Stroboconn

Model 6T-5

A MANUAL TELLING
HOW TO USE THIS ELECTRONIC INSTRUMENT
TO MEASURE SOUND FREQUENCIES

PUBLISHED BY

CONN CORPORATION

Accessory Division

ELKHART • INDIANA

Part No. 71078

Copyright CONN CORPORATION, 1964

Printed in U.S.A.

TABLE OF CONTENTS

SECTION I
INTRODUCTION

1. The Stroboconn is an electronic device for rapid and accurate *visual* measurement (or comparison) of sound frequencies to within 1/100th part of one semitone.

2. The range of the Stroboconn encompasses 84 semitones, one-half a semitone below C-1 (first-octave "C" at lower end of piano keyboard) to one-half a semitone above B-7 (seventh-octave "B" at upper end of piano keyboard), essentially the entire range of the piano. Expressed in frequencies, this range is from 31.772 to 4,066.8 cycles per second. No comparison tones are used and no mathematical computations or reductions are necessary. The Stroboconn is accurate to .05%.

SECTION II
GENERAL DESCRIPTION

1. The complete Stroboconn is made up of one encased Scanning Unit, one encased Tuning Unit, one desk-type microphone, and the necessary interconnecting electrical and 105-120 v. AC power cables. *(See Figure 1.)* Power requirement, 215 watts.

2. A list of accessories valuable for certain special testing procedures and convenient in normal usage will be found listed in Section VIII, Paragraph 1, of this Manual.

SECTION III
DETAILED DESCRIPTION

1. SCANNING UNIT.

a. As may be seen from the illustration in Figure 1, the Scanning Unit of the Stroboconn has in its front side twelve windows occupying positions corresponding to the white and black keys of the piano in an octave from C to B. The twelve notes of the chromatic octave are thus represented. Sound picked up by the microphone causes whirling stroboscopic disks in these windows to become illuminated by a neon tube whose rate of flashing corresponds exactly to the frequency of the tone sounded.

b. On each of the whirling disks there are seven stroboscopic pattern bands, each representing a particular musical note as it occurs in one of seven octaves. Thus 7 x 12, or 84, musical notes may be measured.

c. Because the Stroboconn is completely non-selective in its measurement of musical notes, or any other sound within its range, several pattern bands may appear simultaneously if the tone or sound is complex in nature. A pure tone, such as produced by a flute, will cause only one pattern band of black "spokes" to appear for each note sounded. A violin tone, which has many overtones of different frequencies, will cause several pattern bands to appear in various windows. *(See Figure 2.)*

d. The Stroboconn also will measure each of any number of notes sounded at one time. The summation and difference frequencies resulting when two or more notes are sounded simultaneously will be indicated by faint grayish patterns. *(See Figure 3.)*

e. The fundamental of any one tone, if unknown, may be located by looking for the black-spoked band that appears nearest the apex in any of the twelve wedge-shaped windows of the Scanning Unit. If the fundamental of the tone is known, such procedure is unnecessary, as each of the twelve windows is labeled as to the note it represents and measures. These window markings can be changed, however, to correspond to the key of the instrument whose tones are being tested. This is accomplished by use of the transposing knob on the right side of the Scanning Unit. At the extreme left of the twelve window labels is a small opening wherein the key signature is displayed. *(See Item 12, figure 1.)* By pulling out the transposition knob to different positions the Stroboconn windows can be labeled to read correctly in the keys of C, D♭, E♭, F, and B♭, the commonly used key signatures. Thus when the Stroboconn is set to read in the key of F, for instance, C appears as a label for the window which is marked F when the Stroboconn is set to read in the key of C.

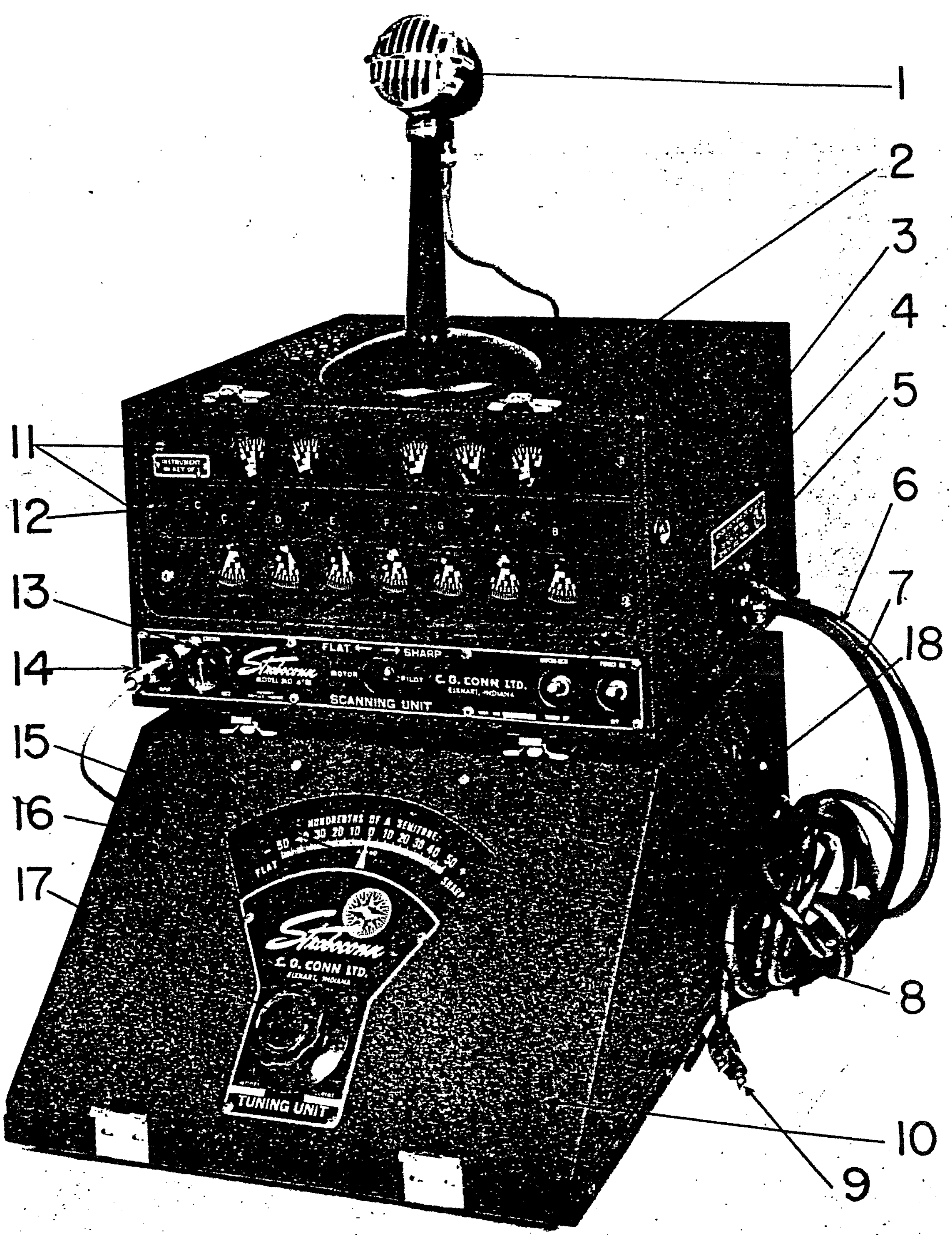


Figure 1—The Complete Stroboconn, Model 6T-5

1. Microphone
2. Scanning Unit
3. Transposing Knob
4. Motor Switch
5. Power Switch
6. AC Power Cable
7. Interconnection Cable
8. Tuning Unit Scale (Sharp Side)
9. AC Connector
10. Tuning Unit
11. Scanning Windows
12. Key Signature Window
13. Volume Control
14. Microphone Connection
15. Tuning Unit Scale Pointer
16. Tuning Scale (Flat Side)
17. Tuning Knob
18. Line Voltage Switch

f. By observation of the Scanning Unit, the operator discovers instantly whether a tone is in tune, sharp or flat. No mathematical computations are necessary. If the black-spoked pattern in the window representing this tone stands still when the Tuning Unit is tuned to "O" (*See Figure 1*), the note is in tune to 1/100th part of a semitone, according to the American Standard of A-440. (See Section V, paragraph 3, *a.*) If the pattern drifts to the operator's right, the tone is sharper than standard. If the pattern drifts to the operator's left, the tone is flatter than standard. Indication of relative sharpness or flatness is also immediately discernible from the speed of drift, which increases both directions from standard.

2. TUNING UNIT.

a. The Stroboconn Tuning Unit is calibrated, by means of a pointer and dial, from 50 cents (50/100th of a semitone) flat of the standard fundamental to 50 cents sharp . . . a span of one semitone. (*See Figure 1.*)

b. A tone more than 50 cents flat or sharp is read as the opposite variation of an adjacent fundamental. For example: An "A" tone 65 cents sharp would be read as an "A♯" that is 35 cents flat, while an "A" tone 65 cents flat would be read as a "G♯" that is 35 cents sharp.

c. Measurement is accomplished by means of an electrically-driven variable tuning fork made of a special metal, Connivar, which is very little affected by temperature. This tuning fork's rate of vibration varies with movement of the Tuning Knob (*See Item 17, figure 1*), and controls the speed of the synchronous motor which drives the whirling stroboscopic disks in the Scanning Unit.

3. MICROPHONE.

a. The Stroboconn microphone is a quality microphone of the high impedance type. It is supplied with desk-type stand and connecting cable with plug-in jack.

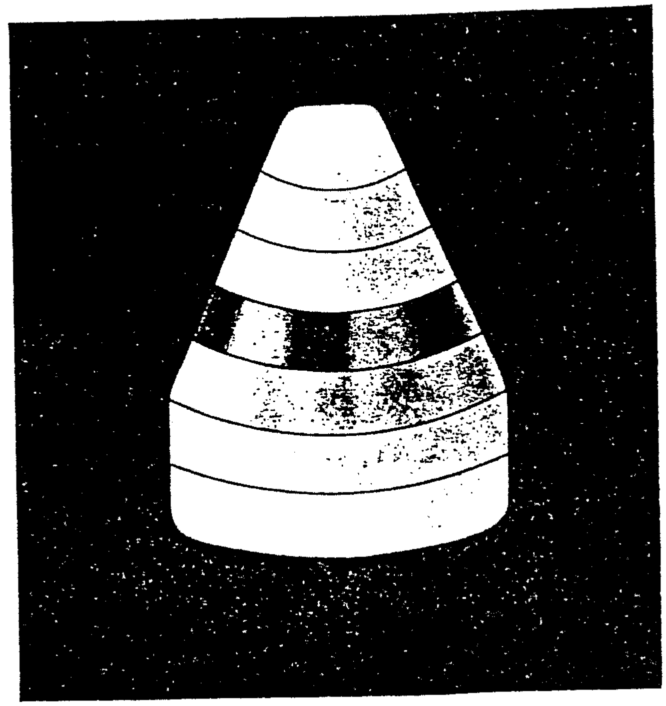


Figure 2—Close-up of a Scanning Window

Illustration shows band pattern of a tone whose fundamental is in the 4th octave and whose overtones are indicated by faint patterns in the 5th and 6th octave bands.

4. CONNECTION AND POWER CABLES.

a. Connection Cable.

(1) The Stroboconn interconnection cable is supplied to couple the Scanning Unit with the Tuning Unit. It is equipped with three-prong connectors that make connection foolproof. *(See 7, figure 1.)*

b. Power Cable.

(1) The Stroboconn power cable is a conventional AC appliance type.

	EQUALLY TEMPERED SCALE	
	CYCLES PER SECOND	CENTS FLAT
SUMMATION TONE	1099.26	15
SOUNDED TONE	659.26	0
SOUNDED TONE	440.00	0
DIFFERENCE TONE	219.26	6

Figure 3—Example of Summation and Difference Tones

SECTION IV

PREPARATION FOR USE

1. Set up the two cases comprising the Stroboconn on their wide sides. Unlatch covers and lift off. Remove cables and microphone from compartment in Scanning Unit case cover. Arrange units as shown in Figure 1, or place Scanning Unit and Tuning Unit side by side.

CAUTION

Do not cover or obstruct ventilating grills of the Stroboconn Units. Overheating will cause damage to instrument.

2. Attach inter-connection, power, and microphone cables as shown in Figure 1.

CAUTION

The Stroboconn is designed to operate on a power source supplying 215 watts at 105-120 volts of 50-60 cycle alternating electrical current. Connection to improper power source may cause damage to the instrument.

The Stroboconn has a line voltage switch which provides normal motor drive power under conditions of low power line voltage. The NORMAL position is recommended for all occasions of use except when the power line voltage is so low that the scanning unit motor will not drive the disks synchronously as evidenced by the motor pilot light blinking or oscillation of the observed stroboscopic pattern. Operating the Stroboconn with the switch in the LOW line voltage position on normal power line voltage will subject the tubes and electrical components to undue electrical strain which will shorten their lives and may result in failure of the instrument.

3. When all connections are made, turn volume control of Scanning Unit to MAX. Depress Scanning Unit Motor Switch (*Item 4, figure 1*) to WARM-UP position. Lift Power Switch (*Item 5, figure 1*) to POWER position. When neon Motor Pilot light glows steadily (about 45 seconds), lift Motor Switch to MOTOR RUN position. This energizes the flashing amplifier. After about 30 seconds, sounds reaching the microphone should cause the windows of the Scanning Unit to become illuminated for the duration of the sound. Once in a great while, the Motor Pilot light may blink after the Motor Switch is lifted to running position. This may indicate that the motor is not running in synchronism with the fork. The blinking should stop in less than a minute. If it does not, depress this switch to WARM-UP position for another period of 45 seconds. A longer warm-up time is sometimes necessary if the Stroboconn has been subjected to extremely cold temperatures. Should the Motor Pilot refuse to glow steadily after the instrument is thoroughly warm, check the power source to see that sufficient voltage is being supplied. (See Section VI, paragraph 5: *a*, (2) (*a*); *b* (1) (*a*), (2) (*a*).

NOTE

Where extreme accuracy is demanded, the Stroboconn, like other electronic measuring devices, should be allowed to run for 30 minutes before using. This permits all electrical and electronic components, as well as the fork, to reach temperature stability. Except for laboratory purposes, however, this longer warm-up period is unnecessary, since the vibration, if any, is extremely small.

4. When the above operations are completed the Stroboconn is ready for immediate use.

SECTION V

OPERATION

1. PRINCIPLES OF OPERATION.

a. The method of measurement employed in the Stroboconn is stroboscopic in nature. A familiar example of stroboscopic phenomena is the one often seen in motion pictures where a wagon wheel appears to stand still or move backward, while the vehicle is moving forward. Movie film is projected at the rate of 24 pictures per second, and because the eye is unable to resolve each picture at this rate of speed, a continuous motion is seen. However, when the spokes of a wagon wheel in a motion picture are revolving at such speed that 24 spokes per second pass any given point, the eye no longer sees motion but an apparently motionless wheel. If slightly less than 24 spokes per second pass any given point, the wheel appears to rotate slowly backward. Similarly, slightly more than 24 spokes per second will cause an apparent slow forward rotation. A wheel in motion appears stationary only when the rate at which the pictures are projected exactly equals the product of the number of spokes multiplied by the number of wheel revolutions per second.

b. In the Stroboconn a neon discharge tube is made to flash in accordance with the pulsations (frequency) of the sound reaching the microphone. The light from this tube is used to illuminate a series of twelve rotating disks which have been imprinted with a pattern such as seen in Figure 4, consisting of seven rings of alternate light and dark segments that correspond roughly to the spokes of a wagon wheel. Each ring, progressing radially from the center, has exactly twice the number of segments as the preceding one, just as musical notes double their frequencies in progressing to successively higher octaves.

c. As an example of how the Stroboconn operates, the 16-segment ring of the Stroboconn "A" (Key of C) disk appears stationary when rotating at a speed of 27.5 revolutions per second and illuminated by light flashes (picture images) occurring at the rate of 440 per second . . . $16 \times 27.5 = 440$.

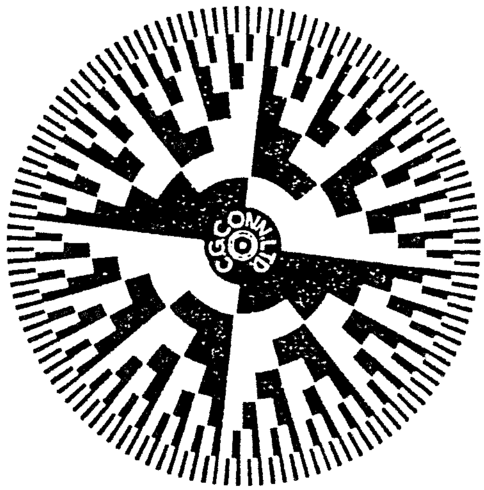


Figure 4—Stroboconn Scanning Disk

d. A sound having a frequency of 438 cycles per second would make the Stroboconn 16-segment "A" ring pattern appear to rotate slowly to the left, and a sound slightly higher in pitch than 440 cycles would cause the pattern on this disk to appear to rotate slowly to the right. In this manner the Stroboconn indicates directly and instantly whether a tone is flatter or sharper than standard. Should the amount of deviation be of interest, the exact frequency of a "non-standard" tone can be measured by regulating the Tuning Unit's tuning knob from its "normal" zero position to a position where the pattern in the window comes to a standstill. A tone is flat by 1/100th of a semitone for every division of the scale that the pointer is moved left of zero; or sharp if the pointer has been moved to the right in order to obtain a stationary pattern.

e. All twelve Stroboconn disks are geared together and are driven by a common power source. Each disk will measure one semitone throughout a range of seven octaves (the number of segmented bands on each), and thus twelve disks will measure a complete chromatic octave through a range of seven octaves.

f. Because the frequency ratio of successive semitones in the Equally Tempered scale is the 12th root of 2, it is impossible to gear the Stroboconn disks together in such a way as to achieve absolutely perfect intervals. However, by using the two gear ratios 89/84 and 107/101 an exceedingly close approximation to true equal temperament is possible. The maximum error is 12% of 1/100 of a semitone. This error is about 25 times smaller than any error that can be detected by the keenest human ear. So, for all musical purposes, this error in semitone intervals is of no consequence.

g. The twelve disks are geared together to assure that measurements are always in correct intervals of the Equally Tempered scale. For instance, if a scale based upon A-435 instead of the American standard of A-440 is desired, it is possible to obtain correct intervals for all other notes in twelve octaves merely by adjusting the Stroboconn 4th-ring "A" pattern to a standstill at a frequency of A-435 (A_4—20 cents).

h. This adjustment is accomplished through use of the Stroboconn Tuning Unit. The Tuning Unit of the Stroboconn houses an extremely temperature-stable Connivar tuning fork. At "O" setting of the Tuning Unit (*See Figure 1*), this fork vibrates at 55 cycles per second, and is used to control the frequency of the power supply to the synchronous motor that drives the twelve stroboscopic disks in the Scanning Unit.

i. Two sliding weights operated by the Tuning Knob (*See Item 1, figure 11*) vary the "normal" 55 cycle per second rate of vibration of the fork over a calibrated range of one semitone, and this in turn varies the speed of the scanning disk motor in direct proportion. Thus, some combination of disk pattern and speed of rotation can be found to correspond within 1/100th part of a semitone as found in the Equally Tempered scale to any frequency from 31.772 to 4,066.8 cycles per second.

2. OPERATING INSTRUCTIONS.

a. General Instructions.

(1) When the Stroboconn is prepared for use according to Section IV, proceed as directed in the paragraph containing applicable technique. (Paragraphs *b, c, d, e, f, g* hereunder.)

(2) The Stroboconn may be used for two general purposes: 1. A frequency standard; 2. A frequency measuring device.

(3) When used as a frequency standard a musical tone (or any frequency within range) is altered until it produces a stationary pattern in one of the Scanning Unit windows for a predetermined standard of frequency. Into this classification of use falls the tuning of musical instruments.

(4) The Stroboconn, when used as a frequency measuring device, is tuned to produce a stationary pattern in one of the Scanning Unit windows while a tone of unknown frequency is sounding, and the measurement reading of this frequency is taken directly from the Tuning Unit's calibrated scale. In the case of musical tones the reading will be in cents plus or minus from a standard semitone in the Equally Tempered scale. If the actual frequency in vibrations per second is desired, this may be found by referring to the booklet "A Table Relating Frequency to Cents," which is listed in Section VIII, paragraph A5, Page 19.

(5) The Stroboconn microphone is a very sensitive instrument which will pick up sound from quite a distance. It is usually desirable, however, to place the microphone near the source of sound to be tested, and to reduce the volume control on the Scanning Unit to some point below maximum, where a clear pattern can be observed but where unwanted sounds are not picked up by the microphone. No damage will be caused by excessive sound intensity. However, clearer patterns will result if the procedure above is followed and full volume is used only when needed.

b. Musical Instrument Testing.

(1) *Mallet Played Instruments.*

The xylophone, marimba vibraphone, glockenspiel, etc., are best tested and tuned by placing the microphone as near the bar being sounded as possible. Any vibrato mechanism should be turned off and the resonator butterfly valves should be turned so that the tube is as open as possible.

(2) *Piano.*

First, determine whether the piano is to be tuned to A-440 or to some lower or higher standard, and then set pointer of the Stroboconn Tuning Unit to this position. Place the microphone as near as possible to the string being sounded. (Some tuners prefer to use a contact microphone.)

Many tuners prefer to start tuning at the "break" in the strings where the unwrapped strings begin. On some pianos another starting point may be preferable. Mute the strings so that only one string is allowed to vibrate at a time. Sound the starting tone and observe the pattern produced by the fundamental —the lowest frequency present in the tone. If the tone is in the fourth octave, which starts at "middle C", the fundamental pattern will appear in the fourth ring or pattern band of the Stroboconn. Tune the string to make this pattern stationary. Then observe that the pattern in the fifth ring is moving slowly to the right, indicating the second partial of the tone is slightly more than an octave above the fundamental. This is caused by the fact that the partials of piano tones are not integral multiples of the fundamental frequency—they are inharmonic. The sharpness of the second partial of the string just tuned is a guide as to how sharp the string an octave above the string just tuned must be in order to sound right. If, for the example, the fifth ring pattern indicates the second partial is 2 cents sharper than the equally tempered octave, then when the string an octave above the first string tuned is to be tuned, it should be tuned at least 2 cents sharp by moving the pointer 2 cents to the right of the position used as a starting point. This same procedure is repeated as the tuner progresses up the scale from the starting point. It will be found that the octave stretch required will become greater as one progresses toward the top of the scale.

When tuning downward from the starting point on the piano it is possible to automatically attain a "stretched" scale by watching the fourth ring while tuning strings in the third octave. When the fourth ring pattern is stationary, the third ring pattern will drift to the left. This means that the fundamental of the third octave string is tuned flat in order to make its second partial in tune with the fundamental of the string an octave above it. When tuning in the second octave the third ring pattern or the fourth ring pattern can be used, depending upon the clarity of the pattern, the piano, and which technique produces the most satisfactory results. The same is true for the first octave. The low register tones have very weak fundamentals, so it is quite difficult to get clear stroboscopic patterns from them. However, the upper partials are strong and they determine whether or not the piano sounds in tune. They produce clear patterns on the Stroboconn generally and enable the tuner to bring them into proper relationship with the notes above.

Piano tuning is quite complex because of the inharmonicity of the partials of its tones. The inharmonicity varies from string to string on the same piano and is different in different pianos. Therefore, no hard and fast rule can be given as to how much to "stretch" each octave on all pianos. "Stretching" will be the least in the middle range of the piano and greater at each end of the scale.

In addition there are a number of other factors that must be understood and mastered if one is to tune pianos satisfactorily.

(3) *Bowed String Instruments.*

The microphone should be placed as near the instrument as possible. Intonation of both tones of a double-stopped combination may be tested at the same time.

(4) *Plucked String Instruments.*

The microphone should be placed as near the instrument as possible. In testing harps the microphone should be placed near the strings. All the notes in a chordal combination may be tested at one time.

(5) *Cup Mouthpiece Instruments.*

Since the intensity of sound from most cup mouthpiece instruments is high, improvement may sometimes be made in the Stroboconn pattern if the microphone control is turned down considerably, or the microphone is moved some distance from the instrument.

(6) *Keyed Wind Instruments*

The same technique is used as is employed in testing cup mouthpiece instruments.

(7) *Pipe Organs, Reed Organs and Harmonicas.*

In pipe organs best results will be obtained if the microphone is placed near the pipe being sounded. In testing reed organs the microphone should be placed near the reed, and in testing harmonicas, the instrument itself should be held close to the microphone.

(8) *Tuning Forks and Bars.*

Place the microphone near to and parallel to the flat side of the vibrating part.

c. Testing Vocal Tones.

The vocalist should stand 12 to 14 inches from the microphone. Since some voices are particularly full of strong overtones, faster readings are obtained when the fundamental of the tone sung is know to the operator.

d. Testing Electronic Musical Instruments.

The microphone may be placed near the speaker of the instrument, or impulses may be fed directly into the Stroboconn's microphone connection from the electronic instrument's loudspeaker connections, dispensing with use of the microphone entirely.

e. Testing Laboratory Instruments.

(1) The electrical output of an oscillator or other pulse generating electronic equipment of comparable impedence may be fed directly into the microphone input jack of the Stroboconn. If frequencies in cycles per second are desired, the readings of the Stroboconn can be converted by reference to the booklet, "A Table Relating Frequency to Cents," in Section VIII, Paragraph A5, Page 19, of this manual.

(2) When it is necessary to calibrate or adjust an oscillator to a particular frequency in cycles per second, the setting of the Stroboconn for this frequency may be obtained from the above-mentioned booklet and the oscillator adjusted to give a stationary pattern in the Stroboconn window applicable. The high order of accuracy obtainable (better than 1/20th of one percent) is particularly useful in many laboratory applications. While the normal upper frequency limit of the Stroboconn is 4,066.8 cycles per second, this may be extended upward indefinitely by the use of suitable frequency dividing equipment.

f. Measuring Mechanical Speeds.

(1) The Stroboconn is particularly useful in measuring rotative speeds of encased parts such as the impeller of a supercharger. Here rotative speed may be measured by microphone from the sound generated while running. Revolutions per minute are calculated by dividing the frequency reading of the Stroboconn by the number of fins on the impeller and multiplying by 60.

(2) The speed of rotating shafts and exposed parts may be determined by use of a toothed wheel and a magnetic pick-up coil to provide electrical impulses that are fed directly into the Stroboconn through the microphone jack. Here, again, the generated frequency is divided by the number of teeth on the wheel and multiplied by 60 to determine r.p.m. The lower limit of measurement is determined by the number of teeth on the wheel, the upper by the highest frequency measurable with available frequency divider equipment.

With a single-tooth wheel, speeds up to 240,000 r.p.m. may be determined directly without use of a frequency divider.

g. Inspecting by Sound.

The Stroboconn is used with great success by manufacturers of products which are inspected by "ringing," such as grinding wheels. When the wheels are "rung," the Stroboconn frequency reading of the sound produced reveals defective wheels. Satisfactory wheels are also graded as to hardness by the same method.

3. TIPS TO THE OPERATOR.

a. Changes in temperature have a great effect on musical instruments—wind instruments become sharp with a rise in temperature and string instruments become flat. Bells and other instruments using solid vibrating material (xylophone, marimba, ordinary tuning fork, etc.) likewise become flat with a rise in temperature. Most instruments are made to perform with best intonation at a temperature of 72 degrees Fahrenheit under conditions of 50% relative humidity. Tunable wind instruments, however, are manufactured with a scale that is acceptable within a range of 23 degrees Fahrenheit either way from this standard. The Stroboconn, because it uses an extremely temperaature-stable Connivar fork, may for all practical purposes be considered exactly correct regardless of temperature. Change in the Stroboconn's indication of pitch due to temperature is less than 20/1,000,000 (twenty millionths) per degree Centigrade. Error due to change in line voltage has also been compensated for and is extremely small, having no significance except in very precise laboratory measurements.

b. Musical instruments are built to have correct intonation with reference to the tuning note. As a general practice, an instrument's tuning note should always be checked first. Some musicians, however, have a tendency to sound the tuning note unnaturally. Any error due to this tendency may be reduced by measuring other tones within the range of the instrument, or a series of tones, to determine the average tuning. Sometimes a musical passage is used to check intonation. In making such a measurement it is helpful if the Stroboconn observer is familiar with the passage being played. He can then locate and measure the tones more rapidly.

c. Since some variation is allowable in actual musical performance, a student should not be discouraged if he cannot make each pattern of the Stroboconn stand perfectly still. Because of the instrument's extreme sensitivity, differences in pitch smaller than those discernible by ear often will cause some motion in the band pattern. Vibrato will cause the pattern to rock back and forth.

d. Many excellent musicians feel that strict adherence to the Equally Tempered scale does not permit the fullest measure of artistic musical performance. It has been found that, while the Equally Tempered scale is not strictly adhered to, neither is the Just nor Pythagorean scale consistently used. The Equally Tempered scale, with its flexibility and wide acceptance, is therefore justified as the best reference from which to measure the deviations of actual performance. The Stroboconn, since it is infinitely variable within a wide musical range, does not subscribe to any particular scale, though it is calibrated in terms of the Equally Tempered scale.

e. Struck strings, bars and bells may produce inharmonic overtones. The non-selective action of the Stroboconn makes it possible to measure frequencies of these overtones even in the presence of strong fundamentals.

NOTE

The fundamental tone (if unknown) may be located by looking for the black-spoked band that appears nearest the apex in any one of the twelve wedge-shaped viewing windows.

f. In making a formal test of the intonation of a musical instrument or the skill of a musician, each note within range should be measured and a record kept. Several players should be used to check the intonation of any particular instrument and the average of each note played should be computed.

NOTE

An intonation chart such as shown in Figure 5 is very useful in recording results of Stroboconn tests. Charts such as this are available for general testing, and charts for particular musical instruments are also available. See Section VIII, Paragraph A6, Page 19.

No. ____________

Intonation Survey

Musician ____________

Age ______ Date of Birth ____________

Parents Name ____________

Address ____________ Tel. ____________

School ____________ City ____________

Organization ____________

Have Played ______ Years ______ Months

Instrument or Voice ____________

Instrument in the Key of ____________

Make and Model ____________

Serial Number ____________

Age of Instrument ____________

Date	Time
	m. to m.
	m. to m.
	m. to m.
	m. to m.
	m. to m.

Temperature ____________

Humidity ____________

Loudness ____________

Observer ____________

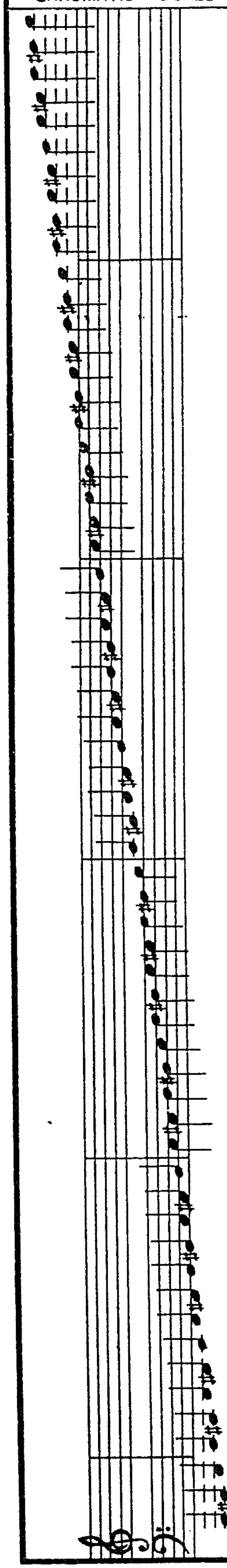
Mouthpiece Used ____________

Tuning Device Setting ____________

Valve Slide Positions { 1st. ____________
2nd. ____________
3rd. ____________

Remarks:

Chromatic Scale



Note	Cents	Deviation				Ave.	Rel.
A_6							
$G^{\#}_6$							
G_6							
$F^{\#}_6$							
F_6							
E_6							
$D^{\#}_6$							
D_6							
$C^{\#}_6$							
C_6							
B_5							
$A^{\#}_5$							
A_5							
$G^{\#}_5$							
G_5							
$F^{\#}_5$							
F_5							
E_5							
$D^{\#}_5$							
D_5							
$C^{\#}_5$							
C_5							
B_4							
$A^{\#}_4$							
A_4							
$G^{\#}_4$							
G_4							
$F^{\#}_4$							
F_4							
E_4							
$D^{\#}_4$							
D_4							
$C^{\#}_4$							
C_4							
B_3							
$A^{\#}_3$							
A_3							
$G^{\#}_3$							
G_3							
$F^{\#}_3$							
F_3							
E_3							
$D^{\#}_3$							
D_3							
$C^{\#}_3$							
C_3							
B_2							
$A^{\#}_2$							
A_2							
$G^{\#}_2$							
G_2							
$F^{\#}_2$							
F_2							
E_2							
$D^{\#}_2$							
D_2							
$C^{\#}_2$							
C_2							
B_1							
$A^{\#}_1$							
A_1							

COPYRIGHT 1940 BY C. G. CONN, LTD.

OJK:RWY:LEW:RDL 10-4-40

Figure 5—General Intonation Chart

SECTION VI

INSPECTION, LUBRICATION, MAINTENANCE

1. INSPECTION.

a. The Stroboconn is strongly but simply built. The only inspection needed is observation of the neon Motor Pilot light on the panel of the Scanning Unit to see that it glows steadily after a switch from WARM-UP to MOTOR-RUN is made.

2. LUBRICATION.

a. Where the Stroboconn is used steadily 8 hours or more a day, oil in the Scanning Unit gear box should be replenished about every six months. Access to the gear box may be had by removing the unit's cover as described in Paragraph 5, *a*, (1), this Section. No oil should be visible when the gear box plug (*Item*

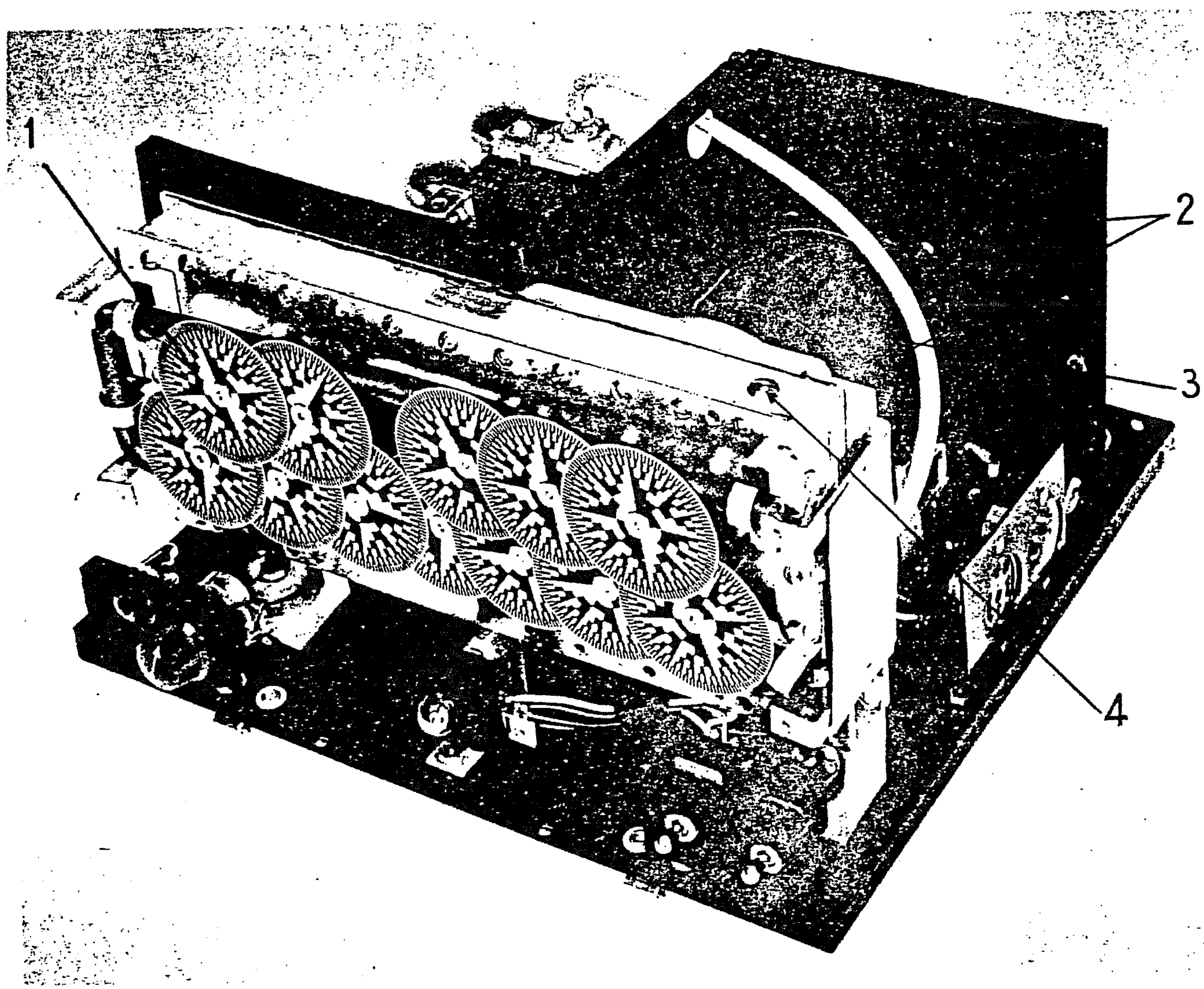


Figure 6—Stoboconn Scanning Unit With Cover and Mask Off

1. Scanning Disks
2. Oil Cups for Motor
3. Synchronous Motor
4. Gear Case Oil Plug

4, *figure 6*) is removed, as it is held by absorption in the felt lining of the reservoir. One-half ounce is sufficient for six months of operation under the above conditions. Pour oil into reservoir with motor running.

CAUTION

Only special Stroboconn gear box lubricating oil should be used. Any other oil may cause damage to the instrument. See list of accessories in Section VIII, Paragraph A4(b), Page 19.

b. The synchronous motor in the Scanning Unit should be oiled every two months when used steadily 8 hours per day. When used only periodically, once every six months is adequate lubrication. Any good lightweight motor oil may be used, but the motor oil listed in Section VIII, Paragraph A4(a), Page 19, is recommended.

3. MAINTENANCE.

a. Precautions.

(1) The Stroboconn in *not* intended for use under extremes of temperature or under conditions of extreme humidity, and it is *not* fungi-proofed.

(2) If the Stroboconn has not been used for a long period during a condition of high humidity, the instrument should be allowed to warm up several hours before using. Connection and microphone cables should be thoroughly dried. These cables should be kept clean at all times.

(3) It should be remembered that the Stroboconn is an electronic instrument and should, therefore, be reasonably protected from jars, bumps and excessive vibration.

(4) The microphone should be protected from jars, and should not be blown into when testing. Also it must be protected from long exposure to direct sunlight or any source of heat which will cause it to attain a temperature above 120 degrees Fahrenheit.

(5) The grills of the Stroboconn units should not be covered when the instrument is in operation. Excessive heat will cause damage to the instrument.

b. Electronic Tube Replacement.

The Stroboconn's circuits are not critical as to electronic tube replacement, but only a tube whose number corresponds with the number stamped on the chassis beside the tube socket should be used. Remove the access panels on the left side of units to replace tubes.

c. Fuse Replacement.

If failure of an electronic tube or other circuit component has caused the Stroboconn fuse to "blow," it should be replaced with one of exactly the same rating, as shown in Section VIII, Paragraph B *a*. Otherwise, serious damage to the instrument may result.

d. Neon Lamp Replacement.

Should the neon Motor Pilot lamp fail, replace with T4½, 2-prong, bayonet base type NE-48 or equivalent.

e. Neon Tube Replacement.

The flashing neon tube used to illuminate the whirling disks of the Scanning Unit may be replaced by removing the four securing clamps and unsoldering wire leads of the lamp from the terminal board, after removing the unit's cover as directed in Paragraph 5, *a*, (1), this Section.

4. CALIBRATION CHECK.

A simple spot check of the Stroboconn's accuracy may be made by comparison with the A-440 signal broadcast by the Bureau of Standards radio station WWV in Washington, D. C. WWV broadcasts many services on several frequencies. This broadcast schedule is available from the Bureau. The signal may be fed from loudspeaker to microphone, or directly into the microphone input jack of the Stroboconn. The Bureau of Standards A-440 signal should cause the scale-of-C, fourth-ring A pattern to stand still when the Tuning Unit pointer is adjusted to zero reading. (Also, see Paragraph 6, this Section.)

5. CIRCUIT CHECK

a. Scanning Unit.

(1) Preparation.

First remove screws in cover, the volume control knob, and the transposition knob, which unscrews. (*See Figure 1.*) Lift up back of cover while holding front side down. Slide cover forward to clear neon Motor Pilot lamp. Then lift straight up.

(2) Amplifier.

(*a*) Connect a-c power cable and lift Power Switch (*5, figure 1*) to POWER position. After 45 seconds, lift Motor Switch (*Item 4, figure 1*) from WARM-UP position to MOTOR-RUN position. Allow another 45 seconds for warmup and then remove shield cap from 6J7 input tube and touch grid cap with finger. U-shaped neon tube should light. If this checks all right, look for short circuit in the microphone circuit or defective contact at input jack. Measure resistance at the microphone plug. A dynamic microphone should have a continuity resistance of several hundred ohms; a crystal microphone should be an open circuit. Next, measure resistance between grid clip and ground. This should be 3 megohms with the volume control at MAX., and about 30 ohms or less at OFF.

(*b*) If U-shaped neon tube does not light when grid cap is touched, check electronic tubes.

WARNING

Shut off a-c power. High voltage may cause bodily injury if power is on when next step is performed.

Pull out neon tube cable plug and measure resistance between its center prong and shell. This should be an open circuit at low voltages. Next, measure resistance between center terminal of plug socket and ground. This should be 44,000 ohms, approximately.

(*c*) Should the above fail to reveal the source of trouble, take chassis from case by removing nuts at corners. Connect a-c power and measure voltages indicated on schematic diagram (*Figure 7*). Compare results with voltages listed. Any unusual discrepancy should be investigated. Disconnect a-c power and measure resistances and capacitances of components as given on the schematic diagram. Check for accidental grounds and inspect all wiring and all soldered connections. Next, connect a-c power and measure

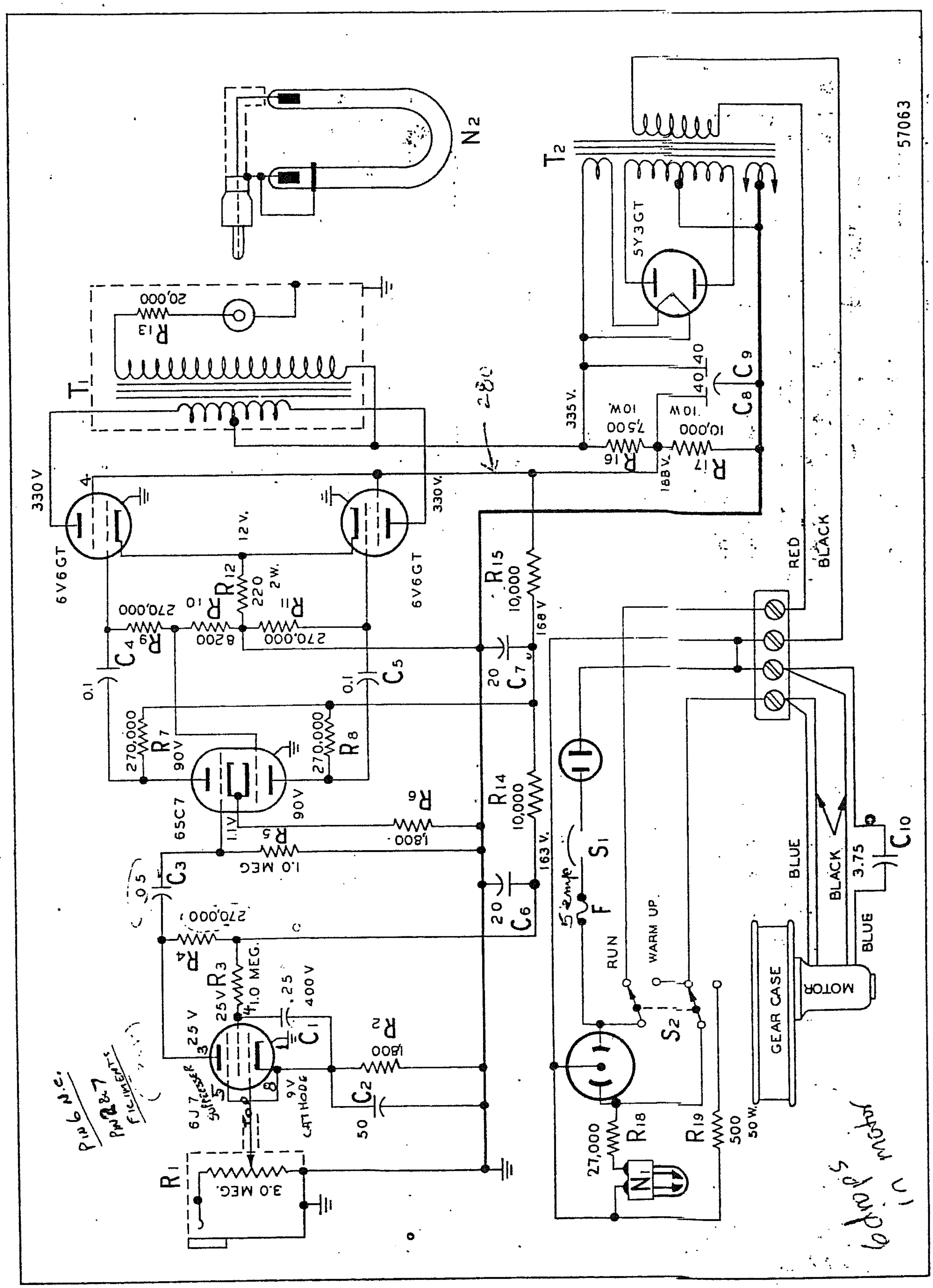


Figure 7—Schematic Diagram of Scanning Unit

56122-2

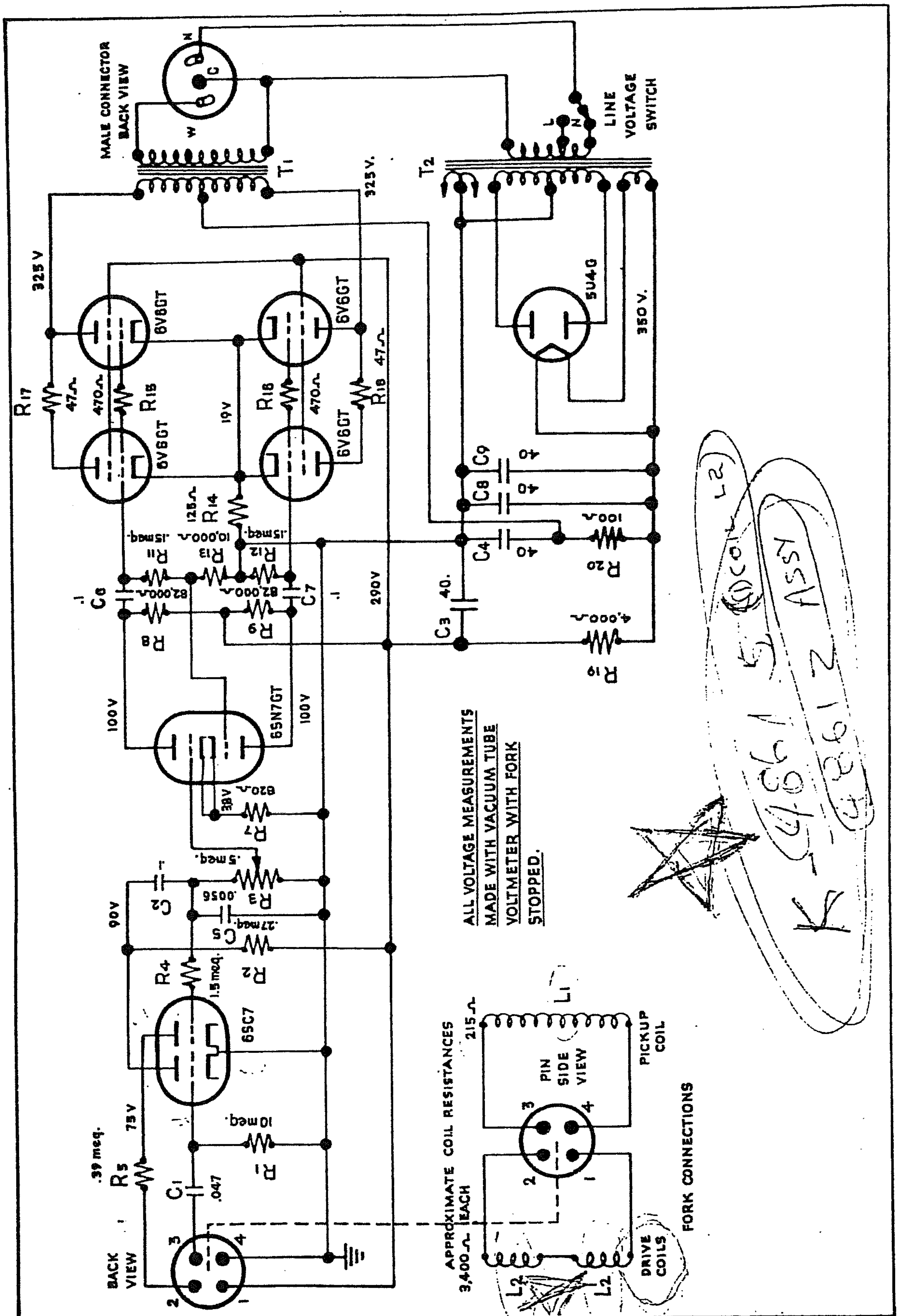


Figure 8—Schematic Diagram of Tuning Unit

gain. With an input of 1.5 millivolts at 440 cps applied to the grid of the 6J7 tube (115 v. line voltage), the U-shaped neon tube should glow steadily.

(3) Gear Box.

Connect a-c power, lift Power Switch to POWER position, and operate with Motor Switch in WARM-UP position. After running for 15 minutes, listen to sound produced. A high-pitched whine indicates insufficient oil, while a rattling sound may indicate worn bearings and gears. Unscrew oil plug (*See Item 4, Figure 6*) and add not more than ½ ounce of Stroboconn gear box lubricating oil while motor is running. (See Paragraph 2, *a*, this Section.) This should be completely absorbed by the felt reservoir lining in a few minutes. If, after oiling, the gear box is still noisy, do not disassemble or attempt to repair. This requires special equipment usually not available. The precision of this assembly determines the steadiness of the pattern. If necessary to return for factory servicing, follow instructions in Section VII of this manual.

b. Tuning Unit.

(1) Preparation.

(*a*) Remove side screws and tuning knob; lift cover straight up.

(2) Amplifier.

(*a*) Attach connection cable to Scanning Unit. Connect a-c power cable to Scanning Unit and to power supply. Lift Power Switch on Scanning Unit (*Item 5, Figure 1*) to POWER position, Motor Switch (*Item 4, Figure 1*) may be in either WARM-UP or MOTOR-RUN position. Allow 45 seconds for amplifiers to warm up. Pluck fork gently with fingers and note whether Motor Pilot lamp of Scanning Unit glows. If not, turn compensator control clockwise with screw driver. (*See Item 4, Figure 11.*)

NOTE

The compensator control should be adjusted clockwise to a point where the Motor Pilot lamp will continue to glow steadily when motor is switched to MOTOR RUN position, but no farther. If this adjustment is set too high, a shaking or oscillating pattern may result in the twelve viewing windows.

(*b*) If adjusting the compensator controls has no effect, check electronic tubes. Should these tubes be all right, disconnect power, remove nuts holding chassis in case, and lift out. Test at fork connector cable socket for resistances of drive and pickup coils as indicated on the schematic drawing, (*Figure 8.*) Reconnect power and measure voltages as indicated in Figure 8. Compare results with voltages listed. Any unusual discrepancy should be investigated. Disconnect power and measure resistances and capacitances of components as indicated in Figure 8. Check for accidental grounds; inspect all wiring and soldered connections. Measure gain with power connected. It should not require more than 20.0 millivolts of 55-cycle power applied to the first grid of the 6SC7 tube (compensation control on chassis turned clockwise all the way), to get 80 volts output to the Scanning Unit motor.

(3) Fork Assembly.

(*a*) With power supplied through Scanning Unit off, inspect carefully for dirt or foreign matter on tines, and also between tines and pick-up (center) and drive (outside) magnet poles. (*See Items 2 and 3, Figure 11.*)

CAUTION

Care should be used to avoid breaking fine coil wires.

(*b*) With power on and Motor Switch of Scanning Unit in MOTOR RUN position, pluck fork gently with fingers. If Motor Pilot lamp lights but fails to continue to glow steadily, drive coils are operating improperly, or compensator control needs adjusting. Advance compensator control by turning clockwise with screw driver as far as it will go (*See Item 4, Figure 11*), and pluck fork again. Adjust compensator control as instructed in paragraph 5: *b*, (2), (*a*) this Section, if Motor Pilot lamp continues to glow steadily. If not, turn compensator control counterclockwise as far as it will go, and connect vacuum tube voltmeter across whole control. With the fork operating properly, the a-c voltage developed across the control should be approximately 12 v. This reading should not change by more than 1.5 v. as the fork's sliding weight is moved from one end to the other. If fork drive coil is defective, do not attempt to repair, as even loosening parts of this assembly will usually destroy calibration. Special equipment is required to recalibrate, and this equipment is usually not available. If necessary to return for factory servicing, follow the instructions in section VII of the manual.

6. CALIBRATION

It is possible that the Stroboconn may get out of calibration from abuse such as extremely rough handling. Even when its accuracy is outside of the guaranteed limit ($\pm$ 1/20%), however, it may still be more accurate than other calibration devices available. Two exceptions are the 440 cycle broadcasts from WWV and commercial power in *some* districts. (See Paragraph 4, this section.) The WWV broadcasts are accurate, barring accidents, to about one part in 10,000,000. The *average* received frequency will be of the same accuracy. Irregularities in radio transmission, however, will permit momentary variations of about 1% in the received frequency, especially at points remote from Washington.

Commercial power frequency can be used as a secondary check of the Stroboconn, although a discrepancy in power frequency reading may be found, due to a short-time deviation from nominal. The nominal readings, averaged over 24 hours, are G-1 + 35 cents for 50 cps and B-1 − 49.4 cents for 60 cps. At the proper setting, the pattern in the Stroboconn window should appear motionless, providing the power supply is accurate.

In the United States the *average* frequency is nearly always precise (for synchronous clock operation) but the actual frequency at any particular time may vary from nominal by as much as 1% or more.

If the Stroboconn is sufficiently out of calibration to impair its usefulness, the whole instrument should be returned to the factory for repair.

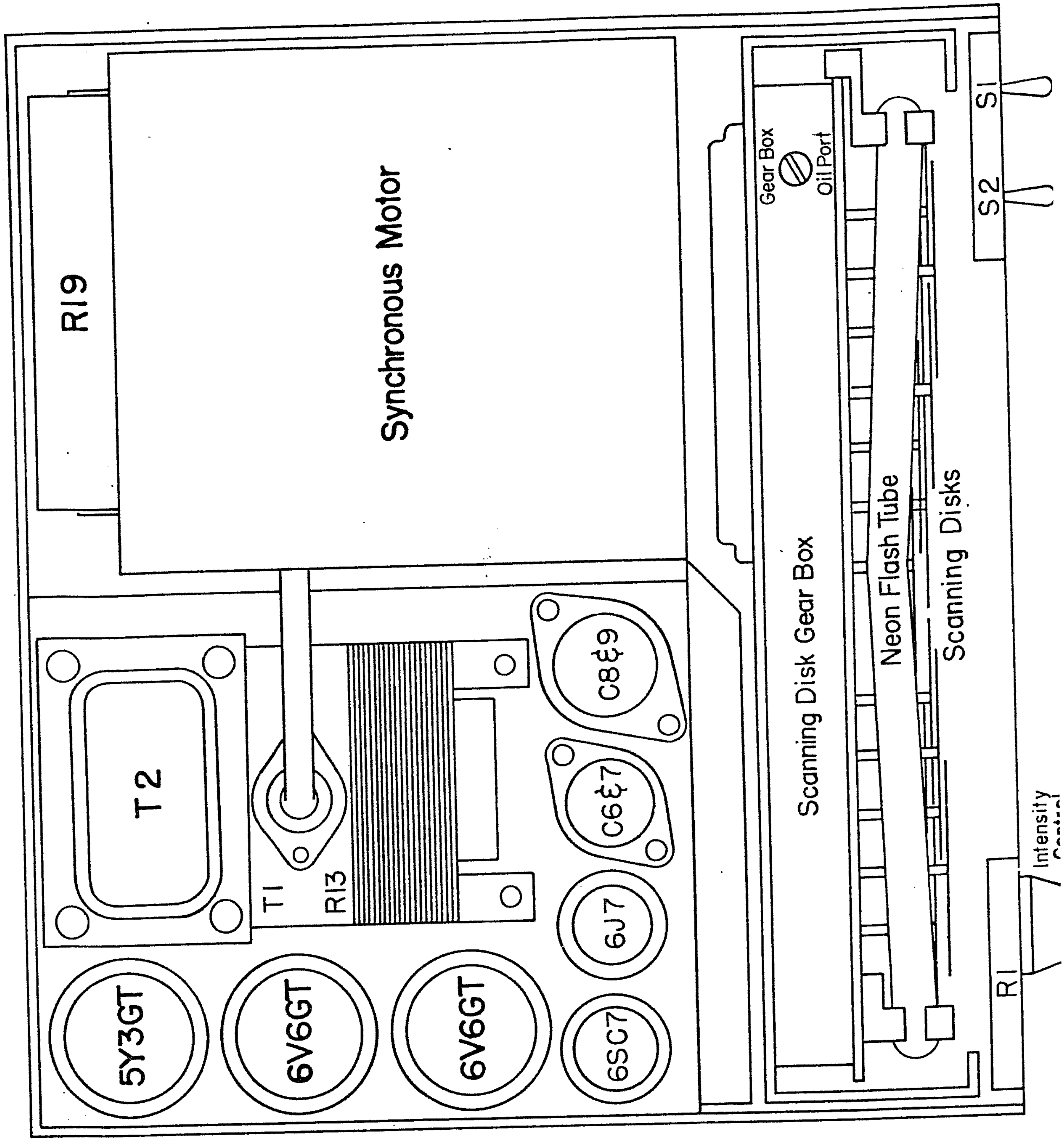


Figure 9—Simplified Schematic Top View of Scanning Unit

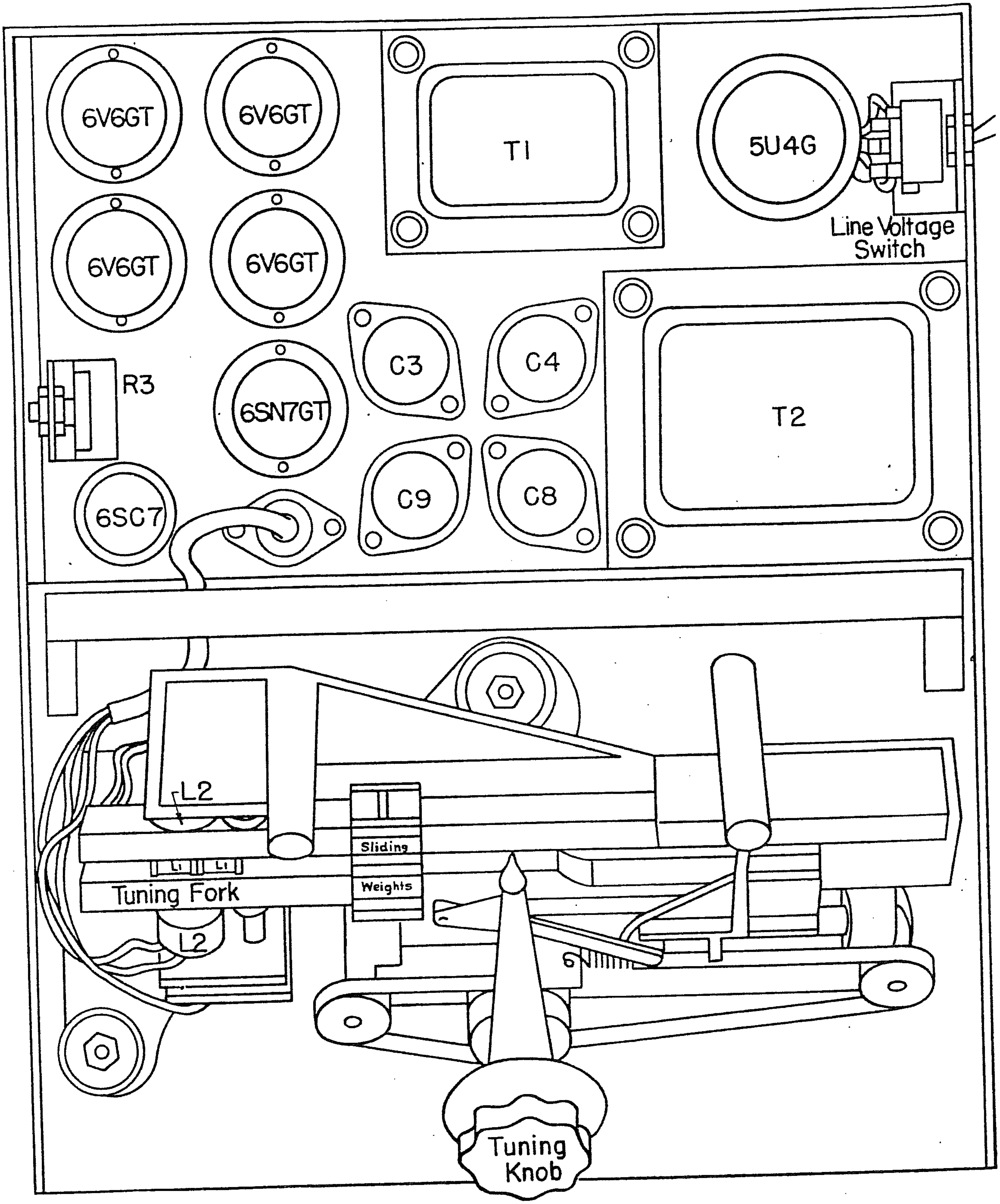


Figure 10—Simplified Schematic Top View of Tuning Unit

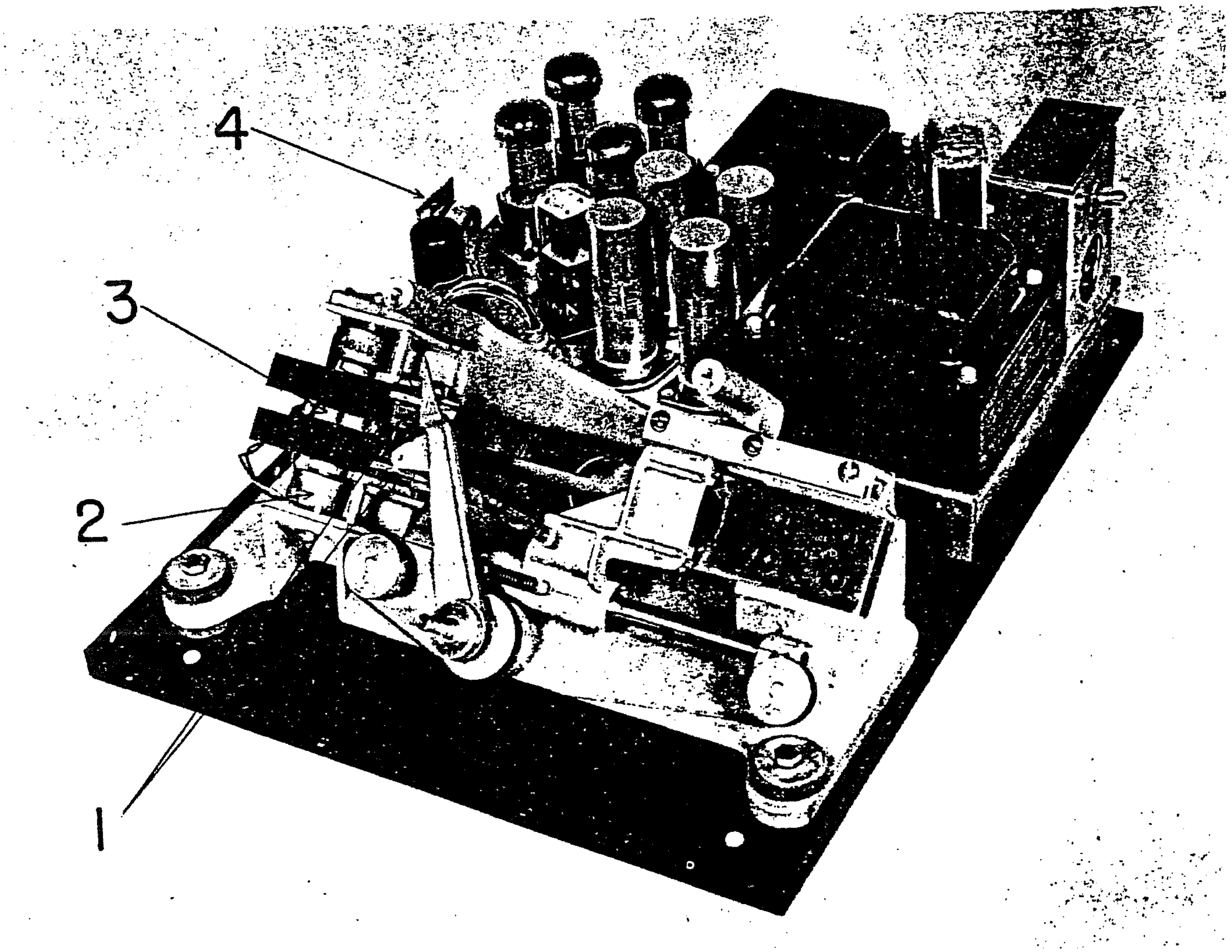


Figure 11—Tuning Unit With Cover, Scale and Partition Removed.

1. Sliding Weights on Fork
2. Drive Coils
3. Pickup Coil
4. Line Voltage Compensator Control

SECTION VII

REPAIR POLICY AND INSTRUCTIONS FOR RETURNING INSTRUMENT TO THE FACTORY

A. LOCAL REPAIR

The Stroboconn is a specialized electronic instrument, and most repairs require special equipment. To avoid the inconvenience and transportation expense of returning the instrument to the factory when it is malfunctioning, it is suggested that it be taken to a competent electronic repairman with instructions to do no more than this service manual recommends.

B. INSTRUCTIONS FOR RETURN

If it is necessary to return the instrument to the factory for repairs, carefully follow these instructions.

1. Pack the Stroboconn carefully in a rugged cardboard or wood box. Be sure all parts fit snugly within the box.
2. Include all components (i.e., cables and microphone).
3. Label box "FRAGILE".
4. Ship instrument prepaid to: CONN ORGAN CORPORATION, MADISON, INDIANA.
5. Mail detailed instructions, including description of malfunction and instrument serial number to: CONN CORPORATION, SERVICE DEPARTMENT, ELKHART, IND.

All repairs are individually priced on a time and material basis, and costs can not be determined prior to examination.

SECTION VIII

ACCESSORIES AND REPLACEMENT PARTS

A. ACCESSORIES

1. Neon Glow lamp with socket. Used to test line voltage to determine whether it is a. c. or d. c.—#48521
2. Contact microphone equipped with 8 ft. cable and extra alligator clip for use in piano tuning.—#56272-2
3. Longer (7 foot) interconnection cable between tuning and scanning units.—#56902-2
4. Stroboconn Oil.
   a. Oil for Scanning Unit motor. 1-ounce bottle.—#48525
   b. Oil for Scanning Unit gear box. 1-ounce bottle.—#48526
5. "A Table Relating Frequency to Cents," by R. W. Young, gives frequencies for each 1/100th part of a semitone, auxiliary tables, and other valuable information.—#1366
6. Intonation Test Charts for logging intonation of instruments or players.
   a. General Intonation.
   b. Grand Staff.
   c. Saxophone Test.
   d. Flute Test.
   e. Clarinet Test.
   f. Oboe Test.
   g. French Horn Test — B♭.
   h. French Horn Test — F.
   i. Trombone Test.
   j. Treble Clef, 3 valve, cup mouthpiece instruments.
   k. Bass Clef, 4 valve, cup mouthpiece instruments.
   l. Piano Test.
   m. Frequency Chart. Compares frequency level in semitone count to frequency in cycles per second.

B. REPLACEMENT PARTS

a. Scanning Unit.

R1, Volume Control, 3 Megohms—#50270
R2 & 6, Resistor, 1800 Ohms, ½ watt—#45229
R3 & 5, Resistor, 1.0 Megohm, ½ watt—#50891
R4, 7, 8, 9 & 11, Resistor, 270,000 Ohms, ½ watt—#45224
R10, Resistor, 8200 Ohms, ½ watt—#48487
R12, Resistor, 220 Ohms, 2 watt—#48439
R13, Resistor, 20,000 Ohms, 10 watt—#50897
R14 & 15, Resistor, 10,000 Ohms, ½ watt—#50937
R16, Resistor, 7500 Ohms, 10 watt—#50899
R17, Resistor, 10,000 Ohms, 10 watt—#50894
R18, Resistor, 27,000 Ohms, ½ watt—#57094
R19, Resistor, 500 Ohms, 50 watt—#50900
C1, Capacitor .22 Mfd. 400 volt—#43659
C2, Capacitor, 50 Mfd. 25 volt Electrolytic—#44760
C3, Capacitor, .047 Mfd., 400 volt—#43591
C4 & 5, Capacitor, 0.1 Mfd. 400 volt—#56649
C6 & 7, Capacitor, 20-20 Mfd., 450 volt Electrolytic—#43810
C8 & 9, Capacitor, 40-40 Mfd., 450 volt Electrolytic—#43808
C10, Capacitor, 3.75 Mfd., Oil Filled—#50906-3
N1, Lamp, Neon Pilot—#50804
N2, Lamp, Tubular Neon—#52057
S1, Switch, SPST Toggle—#50908
S2, Switch, DPDT Toggle—#50907
F, Fuse, 5.0 ampere—#50918
T1, Transformer, Output—#56968
T2, Transformer, Power—#56874

4 mf
1650

Bodine Electric
1650RPM
No 2270948
Type NCY-12

b. Tuning Unit.

R1, Resistor, 10 megohm, ½ w—#55176
R2, Resistor, .27 megohm, 1 w—#43648
R3, Resistor, .5 megohm, potentiometer #50816
R4, Resistor, 1.5 megohm, ½ w—#50889
R5, Resistor, .39 megohm, 1 w—#44940
R7, Resistor, 820 ohm, ½ w—#56368
R8 and R9, Resistor, 82,000 ohm, 1 w—#48290
R11, Resistor, .15 megohm, ½ w—#48545
R12, Resistor, .15 megohm, ½ w—#48545
R13, Resistor, 10,000 ohm, ½ w—#48546
R14, Resistor, 125 ohm, 10 w—#56867
R15, Resistor, 470 ohm, ½ w—#43846
R16, Resistor, 470 ohm, ½ w—#43846
R17 and R18, Resistor, 47 ohm, 1 w—#48501
R19, Resistor, 4,000 ohm, 10 w—#57233
R20, Resistor, 100 ohm, 20 w—#57234
C1, Capacitor, .047 mf, 200 v,—#56762
C2, Capacitor, .10 mf, 400 v,—#56649
C3 and C4, Capacitor, 40 mf, 500 v, electrolytic #48534
C5, Capacitor, .0056 mf, 400 v, —#56664
C6 and C7, Capacitor, .10 mf, 400 v,—#56649
C8 and C9, Capacitor, 40 mf, 500 v, electrolytic—#48534
T1, Transformer, output—#56187
T2, Transformer, power—#56169

Motor 50906-2

C. EXTERNAL PARTS

1. Interconnecting Cable—#56902-1
2. Microphone—#45280
3. Power line Cable—#50903