StroboTUNER

OPERATION
AND
SERVICE
MANUAL

C. G. CONN LTD.

BAND INSTRUMENT DIVISION — ELKHART, INDIANA

StroboTUNER

MODEL ST-1

HOW TO USE THE STROBOTUNER

FOR

PIANO TUNING

ORGAN TUNING

INSTRUMENTAL AND VOCAL MUSIC TEACHING

Published By

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INTRODUCTION

The Strobotuner is a simplified version of the well-known Stroboconn. It was designed to provide piano and organ technicians with an accurate and highly portable instrument for fast and accurate tuning; and to provide teachers of instrumental and vocal music with a basic standard of intonation for improving the performance of bands and orchestras.

Technically, the Strobotuner is an electronic device for accurate, visual presentation and measurement of sound frequencies. It determines, by stroboscopic comparison of a sound frequency with a standard frequency, whether a musical tone is sharp, flat or in tune with the equally tempered scale based on the standard A of 440 cycles per second.

The range of the Strobotuner encompasses 84 semitones; one-fifth of a semitone below C-1 (first-octave "C" at lower end of piano keyboard) to one-fifth of a semitone above B-7 (seventh-octave "B" at upper end of piano keyboard), essentially the entire range of the piano.

DESCRIPTION

General—The complete Strobotuner consists of a single encased unit with a fully-detachable cover, firmly held in place by a latch on either side, and a microphone. When packed for carrying, the Strobotuner is entirely self-contained. See figure 1. The permanently-attached,

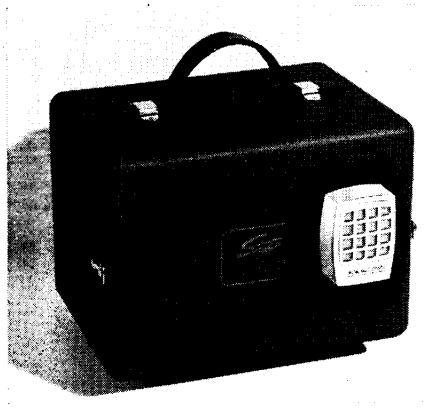

Figure 1—Cutaway showing complete Strobotuner and microphone packed for carrying.

eight-foot power cord and microphone are placed between the face of the instrument and the cover for transporting. A small cloth microphone bag is furnished to prevent possible damage to the face of the instrument when packed.

The microphone is an all-purpose, high impedance type. It is supplied with a five-foot connecting cable and plug.

The Strobotuner case is finished in gray wrinkle and measures 10⅛″ long, 7½″ deep and 7¾″ high. A sturdy leather carrying handle which lies flat when not in use is attached to the top of the instrument. Packed for carrying, the Strobotuner weighs 13 pounds.

Description—Detailed—Referring to the keyed illustration in figure 2, page 6, it will be seen that the Strobotuner has a single viewing window located in the center of the face panel. Behind this window is a stroboscopic disc on which are imprinted seven circular bands consisting of alternating light and dark segments. Each of these bands represents an octave, the smallest band near the hub of the disc representing the first octave, and progressing to the outer-most band which represents the seventh octave. A

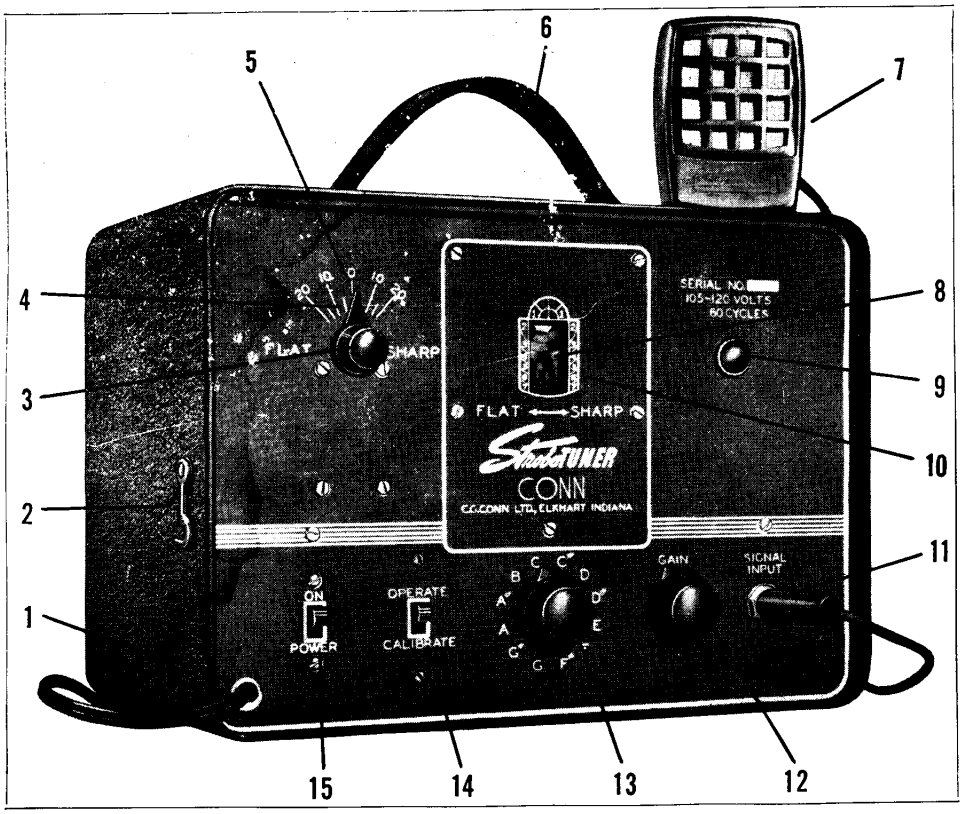

Figure 2—The Complete Strobotuner, Model ST-1

1. Power Cord
2. Cover Latch
3. Tuning Knob
4. Tuning Pointer
5. Tuning Scale
6. Carrying Handle
7. Microphone
8. Scanning Disc
9. Pilot Light
10. Octave Band Numbers
11. Microphone Connection
12. Gain Control
13. Tone Selector Knob
14. Calibration Switch
15. Power Switch

number on the panel coinciding with each band indicates the octave it represents.

Directly below this scanning window is a tone selector switch with a position for each of the twelve chromatic notes of the musical scale. In operation, this tone selector knob and the multiple band stroboscopic disc in the scanning window work in combination to provide the Strobotuner's full, seven octave range.

Located at the left of the viewing window in the upper-left corner of the face panel are a tuning knob, pointer, and scale. The scale is graduated in five-cent intervals from zero in the center to 20 "cents" left for flat and to 20 "cents" right for sharp. (One cent equals one-one hundredth of a semitone.) Use of this pointer and scale adjustment is made for measuring the amount a tone is sharp or flat, for tuning to pitches other than standard A-440, and for calibrating the instrument before use, as explained in the next section.

Across the bottom of the Strobotuner face panel, from left to right, are the power cord (lower left corner), power switch, calibration switch, note selector switch, gain control knob and microphone input receptacle.

PREPARATION FOR USE

Setting Up—Remove the cover and plug the power cord into any 110 volt, 60-cycle outlet. Then insert the microphone plug into its receptacle in the lower right corner of the face panel and turn on the power switch by sliding it up as far as it will go. The pilot lamp will light when the power switch is turned on, indicating to the operator that current is flowing properly.

Allow approximately ten to fifteen minutes for the Strobotuner to warm up. This is necessary to permit the electrical components and tubes that operate the spinning disc to reach a stable operating temperature.

IMPORTANT: Do not obstruct the ventilating grill on the back of the instrument. In use, the Strobotuner should be located to allow air circulation around these grills. Otherwise overheating may occur and cause damage to the instrument.

Calibration—The method of the Strobotuner's operation necessitates that it be calibrated to a known frequency before each use. This is accomplished by the following procedure: After the Strobotuner is warmed up, simply depress the calibrate switch as far as it will go. While holding the calibration switch down, adjust the tuning knob until the pattern appearing on the smallest octave band in the disc window comes to a standstill. (A "slip-pointer" arrangement is used for the tuning knob and pointer in order to allow the knob to be rotated as far as necessary to produce a stationary pattern, but still permit the pointer to be set at any desired position on the scale.)

Next, move the pointer to the "zero" position leaving the tuning knob stationary. (Normally, the pointer can be slipped independently of the tuning knob, but it may be necessary, until operated a number of times, to hold the knob to prevent it from turning with the pointer.) The calibrate switch can be released any time after the pattern has been brought to a standstill so that both hands can be free if needed to reset the pointer.

However, after setting the pointer to zero or any other desired position, recheck the calibration to be certain the tuning knob has not been moved and the instru-

ment is still in calibration. To do this, simply depress the calibrate switch and note whether or not the pattern in the first octave band remains stationary.

When these steps are completed, the Strobotuner is calibrated and ready for operation. The calibration should be checked frequently during operation, however, particularly when use is made of the tuning knob to make measurements or to tune to standards other than A-440. Each time the tuning knob is used to deviate from standard pitch, the calibration should be checked before the succeeding measurement is made.

If desired, standards other than line frequency may be used to calibrate the Strobotuner. This may be necessary where 60-cycle current is not available (see below). Tuning forks of known accuracy, radio signals of A-440, or any other reliable standard is suitable for calibration. If other sources for calibration are used, it is necessary only to feed the signal to the instrument through its microphone in the usual manner. The Strobotuner calibrate switch is not used when calibrating to a standard whose signal is introduced to the instrument through the microphone input. Only the adjustments of tuning knob and pointer are necessary.

Note: In calibrating the Strobotuner with the power line frequency, it is important that it be true 60-cycle current. Calibration with 50-cycle current, for example, will produce discrepancies in the Strobotuner frequency generating unit and errors will result in tuning. The instrument may be *operated* on but not *calibrated* to as low as 50-cycle current. When accurate 60-cycle power is not available, it is important to employ a standard other than power line frequency for accurate calibration.

PRINCIPLES OF OPERATION

The Strobotuner employs the stroboscopic principle in its measurement of sound frequencies, a principle whereby the frequency of the sound introduced is compared visually with a standard frequency within the Strobotuner. A familiar example of this principle is 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 feet per second, and because the eye is unable to separate 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 a 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 motion.

Paralleling this principle, the Strobotuner substitutes its rotating disc for the wagon wheel and two flashing neon bulbs for the movie film. In the Strobotuner the neon bulbs are made to flash in accordance with the frequency of the sound reaching the microphone. The light from these bulbs illuminates the rotating disc which is imprinted with a pattern as seen in figure 3. The pattern consists 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 tones double their frequencies in progressing to successively higher octaves.

The Stroboscopic disc is rotated by means of a small synchronous motor whose speed is controlled by the tone selector switch. The various motor speeds provide a frequency standard for each of the 12 tones of the scale. For example, a tone selector setting for "A" would produce a disc rotation speed of 27.5 revolutions per second. This speed of rotation multiplied by the 16 segments of the fourth octave band results in a frequency of 440 cycles per second, the standard for a fourth-octave "A." Thus, when an "A" of exactly 440 cycles per second is sounded into the microphone, this illuminated band of spokes will appear stationary since the rate of bulb flashes (tone frequency) exactly equals the number of disc spokes passing a given point.

On the other hand, a sound having a frequency of 438 cycles per second would make the Strobotuner 16-segment "A" pattern band appear to rotate slowly to the left; and a sound slightly higher in pitch than 440 cycles would cause the pattern on the disc to appear to rotate slowly to the right. In this manner the Strobotuner indicates directly and instantly whether a tone is flatter or sharper than standard.

Changing the position of the tuning knob serves to vary slightly the speed of the disc within the normal intervals of one semitone provided by the tone selector switch. When the tuning pointer is adjusted to produce a stationary pattern for an "off-pitch" tone, the pointer then shows the approximate number of cents (1/100ths of a semitone) the tone is sharp or flat.

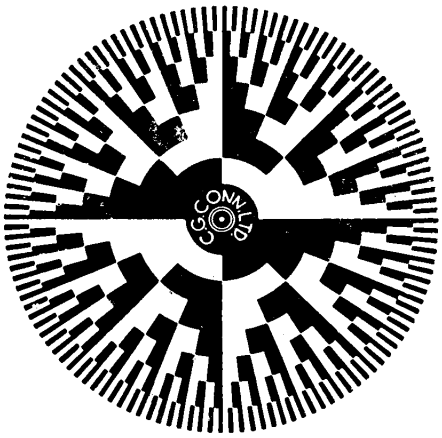

Figure 3—Strobotuner Disc

Adjustment of this tuning knob also provides for measurements in correct intervals of the equally tempered scale for standards other than A-440. If a scale base upon A-435 is desired, for example, it is possible to obtain correct intervals for all other tones in seven octaves merely by adjusting the Strobotuner fourth-band "A" pattern to a standstill at a frequency of A-435 (A4 minus 20 cents).

OPERATING INSTRUCTIONS

More detailed instructions and procedures in relation to the various uses of the Strobotuner follow under appropriate headings, but certain points are generally applicable to all uses and are included here.

When the Strobotuner has been set up and calibrated as directed in the section headed "Preparation For Use," it is ready for operation. But three points of caution should be re-emphasized:

1. Do not cover or obstruct the ventilating grill on the back of the Strobotuner. Overheating will cause damage to the instrument.
2. Since the Strobotuner is designed to operate on a power source supplying 105-120 volts of 60-cycle alternating current, connection to an improper power source may cause damage to the instrument. Be certain of the correct current supply.
3. While the Strobotuner will *operate* on less than 60-cycle current, true 60-cycle current is required in

order to use the regular internal method of *calibration*. If 60-cycle current is not available, the Strobotuner may be calibrated to a very accurate tuning bar, WWV radio signals of A-440, or other reliable standards. (Refer to section on calibration for further details.)

The Strobotuner may be used for two general purposes: As a frequency standard; or as a frequency measuring device.

As A Frequency Standard—When used as a frequency standard a musical tone is altered until it produces a stationary pattern in its appropriate octave band on the stroboscopic disc. First, set the tone selector switch to the tone it is desired to check, and be sure the tuning knob is set at zero. For best results, adjust the gain control to a point where the instrument will not be sensitive to minor room noises. This will produce a more distinct pattern when the tone is sounded since there will be no interfering sounds to create confusing, unrelated patterns. Better results will also be obtained if the microphone is placed as near as possible to the source of the sound being investigated.

When the tone is sounded a characteristic pattern will appear in its appropriate octave band. If the tone is in tune with the equally tempered scale, the pattern will appear to stand still. On the other hand, if the pattern drifts to the left or right the operator knows immediately that the tone is flat or sharp. The tone can then be altered to bring the pattern to a standstill.

A typical pattern of a tone is shown in figure 4. It will be noticed that faint patterns appear in other octave bands. These patterns are caused by the harmonics, or overtones, of the fundamental tone and will often vary in intensity and direction of rotation while the fundamental will at the same time be stable and clear. This is caused by the natural fluctuations which occur within the duration of musical tones.

As A Frequency Measuring Device—In using the Strobotuner as a frequency measuring device, the following procedure is recommended. When it is determined from the drifting pattern that a tone is sharp, for example, the operator turns the tuning knob to the right until the pattern comes to a standstill. The approximate number of cents (hundredths of a semitone) the tone is sharp is then indicated by the pointer. Cent markings on the face panel are provided in intervals of five cents. However, approximations of the number of cents a tone is sharp or flat can be made accurately enough for most practical applications if the pointer should happen to fall between the interval markings.

After the desired measurement has been made the knob is returned to the zero position. Frequently during operation it is advisable to recheck the calibration of the Strobotuner simply by depressing the calibration switch. A periodic check with the knob reset at zero will assure that line voltage and other factors affecting the calibration have not varied.

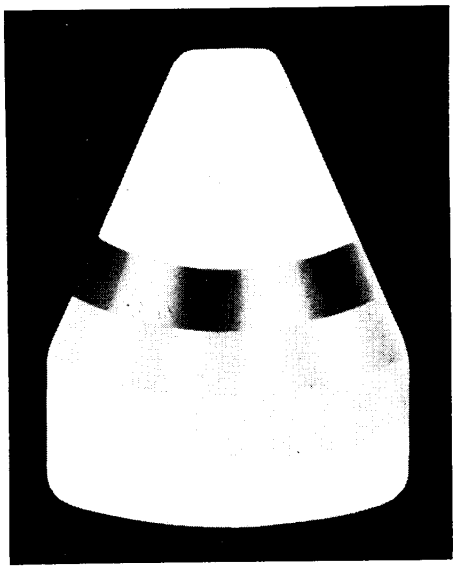

Figure 4—Typical Strobotuner Disc Pattern

SUGGESTIONS FOR USE IN PIANO TUNING

In using the Strobotuner for piano tuning the tuner need not depart from the procedure he customarily uses. The Strobotuner is completely flexible and can be adapted to any individual system. Several pertinent suggestions apply to any procedure used, however, and will be mentioned here.

The Strobotuner should be placed in a position convenient for watching the instrument while tuning the piano. Again, it is advisable to place the microphone as near as possible to the string being tuned. Some tuners prefer to use a contact microphone in place of the airborne type. Either can be used with the Strobotuner. The contact type of microphone offers several advantages which often make it desirable. It can usually be placed in one position on the sounding board and remain for the entire tuning; it sometimes gives better results than the airborne mike, particularly in the extreme upper and lower octaves; and it picks up only the vibrations of the piano strings and eliminates other interfering noises that may exist in the room.

Before tuning it must be determined whether the piano is to be tuned to A-440 or to some lower or higher scale, and the Strobotuner set accordingly. If A-440 is to be used, all that is necessary is to calibrate the Strobotuner in the usual manner, setting the pointer at zero. However, if a scale of A-435 is desired, for example, the Strobotuner must be set in the following manner: First, calibrate the instrument; then adjust the tuning knob left 20 cents (the setting for A-435); Then, to permit full use of the scale intervals for possible later use in octave "stretching," move just the pointer back to zero. The Strobotuner is then set for tuning to A-435.

From here it is a simple matter to tune the piano in the manner to which the tuner has become accustomed. The Strobotuner tone selector knob is set for each tone to be checked and the string pulled up to produce a stationary pattern in the appropriate octave band on the disc.

After setting the temperament octave, and starting with C_5, it may be desirable to start to "stretch" the octaves to conform with the accepted practice for making the piano "sound right." This is easily and accurately done with the Strobotuner by one or more methods. Many tuners, when starting into the upper octaves, begin to advance the knob to the right (sharp) a few cents for each octave. This may be 3, 5, or any number of cents sharp desired. Other tuners will break each octave into 6-tone or 4-tone sections and advance the knob perhaps 1½ cents for each section. The best approach to determine the most satisfactory amount of "stretching" for individual tastes is through experimentation.

The procedure for flatting the lower octaves in "stretching" is a little different. Instead of advancing the scale pointer for each octave as in the upper range, the pointer remains set at zero and the strings are actually tuned to their overtones. In the lower octaves, the fundamental tones are notoriously weak, and the ear tuner unknowingly tunes these tones to their strong overtones, which are always sharp.

Thus, in using the Strobotuner it is the overtones of the lower octave strings, because of their strength, which appear most distinct on the stroboscopic disc and the strings are tuned to these overtones.

Since the overtones of a struck string are sharp with the fundamental, by tuning the string to the overtones, the fundamental is made flat, thereby "stretching" the octave. When tuning the second and third octaves (B_3 down to C_2) tune to the overtones whose patterns appear on the fourth octave band. In other words, tune the second, third and fourth octaves to the pattern which appears in the fourth

octave band, and tune the first octave to the overtone pattern in the third octave band.

A_0, B^b, and B_0 at the extreme lower range of the piano are tuned to the pattern in the second octave band.

The Strobotuner offers several advantages in addition to providing the confidence and certainty of accurate tuning. It speeds the tuning process; enables the tuner to record various customer tunings on charts so they can be exactly duplicated time after time; and it establishes greater prestige for the tuner with his clientele through a scientific approach to piano service.

SUGGESTIONS FOR USE IN ORGAN TUNING

Many of the suggestions with regard to the placement of the Strobotuner and preparation apply also to the tuning of electric, electronic or pipe organs. In these cases, however, the microphone is placed for best results directly in front of the speaker in the case of electric and electronic organs, and near the pipes being tuned in the case of the pipe organ. For tuning electric and electronic organs where direct connection may be desired, a patch cord is recommended in place of a microphone. A patch cord is offered as an accessory to the Strobotuner.

First, both the Strobotuner and the organ to be tuned should be allowed a 10 to 15 minute warm-up period. Then calibrate the Strobotuner in the manner described under the section headed "calibration."

Important: Before proceeding, it is advisable to consult the tuning or service manual for the make of organ being tuned to obtain the recommended procedures.

After preparations have been made, adjust the Strobotuner gain control to produce the best pattern contrast if an airborne microphone is being used. The organ can then be tuned in the usual way, changing the tuning adjustment on the organ to produce a stationary pattern on the Strobotuner disc. The tone selector knob is reset, of course, for each different tone measured.

During the tuning operation, the Strobotuner should be checked for calibration occasionally by depressing the calibration switch with the scale pointer set at zero. If line variation has caused the instrument to vary from A-440 it will then be necessary to repeat the initial calibration procedure.

Instead of tuning successive notes in each octave, some tuners prefer to use this alternate method: First, tune the "Cs" in all octaves with the selector switch set at "C," and then proceed with all the "C♯s," etc. This method reduces the number of tone selector switch settings and may speed the tuning operation.

FOR INSTRUMENTAL AND VOCAL MUSIC TEACHING

The Strobotuner in music teaching basically performs the same function as in other applications—that of showing the operator visually whether or not the tone under investigation is in tune with the equally tempered scale. For the music educator, the Strobotuner provides an accurate visual standard in a tone range which encompasses the range of all the instruments commonly used in the band and orchestra.

As in other applications it is only necessary for the player or vocalist to alter a tone to produce a stationary disc

pattern in the Strobotuner. The tone selector switch, of course, is preset to the tone it is desired to check after the Strobotuner has been calibrated and prepared for operation.

While the checking of an individual student's tone for accurate intonation is a basic function of the Strobotuner, several suggestions can be made for more extensive use of the instrument.

Student Operation—A short explanation of the Strobotuner's operation will usually suffice to get students started on practice with it alone. The points of caution with regard to care in handling the instrument, calibration, placement of instrument to allow air circulation, etc. should be emphasized. Rough handling, excessive bumping or dropping could possibly destroy the Strobotuner's factory-set calibration of scale intervals, necessitating its being returned to the factory for re-calibration.

Disc Pattern Interpretation—In addition to checking and measuring intonation, the Strobotuner pattern serves also as a check on tone quality. Generally, the better the tone quality the more distinct will be the corresponding pattern in the viewing window. A fuzzy, indistinct pattern is usually a sure sign of poor tone quality, whether it be caused by a worn or faulty instrument part, or by error on the part of the player or singer.

Playing Scales—While the Strobotuner is most easily adapted to the checking or measuring of individual tones, chromatic scales can be checked with the help of another individual. It will be necessary, as the player or singer progresses up the scale, for another person to change the tone selector switch for each successive tone. It is recommended, in following this procedure, that each tone be sounded for at least four slow counts in order to allow the instrument to stabilize at the new standard for each change of the selector switch. A four-beat tone is advisable in any case in order to permit an adequate measurement or analysis of the tone.

Charting Performance—A strong incentive to students for improvement is the recording of their intonation readings as measured by the Strobotuner for comparison with later tests to determine progress. This is accomplished usually with two or three students working in a group; one playing or singing, one making measurements on the Strobotuner and the other recording the results on specially prepared charts.

Printed charts are available for each instrument, or they can be simply designed by the bandmaster or teacher. The charts usually consist of a straight vertical line representing perfect intonation and the sharp or flat variations from zero are recorded as dots with a connecting line.

The procedure for measuring the sharpness or flatness of a tone is simple. If the pattern is drifting to the right, indicating a sharp tone, for example, the vernier control knob and pointer are moved slowly to the right until the pattern is brought to a standstill. The pointer then shows the number of cents (1/100ths of a semitone) the tone is sharp. To measure a flat tone the pointer is moved to the left in the same manner. The pointer reading is then recorded on the chart at a point to the right or left of the zero line corresponding with the number of cents deviation.

Such charts are usually prepared in duplicate, one for the director and one for the player. It is a good plan to require the preparation of these charts periodically during the year, checking each new test against the previous chart to note progress.

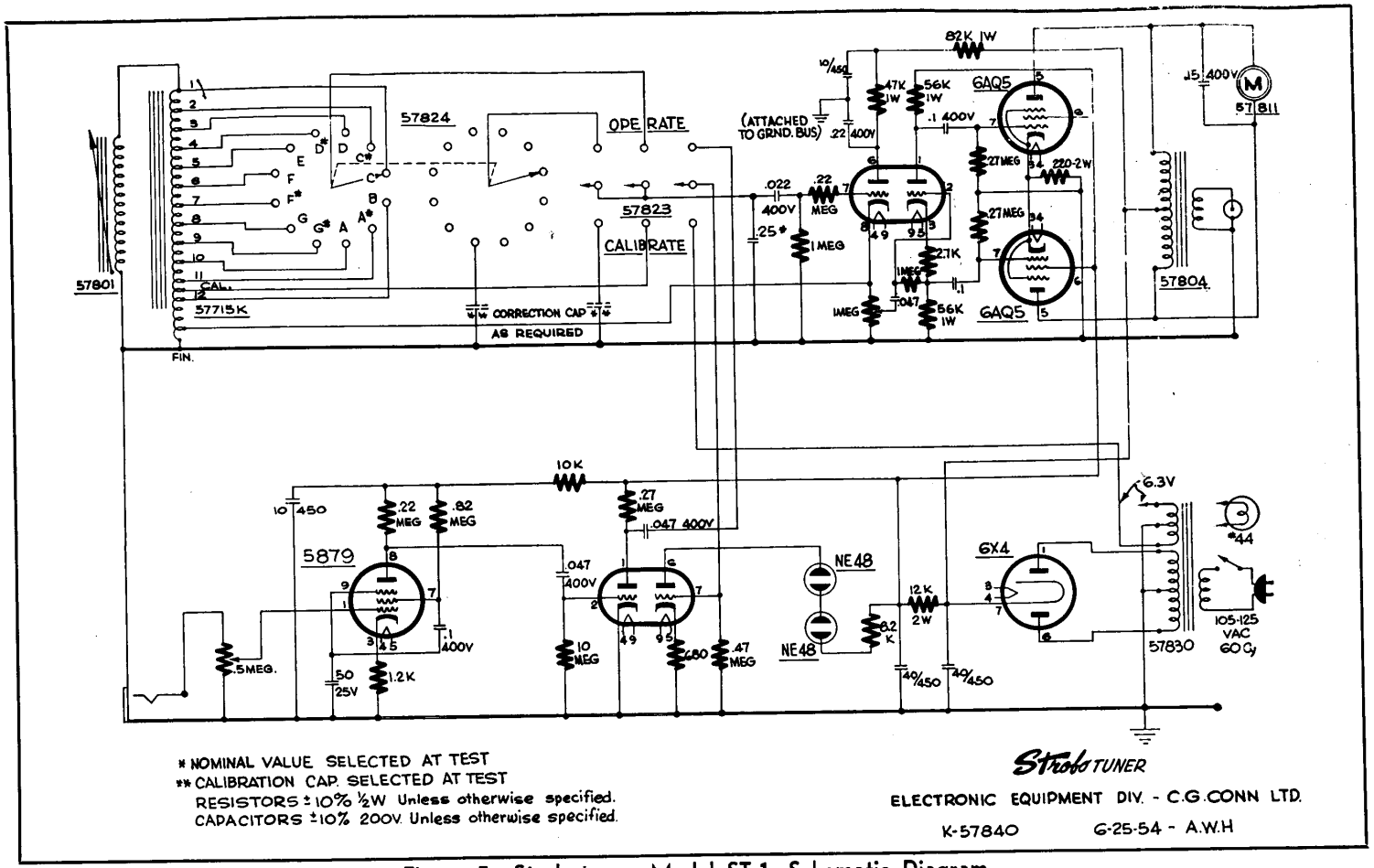

Figure 5—Strobotuner, Model ST-1, Schematic Diagram

REPAIR AND SERVICE POLICY

In the event of damage to the Strobotuner requiring factory repair, it is important in returning the instrument that all information regarding malfunction be included. State carefully things which are known to be causing trouble or any items that need be replaced. Describe defects such as intermittent operation or other malfunctions seen. A full description of trouble and defects will shorten the time needed to repair the instrument.

"Recondition" means repair or replace specific worn or malfunctioning parts, clean thoroughly, check and resolder weakened electrical connections, and generally tighten all removable parts. Worn places, scratches or other physical damages are not usually repaired unless specified.

All instruments received for repair are given the same final tests and calibration checks after repairs are made as new instruments receive. If an old model, it must satisfy the same standards used when it was originally made. Cost estimates will be given on request only, but the quotations are not necessarily final. If inspection reveals the cost will go over original estimates, the owner will be notified, and must send his approval before work will be done.

As an aid in saving time, a letter or order authorizing repair work should be sent so that it arrives at the factory before the instrument. Send the instrument prepaid to ELECTRONICS PLANT, C. G. CONN LTD., ELKHART, INDIANA.

ACCESSORIES AND REPLACEMENT PARTS

PART NO.	DESCRIPTION
56762	Capacitor, .047 Mfd., 200 volt
56759	Capacitor, .1 Mfd., 200 volt
56259	Capacitor, .22 Mfd., 200 volt
43659	Capacitor, .22 Mfd., 400 volt
57831	Capacitor, .15 Mfd., 400 volt
56649	Capacitor, .1 Mfd., 400 volt
43591	Capacitor, .047 Mfd., 400 volt
56311	Capacitor, .033 Mfd., 200 volt
56662	Capacitor, .022 Mfd., 200 volt
43808	Capacitor, 40-50, 450 volt
43632	Capacitor, 10-10, 450 volt
44760	Capacitor, 50, 25 volt
57715	Coil Assembly, Interval
57801	Coil Assembly, Calibrating
55015	Control, .5 Meg.
57825	Control, 1 Meg.
55073	Cord, line
57805	Cord, patch
55052	Jack, input
57820	Knob, ¾"
57821	Knob, 1⅛"
48610	Lamp, pilot #44
57804	Lamp, NE48
57874	Microphone
57875	Microphone
57800	Motor Disc & Lamp Assembly
57803	Pointer & Shaft Assembly
56640	Receptacle, test

PART NO.	DESCRIPTION
55176	Resistor, 10 megohms, ½ watt
50891	Resistor, 1. megohms, ½ watt
56277	Resistor, .82 megohms, ½ watt
45228	Resistor, .47 megohms, ½ watt
45224	Resistor, .27 megohms, ½ watt
56245	Resistor, .22 megohms, ½ watt
43794	Resistor, 56K, 1 watt
43847	Resistor, 47K, 1 watt
50937	Resistor, 10K, ½ watt
57832	Resistor, 12K, 2 watt
48499	Resistor, 2.7K, ½ watt
43741	Resistor, 1.2K, ½ watt
48487	Resistor, 8.2K, ½ watt
48290	Resistor, 82K, 1 watt
48439	Resistor, 220 Ohms, 2 watt
56253	Resistor, 680 Ohms, ½ watt
57823	Switch, calibrate
57799	Switch and Coil Assembly
57775	Switch, power
57824	Switch, rotary
57837	Tube, 6X4
57835	Tube, 6AQ5
57834	Tube, 12AT7
56306	Tube, 12AU7
57836	Tube, 5879
57804	Transformer, output
57830	Transformer, power
57828	Window, lucite