file Sup X

SPECIFICATIONS

for

AN/GSQ-53

TIME SIGNAL SET

TIME SIGNAL SET 24 February 1961

AN/GSQ-53

TIME SIGNAL SET

AN/GSQ-53

1. GENERAL: The Time Signal Set was designed to meet existing and expected real time requirements. The equipment consists of a number of units which generate the timing information, plus a distribution system providing a number of remote visual readout positions as well as voice announcement facilities. The central generator is in unitized form so that an installation can be tailored to suit the requirements of a particular installation.

2. RELIABILITY: The ground unit includes two crystal controlled frequency standards to ensure system reliability. In the event of frequency standard failure, the "standby" standard is electronically switched into the circuit. The oscillators used are stable to $\pm$ 5 parts in 10 -10/day which is approximately $\pm$ 50 micro-seconds per day. This accuracy will hold over a temperature range of -18 to 65°C. Frequency division is accomplished by phase regenerative dividers to insure reliability. In the event of a frequency change in the standard or dividers the design is such that the unit will immediately fail. This is inherently more satisfactory and reliable than digital division.

3. ACCURACY: Using WWV and WWVH for synchronization with the compensating delay networks in the equipment, a world wide accuracy of 10 milli-seconds is achievable. If foreign HF Timing Standards are used the over-all accuracy is doubtful. Interference from foreign time broadcasts in the Far East on HF may reduce this accuracy to 100 milli-seconds. Using VLF timing standards will ultimately enable this system to achieve a world wide station-to-station accuracy of about 1.0 milli-second. This accuracy will require a VLF receiver and a graphic recorder. By using a frequency comparison technique, correction of the frequency standard to 2 parts in 10 -10 can be made in 4 hours using VLF as opposed to approximately 100 days required when using only the HF broadcast standards such as WWV. This may be summed up by saying that the original order of magnitude of synchronization accuracy can be maintained by using VLF techniques. Means are provided to prevent a loss of synchronization of the timing generator due to local power failure but there will be a loss of all information to remote indicators until the return of the local line power.

4. STANDARD FREQUENCY AND TIME INTERVALS:

4.1 The equipment generates the following standard sine wave: 5 mc, 1 mc, 100 kc, 1 kc, 500 cps, 100 cps, 250 cps, 60 cps, and 50 cps.

4.2 The equipment has the following pulse outputs: 1 mc, 10 kc, 1 kc, 100 pps, 10 pps, 1 pps, 1 ppm, and 1 p/hr. These are available from the generator chassis and could be put on a separate timing track if relative time closer than 40 milli-seconds should be needed for binary recording.

5. STANDARD TIME: The equipment generates standard time for recording. Time is set up to the nearest second for serial readout and to the nearest tenth second for parallel output.

5.1 Binary/Decimal Code Time: In this system a 24 hour clock will indicate time every second. The code is an 8-4-2-1 PDM digital type. Both binary and analogue outputs are provided. The code format is as follows: The time code is generated during the first 800 milli-seconds of the second. This is coded into 20 bits that are pulse duration modulated with the trailing edge of each bit denoting the beginning of each 40 milli-second interval. The last 200 milli-seconds are denoted by four (4) milli-second marker pulses followed by a 36 milli-second pulse whose trailing edge identifies the beginning of the next second. In this format the mark or binary one is 24 milli-seconds long and the space or binary 0 is 12 milli-seconds long. (See Figure 1a).

The digital code is presented in serial and parallel form. The serial output gives code to the nearest second. The parallel buffer gives code to the nearest tenth second. This buffer may be externally scanned at any desired scanning rate.

The analogue output from the code generator consists of a 250 cycle tone, amplitude modulated by the serial digital code. (See Figure 1b). This will give 4 milli-second relative time intervals in the serial analogue real time signal.

5.2 Voice Clock: Ten, time on demand, channels are provided along with one continuous time channel. The continuous time channel will give, ten second accuracy, voice time announcements every ten seconds with exact time indicated by tone burst before announcement. Announcement occupies 3 seconds in each 10 second period and occurs immediately following the ten second timing tone burst. With the Remote Time Demand Unit, time can be demanded as often as once every five seconds. Partial time announcements are not possible, therefore, there may be a maximum of five seconds delay after the demand button is pressed before the time announcement is received. Output power is 0 dbm.

5.3 Ruler Time Unit: This unit provides a course and fine ruler time pulse structure. Output is 1 VRMS from 600 ohm source.

Course Structure: 1 minute intervals indicated by three pips of 1 kc tone 1/10 duration spaced 1/10 second apart. 10 second intervals indicated by two pips of 1 kc tone 1/10 second duration spaced 1/10 second apart. 1 second intervals indicated by one pip of 1 kc tone of 1/10 second duration. (See Figure 2a).

Fine Structure. All intervals are indicated by doubling the amplitude of a 5 kc tone designated maximum amplitude (MA). 1 second interval indicated by 5 groups each of 5 cycles MA separated by 5 cycles of low amplitude. ∅.1 second interval indicated by 3 groups each of 5 cycles MA separated by 5 cycles of low amplitude. ∅.∅1 second intervals indicated by single group of 5 cycles MA. ∅.∅∅1 second intervals indicated by single cycles MA occurring every 5 cycles. ∅.∅∅∅1 second intervals indicated by the $\frac{1}{2}$ cycle points on the basic 5 kc tone. (See Figure 2b).

6. READER AND SEARCH CONTROL UNIT: This unit permits tape search of the analog time code at any speed which does not increase the 250 cycle carrier to greater than 50 kc. This means the playback unit can search at fixed speeds of the fast forward and rewind speeds of the vast majority of existing recording equipment. Search of binary recording, however, with this unit must be made at the on-line rate. The reader converts the 250 cycle analogue signal to the digital PDM format and amplitude modulates one side of a 1 kc or 10 kc pulse train. (See Figure 1c.) This has been provided to give smaller relative time marker intervals than obtainable from the 250 cycle analogue carrier or the 25 cycle digital code format. For the search operation the desired time of interest is programmed by setting selective switches. Also the unit has a recycle mode which allows repetitive scanning of any present time interval. Nixie readouts provide a visual indication of the time.

7. TECHNICAL CHARACTERISTICS

7.1 General: The AN/GSQ-53 equipment consists of the following assemblies (1) VLF Synchronization Equipment, (2) Time Generating Equipment, (3) Reader and Search Control Equipment, and (4) a group of accessories.

7.1.1 The VLF Synchronization Equipment consists of the following components: VLF Receiver, Phase Comparator, and Graphic Recorder.

7.1.2 The Time Generating Equipment consists of the following components: Synchronizer and Power Supply, Digital Clock, Frequency Standard, Patch Panel, and Oscilloscope.

7.1.3 The Reader and Search Control Equipment consists of the following components: Time Signal Analyzer and Power Supply with Desk Rack.

7.1.4 The Accessories consist of the following: Voice Clock, Ruler Time Module, Remote Time Display Units, and Remote Time Demand Units.

7.2 Technical Characteristic of the VLF Synchronization Equipment:

7.2.1 VLF Receiver. The VLF Receiver is a 5 band pre-tuned receiver in the 14-30 kc band. The receiver changes the VLF input signal to both 1 kc and 100 kc and these are provided as outputs.

7.2.2 Phase Comparator. The Phase Comparator is used to measure the phase difference between the VLF Receiver output signal and 100 kc input from the frequency standard chassis. A phase difference meter is included to measure the phase differential. A d-c voltage analogous to the phase difference is provided as an output for the graphic recorder.

7.2.3 Graphic Recorder. The Graphic Recorder is used to plot the frequency difference between the VLF carrier and the frequency standard.

7.2.4 Patch Panel. The patch panel is a common connection point for all output signals. Two BNC type connectors are provided on the rear of the panel and one BNC type connector is provided on the front of the panel for each output. This panel also provides a receptacle for plug-in of the Ruler Time Module.

7.2.4.1 Output data

(a) Sine wave: 5 mc#1, 5 mc #2, 1 mc #1, 1 mc #2, 100 kc, 10 kc, 1 kc, 500 cps, 250 cps, 60 cps, 100 cps, and 50 cps. Sine wave outputs o dbm.

(b) Pulse: 1 mpps, 10 kpps, 1 kpps, 100 pps, 10 pps, 1 pps, 1 ppm, and 1 pphr. Output 0-12 VDC from 600 ohm cource.

(c) Signal: Analog time coded signal, DC coded signal, Coarse Ruler Structure, Fine Ruler Structure, Combined voice and analog time coded signal.

7.3 Technical Characteristics of the Time Generating Equipment.

7.3.1 Oscilloscope. The oscilloscope is used to synchronize the digital clock with a radio frequency time standard. (VLF or HF)

SUBJECT: TIME SIGNAL SET (CONT'D)

7.3.2 Frequency Standard: The frequency standard chassis will contain the following sub-assemblies: Two Frequency Standards, One Switching Unit, One Frequency Divider Chain and One Power Supply. The Frequency Standards are 5 mc crystal oscillators. The switching unit switches from the main standard to the stand-by standard in the event of mal-function. This switching unit also switches to battery power in the event of main power failure.

7.3.2.1 Output data

(a) Sine wave:

5 mcps - 0.75 VRMS with 50 ohm load
1 mcps - 0.75 VRMS with 50 ohm load
100 kcps - 0.75 VRMS with 600 ohm load
10 kcps - 0.75 VRMS with 600 ohm load
1 kcps - 0.75 VRMS with 600 ohm load
100 cps - 0.75 VRMS with 600 ohm load
60 cps - 0.75 VRMS with 600 ohm load

(b) Pulse: 1 mpps - 0.1 volt peak
This pulse contains harmonies to 100 mc

7.3.3 Digital Clock: The Digital Clock generates standard time using an 8-4-2-1 PDM binary decimal code. Both binary and analog outputs are provided. The binary output is provided in serial and parallel form. The serial output gives time to the nearest second. The parallel output gives time to the nearest tenth second. The analog output is a 250 cycle sine wave amplitude modulated with the serial binary decimal code.

7.3.3.1 Output data

(a) Analog time coded signal -250 cycle sine wave, amplitude modulated with the serial binary decimal code, modulation ratio 6 to 1. A phase shifting network provides phasing of the 250 cycle sine wave for zero cross-over. Output adjustable for 1 VRMS across 600 ohm load.

(b) Pulse train - modulated with the serial binary decimal code. Output 0-12VDC from 600 ohm source.

(c) 24 bit parallel binary output. Output 0-12VDC from 10k OHM source.

(d) 45 bit output for Remote Time Display Units. Output: 0-75 VDC

(e) Sine wave: 500 cps, 250 cps, and 50 cps. Output 1 VRMS from 600 ohm source.

(f) Pulses:

10	micro-second pulse at	10 kpps
250	micro-second pulse at	1 kpps
0.5	milli-second pulse at	100 pps
1.0	milli-second pulse at	10 pps
2.0	milli-second pulse at	1 pps
10	milli-second pulse at	1 p/minute
10	milli-second pulse at	1 p/hour

All pulse outputs 0-12 VDC from 600 ohm source.

7.3.4 Synchronizers and Power Supply. The Synchronizer and Power Supply chassis contains the synchronization and propagation delay circuits. A self-contained power supply also provides power for other chassis. Synchronization is achieved by phase shifting a 10 kc sine wave from the frequency standard. A resolver is used for this purpose. The resolver can be either manually or motor driven. Wave propagation delay is achieved digitally and can be varied in increments of one milli-second up to a maximum of 99 milli-seconds. Alarm circuits are provided for various type mal-functions.

7.3.4.1 Output data

(a) 20 micro-second pulse at 1 kpps (Intensity markers for the oscilloscope)

(b) 6 micro-second pulse at 1 pps for Horizontal Sweep Trigger of oscilloscope.

7.3.4.2 Power Requirements: 95 to 135 VAC, 48 to 62 cycle, single phase.

7.4 The Technical Characteristics of the Reader and Search Control Equipment. This equipment is able to decode the time signal on the tape, and give a visual readout of the precise time of day when the tape was recorded. The equipment has the capability of searching out and locating a particular desired moment of recording from analog signals. Furthermore, this equipment can play the same pre-selected interval of time on the tape repeatedly, and automatically. This is accomplished by having the equipment automatically operate the playback recorder by remote control.

7.4.1 Output data:

(a) pulse width amplitude modulated carrier: 0-12VDC with 50k ohm load.

(b) parallel binary: 0-6 VDC with 50k ohm load

(c) seconds marker: 0-8 VDC with 50k ohm load

(d) a 1 kc and a 10 kc pulse train amplitude modulated with the serial binary decimal code: output -12 to +12 VDC with a 1k ohm load.

7.4.2 Power Requirements: 95 to 135 VAC, 48 to 62 cycle, single phase.

7.5 Technical Characteristics of the Accessory Equipments

7.5.1 Voice Clock: The characteristics of this unit is furnished in paragraph 5.2.

7.5.2 Ruler Time Module: This module has two outputs: Coarse Ruler Structure and Fine Ruler Structure. These two output are shown in Figure 2.

7.5.3 Remote Time Display (Standard). This unit uses six one inch Nixie-type tubes to display time to the nearest second. The Power Supply provides sufficient power for ten of these units.

7.5.4 Remote Time Display (Miniature). Same as above except one-half inch Nixie-type tubes. This unit requires one-half the power of the standard size units, therefore two of these units can be used in place of a standard Remote Time Display.

7.5.5 Remote Time Demand. This unite provides a means for providing voice time announcements on demand. These announcements are provided by the Voice Clock Chassis. The Voice Clock provides power for up to ten of these units.

8. POWER REQUIREMENTS

Equipments and accessories:

Voltage	95 to 135 VAC
Frequency	48 to 62 cps
Wattage	As indicated for individual units in Para. 9.

SUBJECT: TIME SIGNAL SET (CONT'D)

9. PHYSICAL SYSTEM CONFIGURATION: Although the system includes a VLF receiver, it may be necessary in some locations to use HF for synchronization. This is due to the limited number of VLF stations now in operation. An increased number of VLF stations are scheduled for future installation. When these new stations start transmitting time, the VLF method can then be used for synchronization providing greater station-to-station accuracy. The height panel space requirement for each chassis (19" width) is tabulated below:

9.1 VLF Synchronization Equipment

		Wattage
VLF Receiver	7 inches	90 watts
Phase Comparator	7 inches	90 watts
Graphic Recorder	10½ inches	37 watts

9.2 Time Generating Equipment

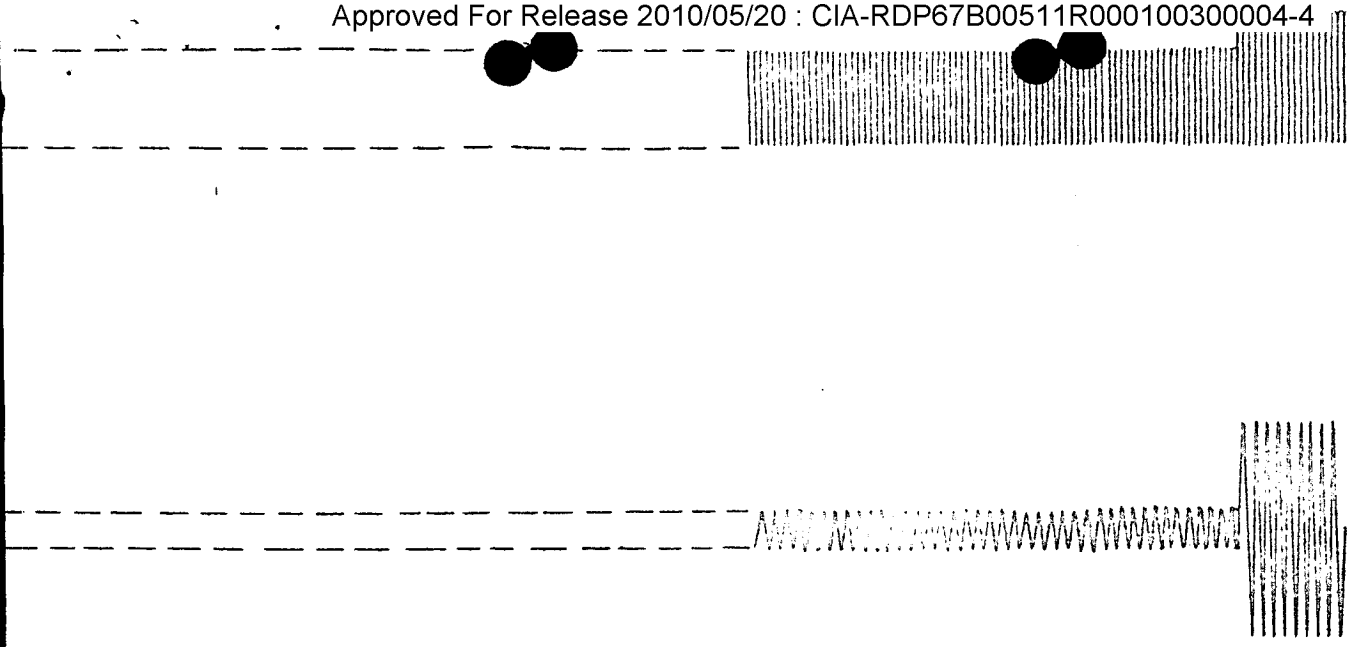
Oscilloscope	7 inches	130 watts
Frequency Standard	7 inches	30 watts
Digital Clock	7 inches	50 watts
Synchronizer and Power Supply	7 inches	50 watts
Patch Panel	5¼ inches	n.a.

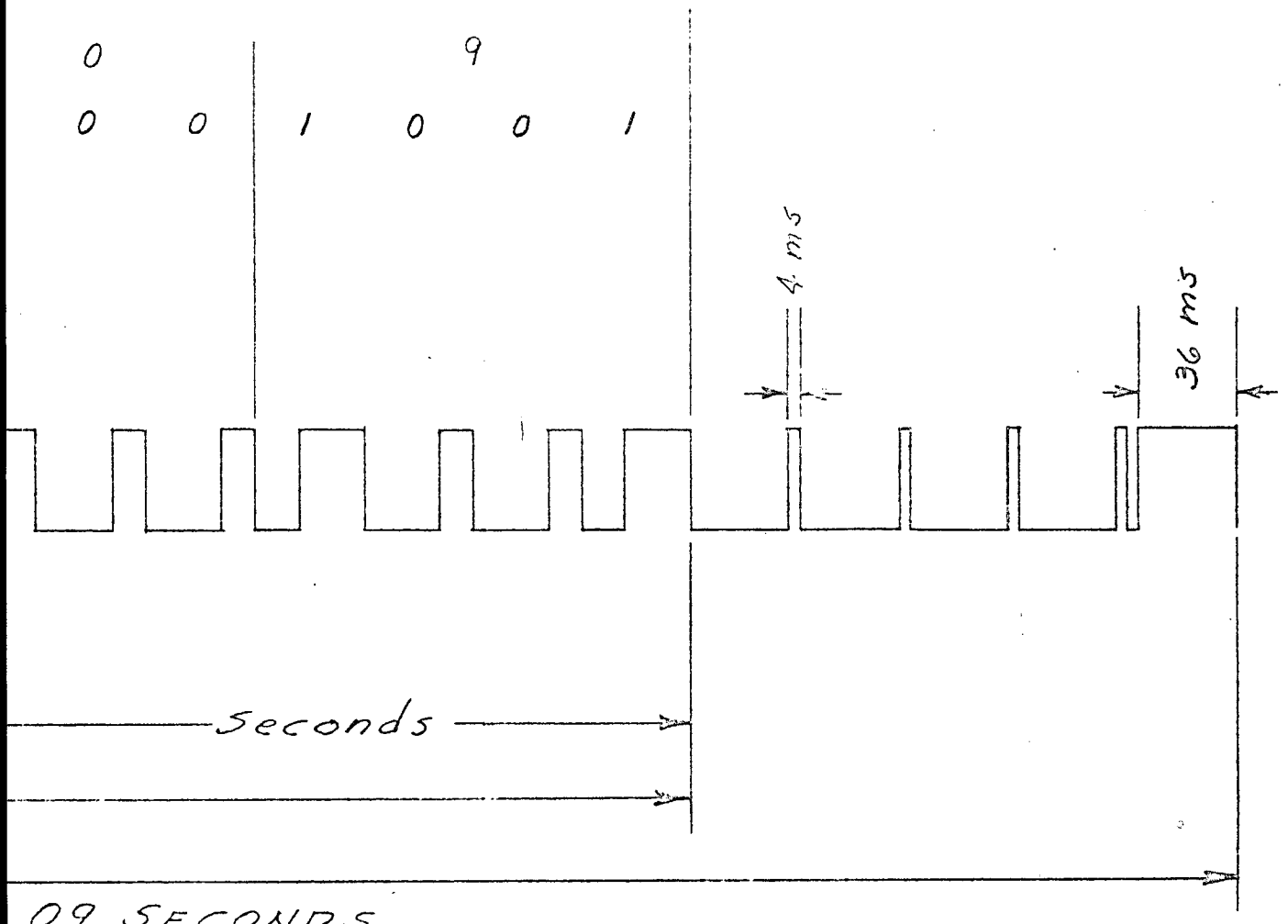
9.3 Reader and Search Control Equipment

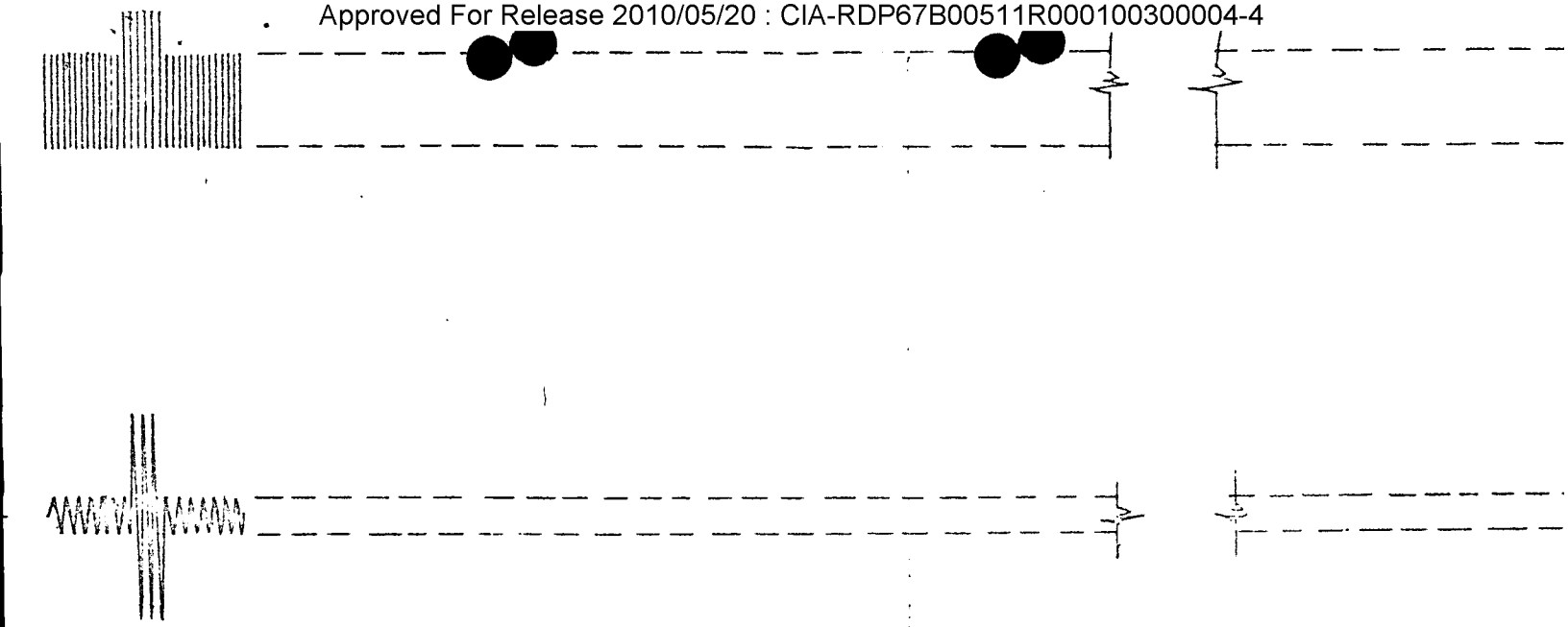
Time Signal Analyzer	7 inches	n.a.
Analyzer Power Supply	5¼ inches	100 watts
Rack for Reader and Search Control Equipment	15 3/4 inches	n.a.

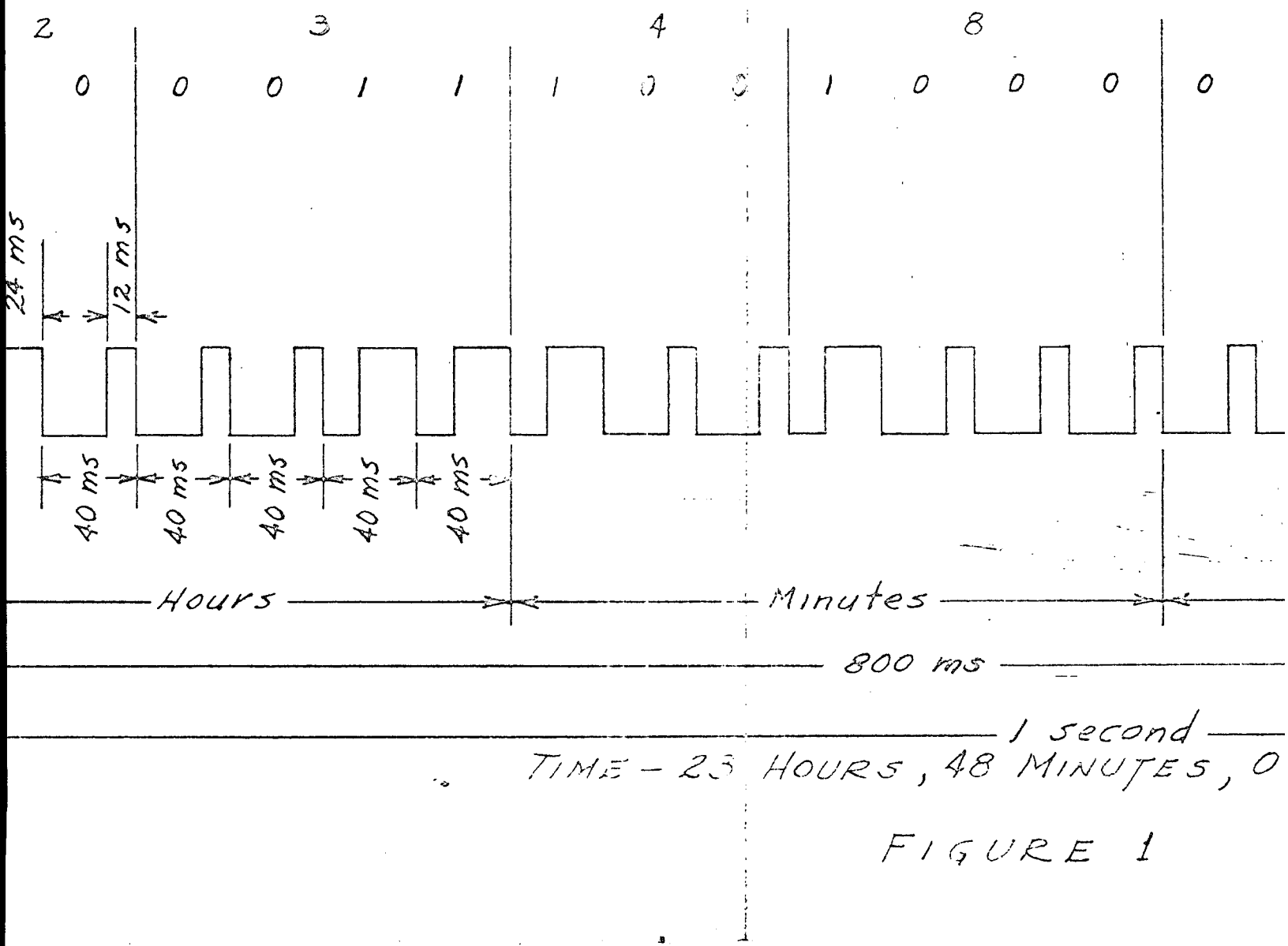
9.4 Accessories

Remote Nixie Display Unit	3½ inches	n.a.
Remote Time Demand Unit	3½ inches	n.a.
Voice Clock	5¼ inches	50 watts
Ruler Time Module (Plugs into Patch Panel)		n.a.







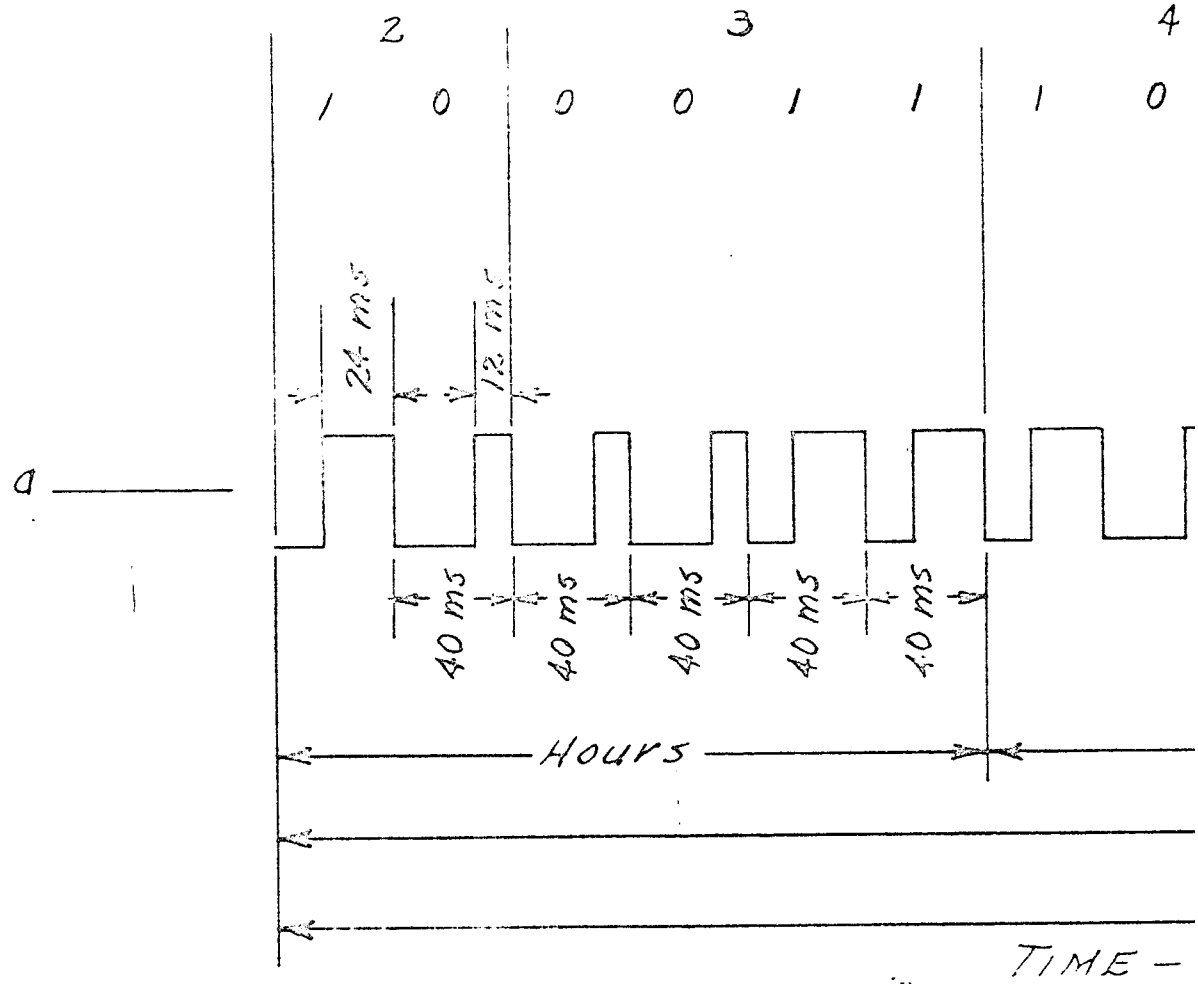


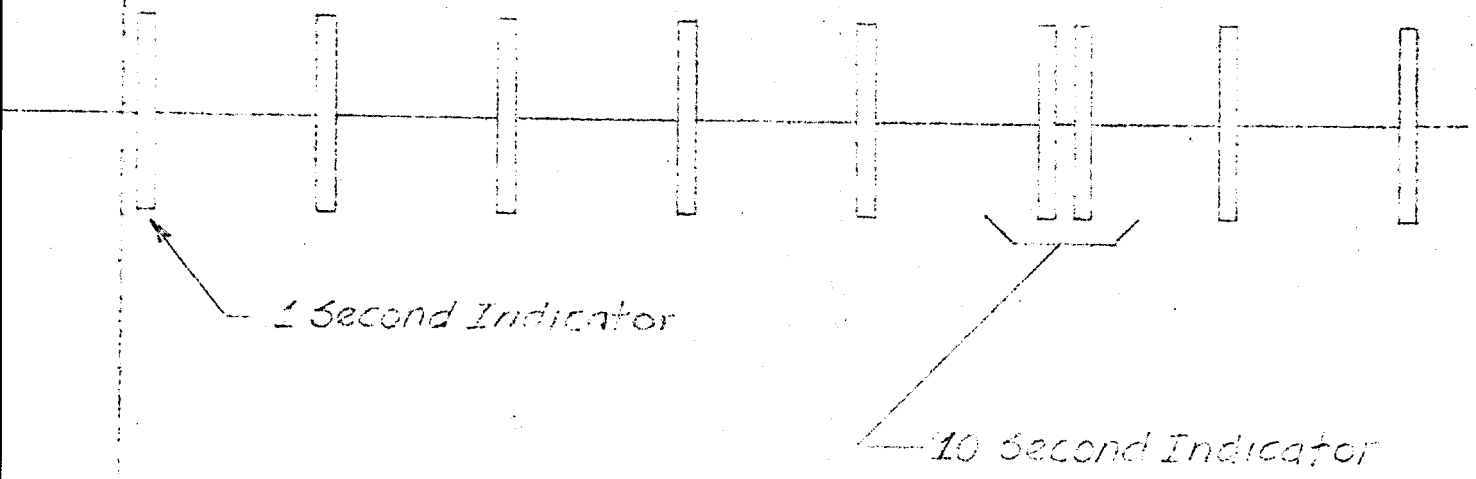
TIME - 23 HOURS, 48 MINUTES, 0

FIGURE 1

c

b





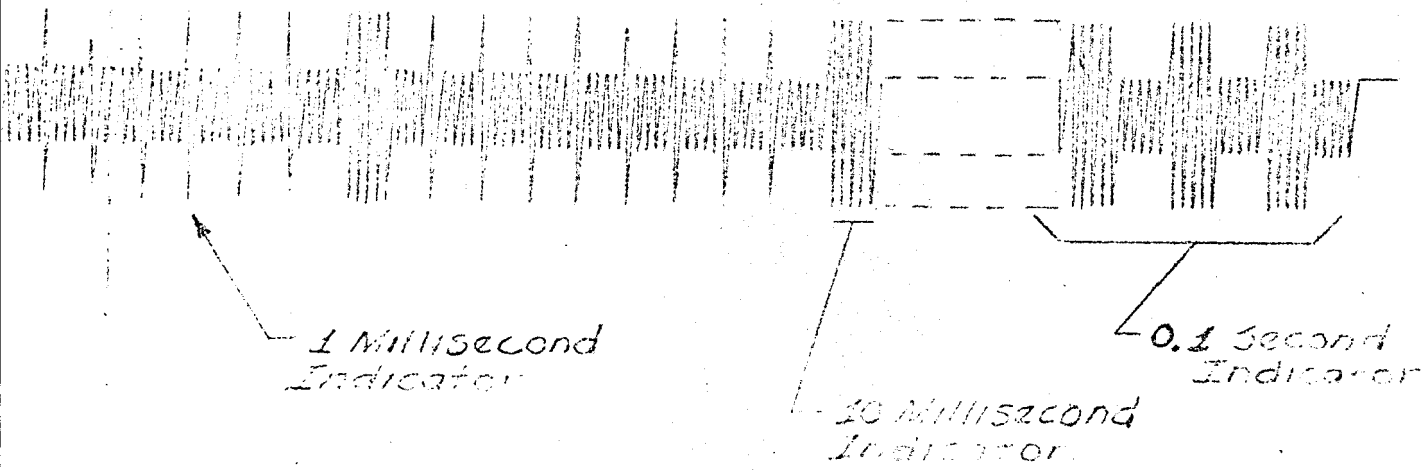
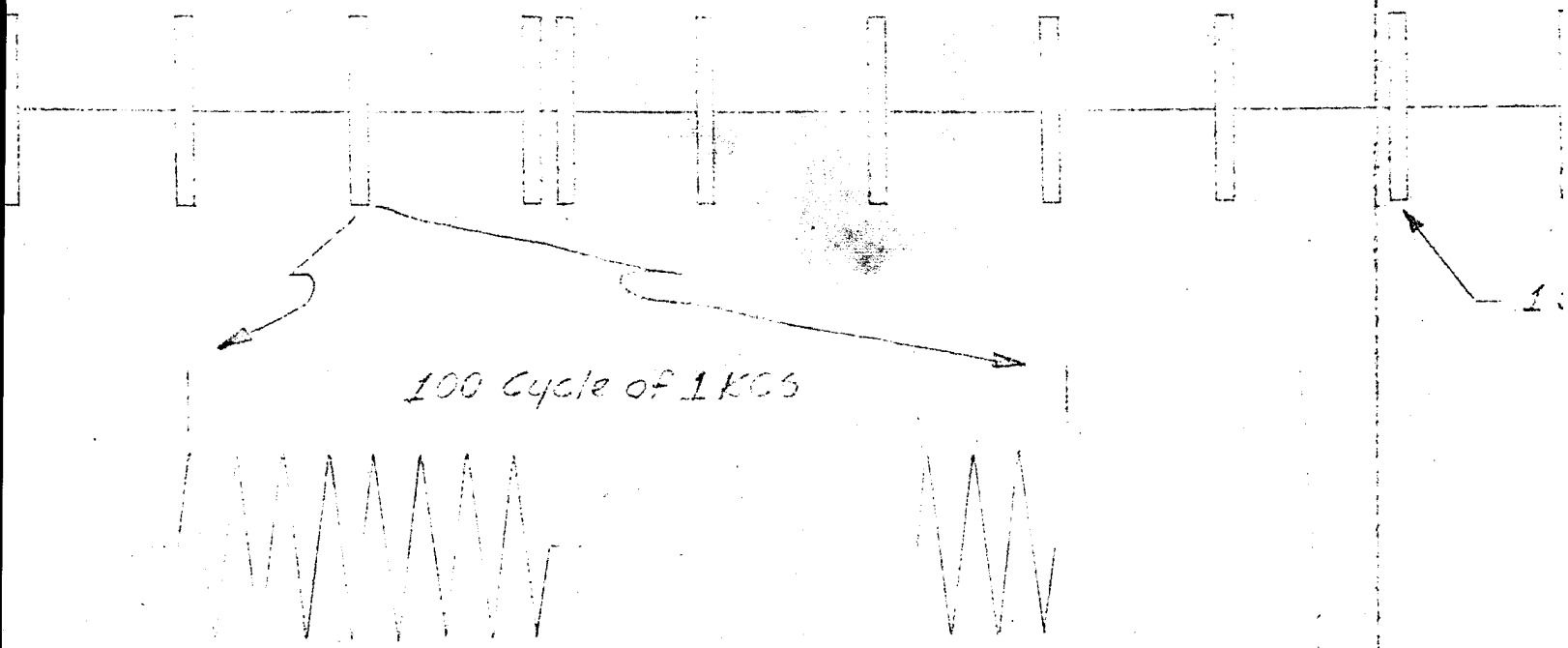
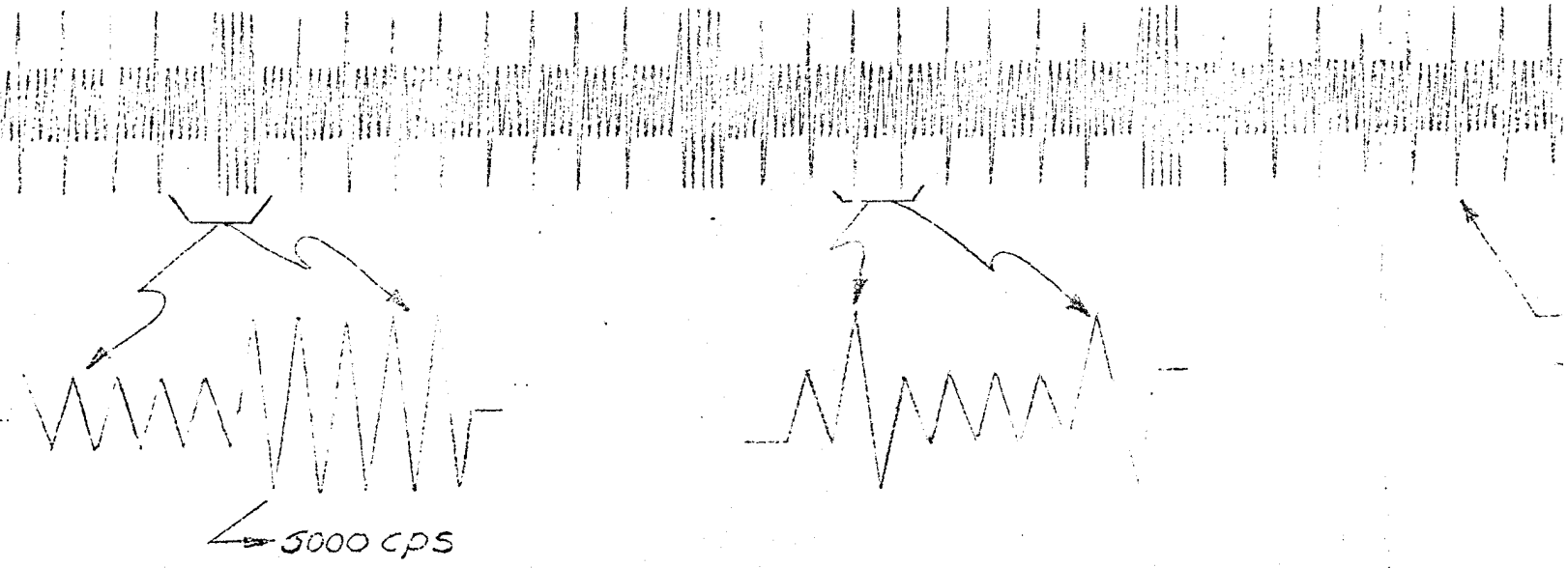


FIGURE 2

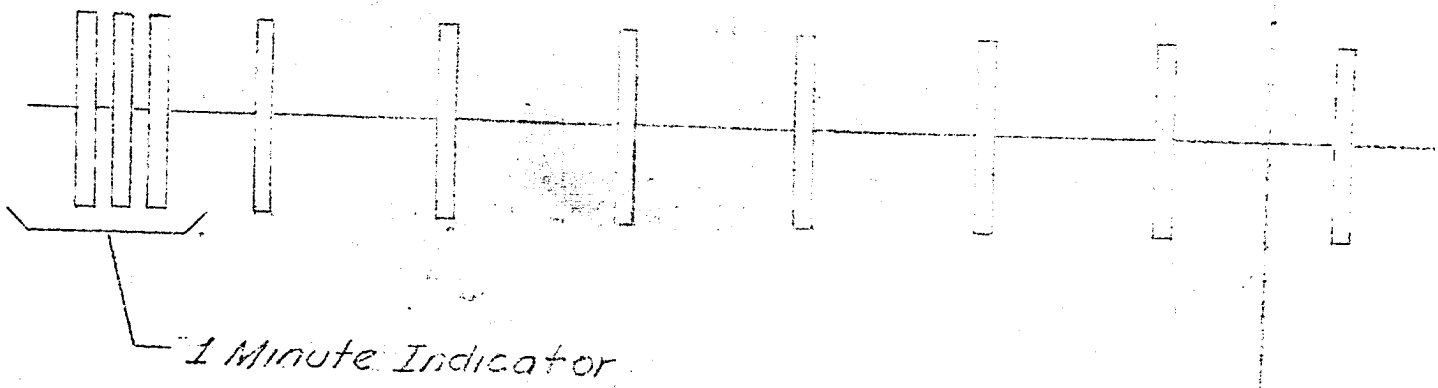
COARSE RULER STRUCTURE



FINE RULER STRUCTURE

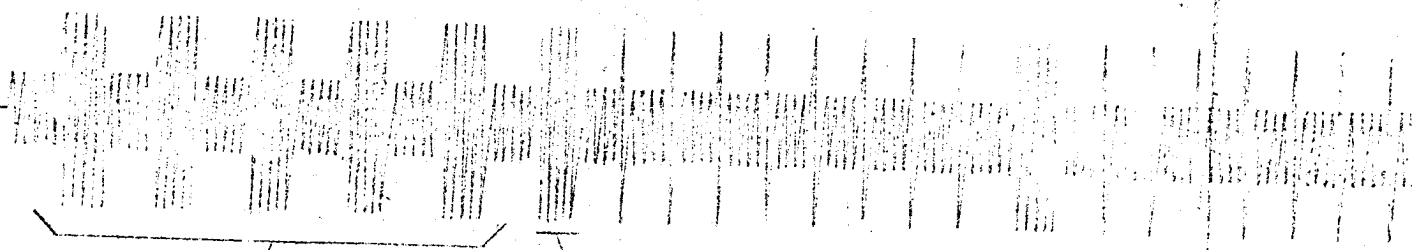


A.



1 Minute Indicator

B.



1 Second Indicator

10 Millisecond Indicator