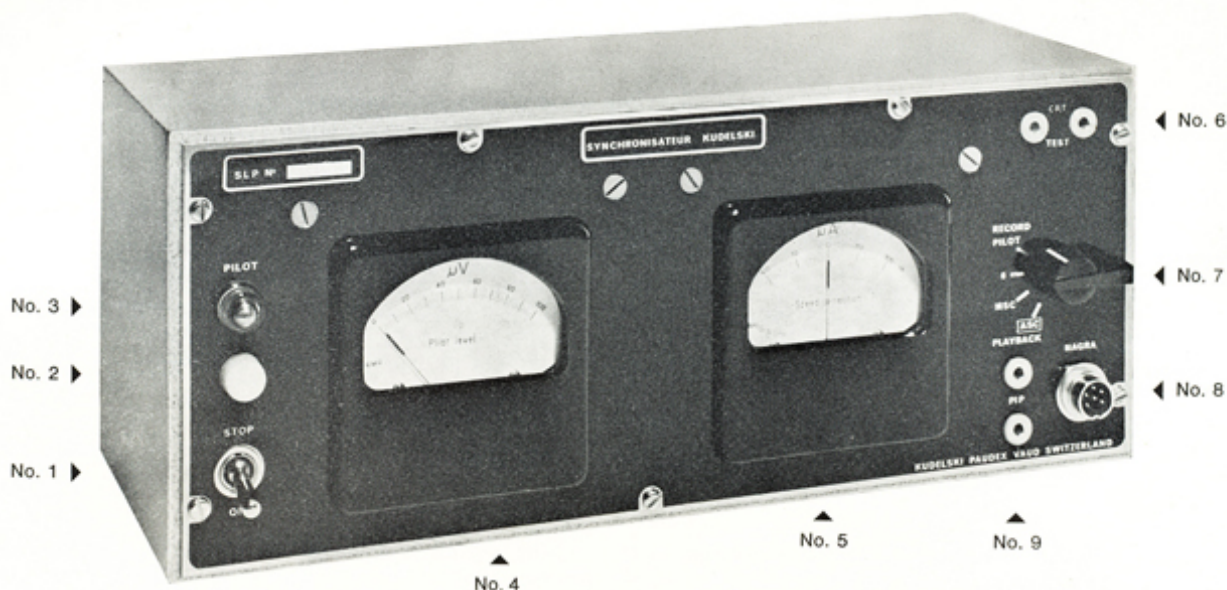
NOTE: The numbers in parenthesis, refer to the picture. -

Here we discuss the use of the SLP Synchronizer.

It is first necessary to set the SLP to the tension in the local mains. This is done by setting the tension regulator (back of set). By pressing the fuse and turning it to the left, it will come out, and it is then possible, with the aid of a small coin, to set the tension regulator to the corresponding tension in the local mains.

Now connect the SLP to the mains with a cable supplied with it and turn it on by means of the ON-STOP switch (N° 1). The ON-OFF bulb (N° 2) should light.

Connect the SLP to the pilot signal input of the Nagra with the appropriate cable. Set the function selector (N° 7) to MSC (Manual Speed Control), which is intended for checking purposes. In this position the SLP does not influence the speed of the Nagra ; the right-hand meter marked, « Speed Correction » (N° 5), will show the phase difference between the mains and the played-back pilot signal.



Once the Nagra, that has on it a tape recorded with a Pilot signal, was started, the SLP will react. A click is heard, and the Pilot Level Meter (N° 4) shows the tension of the played-back pilot signal, this should normally read between 20 and 100 micro-volts. The Speed Correction Meter (N° 5) oscillates faster or slower according to the phase difference between the mains and the pilot signal. One oscillation back and forth, per second, corresponds to a phase difference of 2 %. Normally the phase difference will be much smaller than that. By setting the selector to ASC = Automatic Speed Control, the SLP will start modifying the speed of the Nagra. If the needle does not move, it means that there is no error, and no speed correction is taking place. Movement of the needle to the right means that the Nagra is being slowed down, and to the left, being accelerated. If the needle moves to the right or left and jumps back to the center in a sudden movement, it means that the phase difference is larger than the 1.5 % tolerance, and the Nagra should be slowed or accelerated manually. Normally the SLP will be used in the ASC position during the transfer.

General Operating Instructions

- Place the SLP at some distance from the Nagra (approximately three feet). The heads of the Nagra are not completely shielded, and the SLP, like the other accessories connected with the transfer, radiates a parasite magnetic field, which can set up hum in the sound channel.
- The appearance of the pilot signal actuates a relay in the SLP. The bulb marked PILOT (N° 3), will light. The same relay also connects the mains to the two sockets found on the back of the set. A 6 Amp. current can be drawn from there, which can serve to drive the sprocket tape recorder or an additional signalling lamp.
- Under the selector there are two sockets marked PIP (N° 9). When the pilot signal appears a short pulse is received in these sockets. Connect the Nagra sound output and the sprocket tape recorder input in series with these sockets and superimpose the pulse on the sound track. This audible « PIP » may be found very useful later in editing.
- For checking purposes, the Pilot signal can be taken from the TEST sockets (N° 6), and be fed into an oscilloscope, where it can be observed. This is a 6V peak to peak square wave signal.
- The selector has one position that is marked RECORD PILOT. If the Nagra is actually recording, by setting the selector to this position, a pilot signal can be recorded. This arrangement was designed for purposes of checking the installation, but in certain cases it can be used instead of the pilot signal supply of the ATN.
- The MSC is utilised whenever the recording is made in bad conditions, and the phase difference is higher than the normal 1.5 % tolerance.



THE DH SELF-CONTAINED SPEAKER-AMPLIFIER

THE COMPLETE UNIT

This is an accessory which consists of a light alloy box, containing an amplifier, a high efficiency speaker and 12 1.5 V flash-light batteries.

By connecting this unit to the line output, or monitoring output of the Nagra III, one can listen to a prerecorded tape, or monitor a recording, at a level and quality similar to that of a small HI-FI installation.

During recording, one can monitor the sound either from the play-back amplifier, or from the recording amplifier, thus comparing the sound before and after recording. Provided of course, that the microphone is not within pick-up range of the speaker.

One can also by-pass the incorporated speaker, and connect the amplifier directly to an external loud-speaker (impedance 3-7 ohms).

THE AMPLIFIER

This is a pure class B¹ amplifier. It is of very advanced conception, and can be considered as perfect, in comparison to the other components of the DH. The basic circuitry of this amplifier, has been developed by our engineers, some years ago, but it is only now that the progress in electronic components, enables us to produce it, with the level of quality and reliability that we are accustomed to.

Although a class B¹ amplifier, it has a fidelity rarely achieved even by the best existing amplifiers of this class. This high performance, is achieved by the very conception by which the amplifier is constructed, and not by delicate adjustments and balancing. There is nothing critical in the construction, and the amplifier will give excellent performance over a wide range of temperatures and power supply tensions.

POWER CONSUMPTION

As it is a class B' design, the power consumption, with no signal, is only 2 mA (1 mA is taken by the voltmeter which measures the batteries tension). Generally speaking, the power consumption of the DH unit, is extremely low, compared with the maximum power output available. This is due to the class B' construction, in which the amplifier consumes energy in direct proportion to the power required. Statistically, power peaks are quite rare in normal sounds.

As the impedance of the loud-speaker increases with the frequency, the consumption decreases when the frequency increases. The efficiency of the speaker increases simultaneously.

SPECIFICATIONS

Dimensions: Identical with the Nagra III: 12.5" × 9.6" × 4.4" (318 × 222 × 112 mm).

Weight with batteries: 3.850 Kg.

Empty weight: 2.850 Kg

Input: The DH includes an input attenuator, permitting the regulation of sound volume.

Minimum input tension for complete modulation:

- A. 4,4 V plus 1 to 2db reserve = 5 to 5,5 V. Input impedance between 2,5 to 4,5 Kohm resistive impedance, for connection to the line output of the Nagra III.
- B. About 200 mV 200 Ohm for connection to the monitoring output of the Nagra III.

Output: Either with the incorporated speaker, or with an external load.

Maximum tension, depends on the condition of the batteries. With new batteries: 5.2 V RMS.

The Input and the output are asymmetric, and they have a common pole, which is connected to the box. As the batteries are floating, the DH should not be powered by any outside source having some connection with either the input or the output.

Internal Impedance: much less than 50 milliohms in all the frequency spectrum (20 to 20.000 c/s).

Permissible load: there is no critical limit, more the load is of a lower impedance, higher the output power becomes, and consequently, the power consumption is augmented. By loading with 1 ohm, we obtain about 25 W on the output, but regular flashlight batteries, will not stand this drain for a long time. In practice, the load on the DH is about 4 to 5 ohms, which gives maximum power output of 5 to 6 Watts.

Frequency response curve: flat at $\pm 0,3$ db from 20 to 20.000 c/s ($\pm 0,1$ db on request).

Distortion: less than 0.1 % up to the maximum power in all the spectrum (except at 40 c/s = 0.3 %).

Transitories: There are no transformers or other reverberating elements. The transitories are therefore perfectly transmitted.

The back ground noise of the amplifier is much less than 5 Micro-Volts in the frequency scale considered, which gives a recession of the back ground noise to -120 db. Of course, this is absolutely inaudible.

Functioning temperatures range: We have tested the DH in temperatures between -23° C and +50° C, without observing any noticeable decrease of performance. At very low temperatures, the batteries drop in tension, and in higher temperatures, the life duration of transistors and condensers is diminished.

Acoustical characteristics: The frequency response is acceptable from approx. 50 to 15.000 c/s (at ± 10 db).

The maximum sound level, at 1 kc, at 25 cm from the speaker, is about 110 to 115 phones.

NAGRA AGENCIES FOR SALES AND SERVICE

AUSTRALIA

Simon Gray Pty Ltd.
28 Elisabeth Street
Melbourne C. 1
Phone 63 82 11
Cables Sigray Melbourne

AUSTRIA

Siemens & Halske GmbH
Apostelgasse 12
Vienna III/40
Phone 44 56 01
Cables Siemenshalske Wien
Telex Wien 1866

BELGIUM

General Ciné Co.
Rue Royale 266
Bruxelles
Phone 18 25 81
Cables Cinestu

BURMA

Rangoon Radio Service
217 Sule Pagoda Road
Rangoon
Phone S 72
Cables Eather

CANADA

Kingsway Film Equipment Ltd.
148 Norseman St.
Toronto 18
Phone BE 3 - 1103
Cables Kingequip

DENMARK

Bico Foto Kino Import
131 Rygaards Allé
Copenhagen Hellerup
Phone Ryvang 7775
Cables Bicofoto-Copenhagen

ENGLAND

Livingston Laboratories Ltd.
31 Camden Road
London N.W. 1
Phone GULLIVER 4191
Cables Livinglabs London
Telex 21830

FINLAND

Into O/Y
11 Meritullinkatu
Helsinki
Phone 66 39 09
Cables Into

FRANCE

Simplex Electronique
48, Bd Sébastopol
Paris 3^e
Phone TUR 15-50
Cables Simplexelectro Paris
Telex 23045

GERMANY

Telefunken GmbH
Geschäftsbereich Hochfrequenz
Anlagen
Bücklestrasse 3
Konstanz
Phone 07-33-233
Cables Telefunken Konstanz
Telex 3701

GREECE

K. Karayannis
Karitsi Square
Athens
Phone 223-212
Cables Rakar Athens

JAPAN

Sony Corporation
351 Kitashinagawa-6,
Shinagawa-Ku
Tokyo
Phone 44-0161
Cables Sonycorp Tokyo

LEBANON

Electronics
Av. des Français 63-65
Beirut
Phone 36633
Cables Beldal

MADAGASCAR

Société Comte & Cie.
17, rue Amiral Pierre
Tananarive
Phone 25-74
Cables Comteco

MALAYA

Eastland Trading Co.
No. 1 Prince St.
Singapore 1
Phone 21325
Cables Eastland

NEDERLAND

N. V. Electriciteits Maatschappij
Frederiksplein 22-26
Amsterdam - c.
Phone 62911
Cables Algem Amsterdam
Telex 11234

NIGERIA

Société Commissionnaire
d'Exportation et d'Importation,
P. O. B. 2053
Lagos
Phone 21482
Cables Socita Lagos

NORTH AFRICA

Baranes Brothers
10 Sciria Gedda
Tripoli

NORWAY

Siemens Norge A/S
Rosenkrantzgt. 11
Oslo
Phone 33 78 70
Cables Proton
Telex 1177

PORTUGAL

Paul Savreux
« Pomaral »
ALCOITAO-ESTORIL
Phone Estoril 06-91-36

SENEGAL

Maison Ertec SA
Avenue Albert Sarraut
Dakar
Phone 228-24
Cables Ertec Dakar

SOUTH AFRICA

Vitaphone (Pty) Ltd.
P. O. Box 4637
Johannesburg
Phone 22-2067
Cables Vitaphone

SWEDEN

Svenska-Elektronik Apparater AB
Gubbängstorget 119
Stockholm - Enskede
Phone 010/94 02 70
Cables Selatronics

THAILAND

Asvin Pictures Ltd.
Bamrung Muang Road
Bangkok
Phone 24033
Cables Asvin Bangkok

U. S. A.

Behrend Cine Corp.
161 East Grand Avenue
Chicago 11 ILL.
Phone MI 2-2281

Audio Acoustic Equipment Corp.
208 South East Street
Arlington / Texas

Dallas-Phone AN 2-3136
Arlington-Phone CR 5-2259

Magnetic Sales Co.
1147 North Vine St.
Hollywood 38 Calif.

Phone HO 9-3511

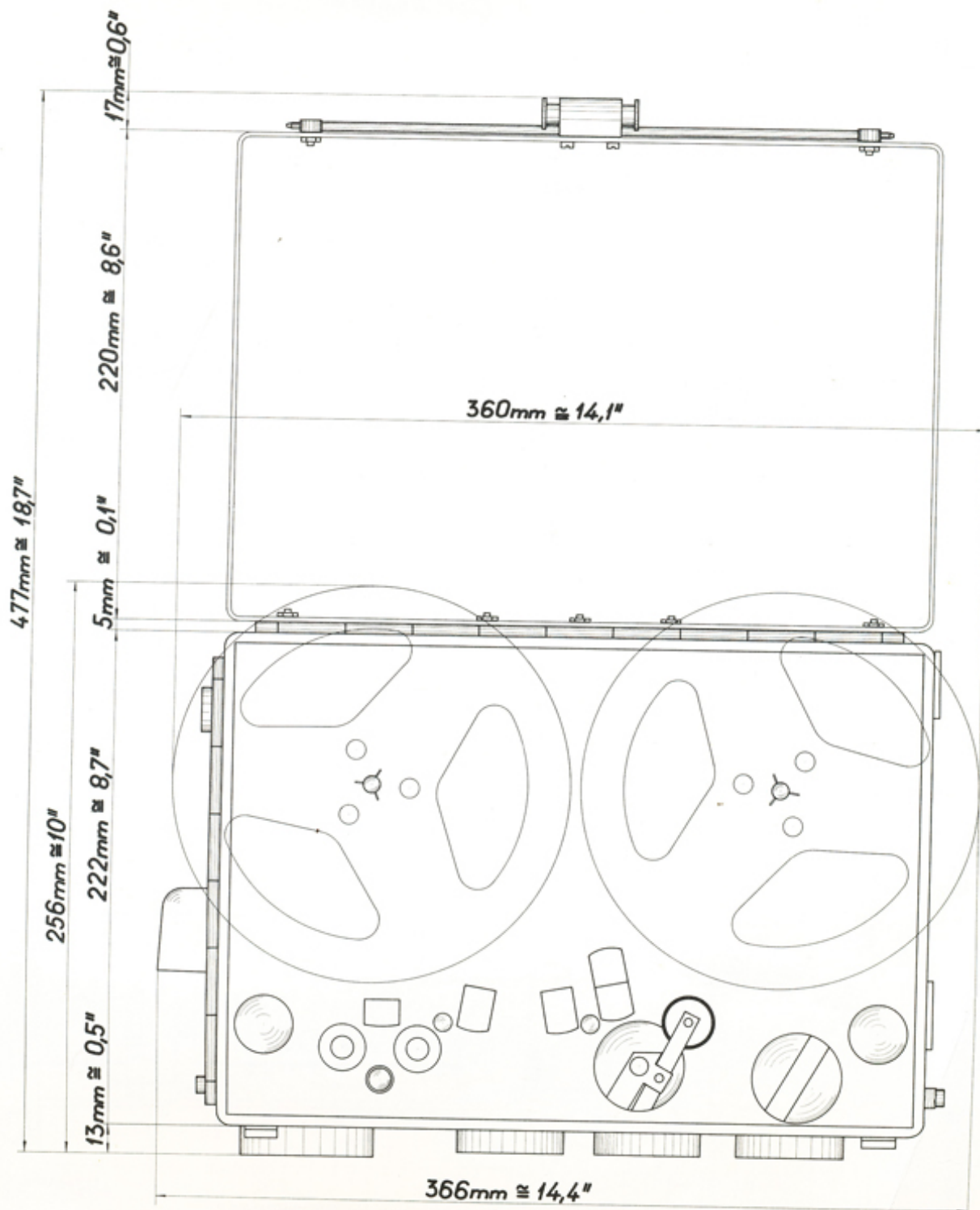
Magnetic Recorders Co.
7120 Melrose Avenue
Hollywood 46 Calif.
Phone 933-5545

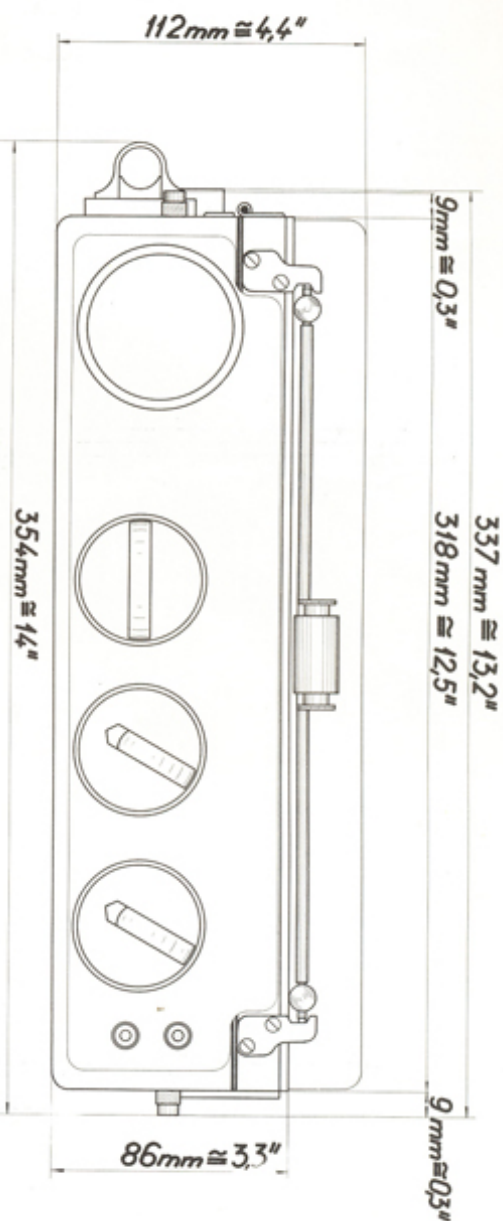
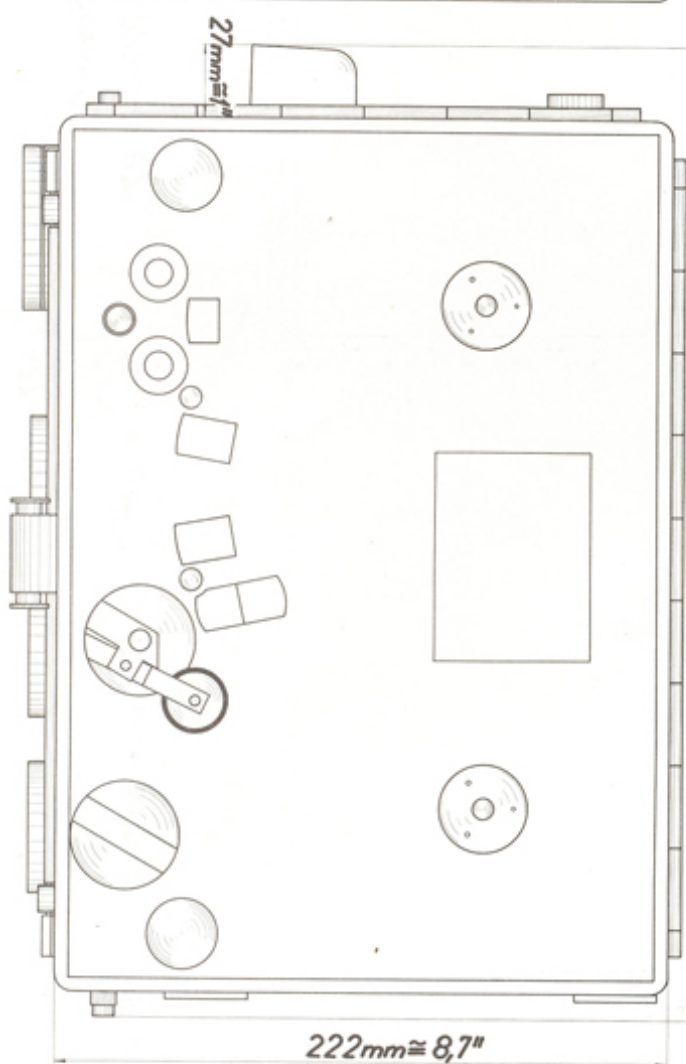
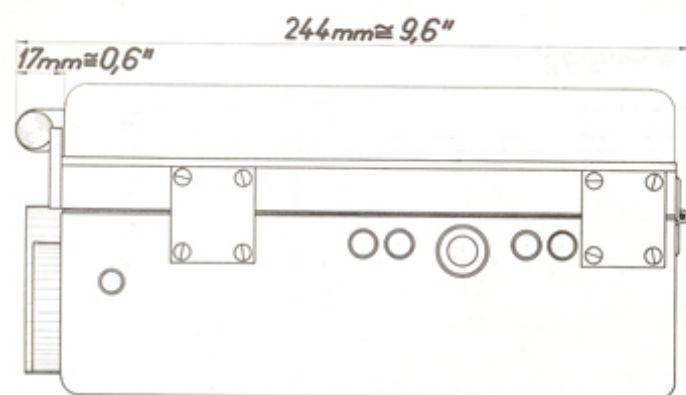
Magna Tech Electronic Co., Inc.
630 Ninth Avenue
Film Center Building
New York 36 N. Y.
Phone JU 6-7242

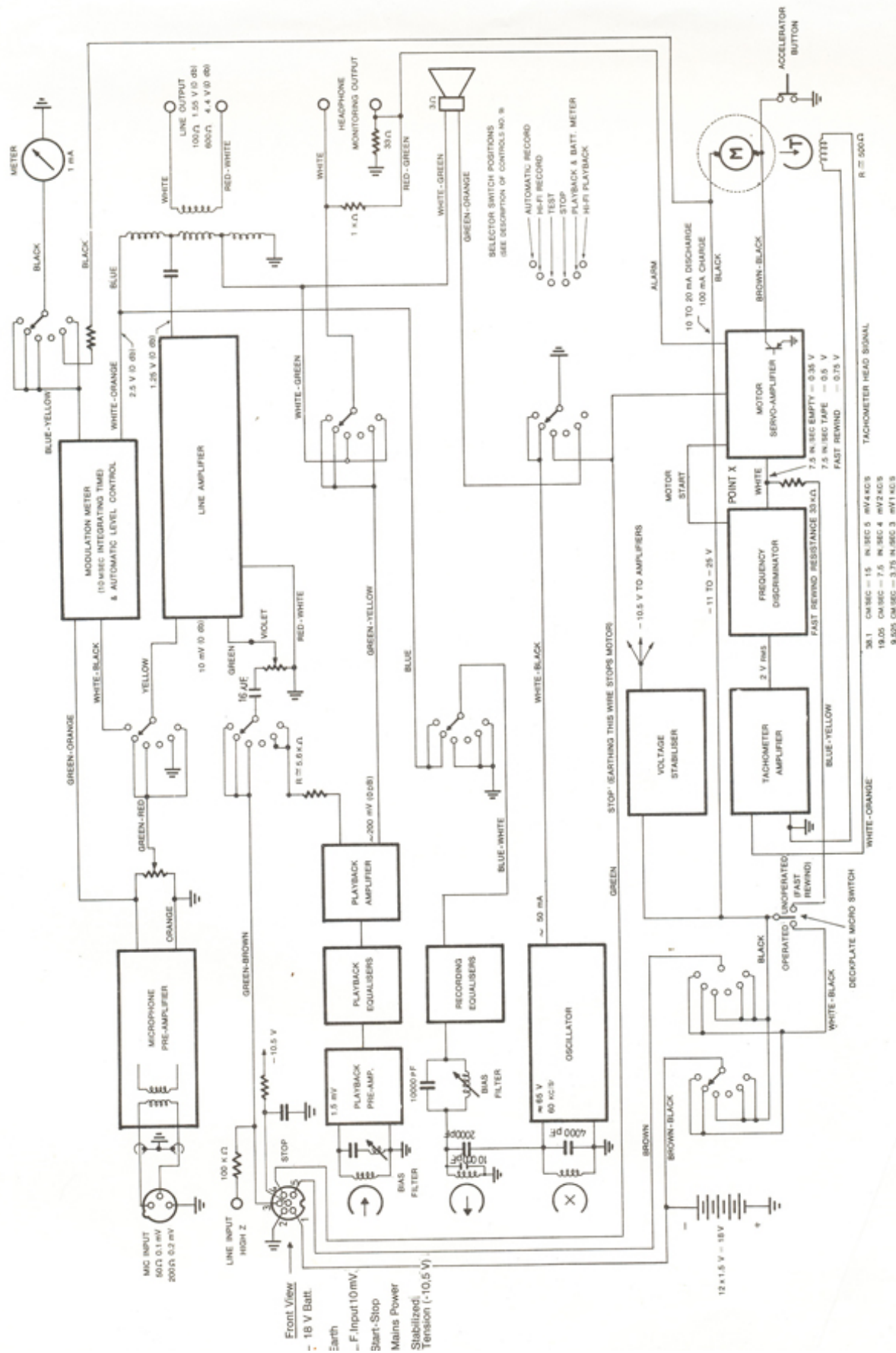
Harvey Radio Inc.
103 West 43rd Street
New York 36 N. Y.
Phone JU- 2-1500

VENEZUELA

Equipos Cientificos
y Educativos SA
Apartado Postal No. 1277
Maracaibo
Phone 79777
Cables Equiciencia







KUDELSKI PADEX-LAUSANNE

BLOCK DIAGRAM NAGRA III

A short extract from the list of the Nagra tape recorder users

A more complete reference list may be obtained from our authorized agents

AFRICA (general)

Inst. franç. de l'Afrique noire, Cie franç. de l'Afrique occident.

ANDORRA

Radio Andorra.

AUSTRALIA

High Commissioner for Australia, Australian Attorney General Office, Australian Broadcasting Corporation, Australian Council of Scientific and Industrial Research Organisation.

AUSTRIA

Österreichischer Rundfunk.
Siemens & Halske GmbH (Sales and Service Agency).

BELGIUM

INR Inst. nat. belge de radiodiffusion, Fondation internat. scientifique, Inst. pour la recherche scient. en Afrique centrale, Musée royal de l'Afrique centrale, Bruxelles.

BURMA

Burma Broadcasting, Rangoon.

CAMEROUN

Information Service, Cameroun.

CANADA

Canadian Broadcasting Corporation, Central Broadcasting Corporation, National Institute for the Blind, National Research Council, Ministère du Nord Canadien, National Film Board.

CONGO

Radio Congo.

DENMARK

Danmarks Radio, Dansk Folkemindesamling Afd. Copenhagen, Inst. for Dansk Dialektforskning Copenhagen, Mr. Knud de Heggermann-Lindencrone.

EGYPT

UAR Broadcasting Cairo.

ENGLAND

British Broadcasting Corporation, National Physical Laboratory, The Church of God of Prophecy, CBS News, Esso Petroleum, CBC, The English Folk Dance & Song Society.

FINLAND

Radio Helsinki.

FRANCE

RTF, Radio Luxembourg, Europe N° 1, Radio Monte-Carlo, Programmes de France, Disques Vogue, Automobiles Peugeot et Renault, Défense nationale, Centre nat. de rech. scientifique, Musée de l'Homme, Artec, Columbia Broadcasting System, Ecole franç. d'Extrême-Orient, France-Soir, Cinécim, Terrafilm, Paris

Overseas Films, Films de la Pléjade, Thomson-Houston Paris, Radiodiff. catholique, Paris, NBC Paris, Centre nat. d'études des télécomm., Paris, Comité du Film ethnographique, Paris, Paris-Match, Pères Blancs, Lille, Dunlop, Paris, Min. des armées, constr. navales, Air France, Société Radio Canada, Université de Rennes, Pathé Cinéma, La Voix d'auteur, Ricordi, OCORA.

GABON

Radio Gabon, Libreville.

GERMANY

Institut für Rundfunktechnik, Hamburg und München, Radio Free Europe, Voice of America, AFN, Foreign Service of the USA, American Committee for Liberation, Windrose Film Hamburg, MCS Film München, Institut für Film und Bild, München. Telefunken GmbH, Konstanz (Sales and Service Agency).

GREECE

Hellenic National Broadcasting.

GUINEA

Ministère de l'intérieur, Conakry, Keita Fodeba.

HOLLAND

Stichting Nederlandsche Radio Unie, Bataafse Intern. Petroleum.

HONG-KONG

Hong-Kong Commercial Broadcasting.

INDIA

Inst. franç. de Pondichéry.

ISRAEL

« Kol Israel » Broadcasting Station, State of Israel Min. of Posts, Mr. Lionel Rogosin, Mr. Wim van Leer, Geva Films Ltd.

ITALY

RAI Radiotelevisione Italiana, Radio Vaticana, Fiat.

IVORY COAST

Ivory Coast Broadcasting.

JAPAN

Sony Corporation, Tokyo (Sales and Service Agency).

KENYA

Wildlife Films, Nairobi.

LEBANON

Lebanese Broadcasting System.

LIBYA

Libyan Broadcasting, Tripoli.

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SWITZERLAND

Reference list (continued from back cover)

MALAYA

Broadcasting Kuala Lumpur, Broadcasting Malacca, Malayan Film Unit.

MAROCO

Radiodiffusion marocaine.

MOZAMBIC

Radio Club de Moçambique.

NIGERIA

Nigerian Broadcasting Corporation, Ford Foundation, University College, Ibadan.

NORWAY

Norsk Rikskringkasting, Staten Forseksgard Vagones.

POLAND

Polskie Radio.

PORTUGAL

Emissora Nacional, Fundação Gulbenkian, Lisboa, Paul Savreux, RARET.

RHODESIA

Federal Broadcasting Corporation of Rhodesia and Nyassaland, National Museum, Bulawayo.

SINGAPORE

South East Asia Shell Films Unit.

SOUTH AFRICA

South African Broadcasting Corporation, Snake Park, Port Elizabeth, Department of Agriculture, Pretoria.

SPAIN

Sociedad española de radio-difusión, Disques Columbia.

SWEDEN

Swedish Broadcasting Corporation, Lennart Olson, Stockholm, Sven Gillsaeter, Stockholm, Ryska Institute vid Stockholm Universitet.

SWITZERLAND

Tous les studios de radio et de télévision, Kriegstechnische Abteilung Bern, Militärflugplätze Dübendorf, Musées d'ethnographie, Neuchâtel et Genève, Mission de Paris, Réarmement moral, Caux, Stations féd. d'essais agricoles, Universal Film, Zurich, General Motors, Bienne, Paillard S. A., Yverdon, PTT.

TANGER

Radio Tanger International, Radio Africa Tanger.

THAILAND

H. R. H. Prince Yugala.

TUNIS

Radiodiffusion Télévision tunisienne.

UGANDA

Radio Uganda, Kampala.

U. S. A.

US Information Service, CBS, NBC, ABC, Cornell University, Stanford University, Ernest Kleinberg Films, Pasadena, Harvard University, Cambridge, The Church of God of Prophecy, Cleveland, Tenn., NYU Medical Center, T. L. Osborn Evangelical Ass'n, Glenn Sound Corp., MPO Videotronics, Grumman Aircraft Corp., UCLA Institute of Ethnomusicology, Columbia University, Indiana State University, Du-Pont de Nemours, Wilmington Delaware, CBS Records, Elektra Records, Decca Records, Encyclopedia Britannica, United Church of Christ, Gospel Recording Inc.

VIET-NAM

USOM.

UNO, OECE, NATO, UNESCO, BIT, CERN, World Health Organization, Union internationale de télécommunication, Food and Agriculture Organization, World Council of Churches.

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