StroboTUNER

ST 6

OPERATION AND SERVICE MANUAL

CONN CORPORATION

ACCESSORY DIVISION — ELKHART, INDIANA 46515

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StroboTUNER

MODEL ST-6

HOW TO USE THE STROBOTUNER

FOR

PIANO TUNING

ORGAN TUNING

INSTRUMENTAL AND VOCAL MUSIC TEACHING

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THE STROBOTUNER

MODEL ST - 6

INTRODUCTION

The STROBOTUNER is an electronic instrument giving an accurate visual indication of the frequency of a sound or an electrical signal. It compares the frequency to be measured with internal frequency standards based upon the equally tempered musical scale but can be used to measure frequencies in any scale.

By stroboscopic comparison it indicates if the frequency being checked is sharp, flat, or in tune with the reference standard.

The range of the STROBOTUNER encompasses seven octaves or 84 half-steps in the musical scale. It ranges from C_1 (three octaves below middle C) to B_7 in ordinary operation. Its useful range actually extends beyond these limits, however, as explained in the instructions.

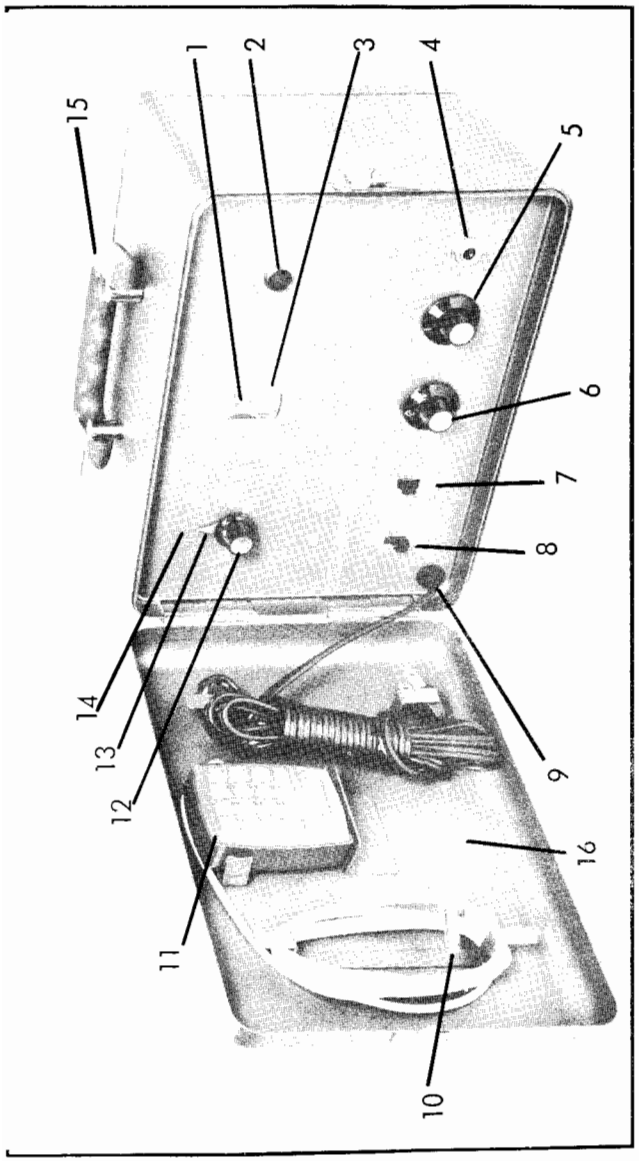


Figure 1 — The Complete Strobotuner, Model ST-6

1. Scanning Disc
2. Pilot Light
3. Octave Band Numbers
4. Signal Input
5. Gain Control
6. Tone Selector Knob
7. Operate - Calibrate
8. Power Switch
9. Power Cord
10. Microphone Plug
11. Microphone
12. Tuning Knob
13. Tuning Pointer
14. Tuning Scale
15. Carrying Handle
16. Cover

OPERATING INSTRUCTIONS

Setting up — Plug the power cord into a power outlet supplying 105 to 120 volts of 60 cycle alternating current. Insert the microphone plug into the Signal Input receptacle (4)*, if a microphone is to be used, and turn on the Power Switch (8) by sliding it upward as far as it will go. The Pilot Lamp (2) will light when the power is on.

Soon after the STROBOTUNER power is turned on an internal motor will start turning the Scanning Disc (1) and a red lamp behind the disc will glow. While it is possible to begin using the STROBOTUNER as soon as the disc is turning and it is illuminated from behind, the instrument should be allowed to warm for approximately ten minutes for the best stability of accuracy.

IMPORTANT: Do not obstruct the ventilating grill on the back of the STROBOTUNER while it is in use. Air must be allowed to circulate through this grill to protect the instrument from overheating and possible damage.

Calibration — It is necessary that the STROBOTUNER be calibrated with a standard frequency in order to establish a standard internal pitch. The frequency standard for calibration can be the power line frequency of 60 cycles per second or it can be the tone from a tuning fork, a piano string, or any other steady tone within the seven octave range of the instrument.

A handy reference frequency, which generally is sufficiently accurate, is the frequency of the power line supplying the STROBOTUNER. It establishes an A_4 - 440 cps in the STROBOTUNER if used. The procedure for calibrating the instrument to the power line frequency after allowing warm up time is as follows:

1. Slide the Operate-Calibrate switch (7) downward as far as it will go.

2. Turn the Tuning Knob (12) to the right or to the left to cause the stroboscopic pattern in number one band of the Scanning Disc (1) to become stationary. The number one band is the one closest to the center of the disc. If the stroboscopic pattern is rotating toward the left (flat), turn the Tuning Knob (12) so its pointer (13) moves to the left until the pattern becomes stationary. If the stroboscopic pattern on the disc is moving to the right (sharp) turn the Tuning Knob (12) so its pointer (13) moves to the right until the pattern becomes stationary.

3. Hold the Tuning Knob (12) stationary with one hand while moving the metal Pointer (13) with the other hand until it is in the zero position for the pointer.

4. Slide the Operate-Calibrate switch (7) upward as far as it will go to the operate position and the calibration procedure using the power line frequency as a reference standard is completed and the instrument is ready for use. The standard frequency level in the STROBOTUNER is

*Numbers in parenthesis refer to Figure 1.

A-440 as long as the Tuning Knob (12) remains as positioned in step number two above.

At any time during the use of the STROBOTUNER it is possible to quickly recheck the calibration with respect to the 60 cps power line frequency by merely sliding the Operate-Calibrate switch (7) down again to calibrate position and noting that the stroboscopic pattern on the inner band on the Scanning Disc (1) is still stationary. If it is drifting in either direction when the pointer (13) is at the zero position, the above calibration procedure is repeated. The Operate-Calibrate switch (7) must be returned to the "operate" position after checking the calibration.

The procedure for calibrating the STROBOTUNER to any tone or signal other than the 60 cps power line frequency after allowing it to warm is as follows:

1. Connect the tone or signal to be used as the calibrating standard into the Signal Input recepticle (4). If the tone from a tuning fork or other tone source is used it is fed into the microphone which is plugged into the Signal Input recepticle (4). If the signal from an oscillator, radio, or other electrical device is used as the calibration standard its signal can be fed directly into the Signal Input recepticle (4). One millivolt (1/1000 volt) is sufficient to produce a stroboscopic pattern (an excess of one volt is not recommended) though more than one volt may be applied if the Gain control (5) is turned down (counterclockwise).

2. The Operate-Calibrate switch (7) is **not** used when calibrating the STROBOTUNER to an external signal. It should remain in its uppermost (operate) position.

3. Set the Tone Selector Knob (6) to the appropriate setting for the tone or signal that is being used to calibrate using the C on the knob as the indicator. For example, if an A tuning fork or bar is being used as the calibrating standard, set the C on the knob (6) opposite the A on the panel.

4. Turn the Tuning Knob (12) to the right or to the left to cause the stroboscopic pattern on the appropriate band of the Scanning Disc (1) to become stationary. For example, if a 440 cps tuning fork or bar is being used as the calibrating standard the stroboscopic pattern will appear in the fourth band from the center of the Scanning Disc (1).

5. Hold the Tuning Knob (12) stationary with one hand while moving the metal Pointer (13) with the other hand until the Pointer is in the zero position. This completes the calibration procedure with an external standard and the instrument is ready for use. If a 440 cps external standard was used the STROBOTUNER is standardized at A-440 when the Pointer (13) is in the zero position. If a 435 cps fork happened to be used, the STROBOTUNER is standardized at A-435 when the Pointer (13) is in the zero position.

NOTE: The STROBOTUNER can be operated from a power line having an alternating current frequency between 50 and 60 cycles per second. However if the power line frequency is used as the standardizing frequency in calibrating the STROBOTUNER it should be known to be 60 cps if an A-440 standard is desired. In most power systems the frequency is held quite close to 60 cps.

Use — After the calibration has been completed the STROBOTUNER is ready for use.

An air-borne microphone is standard equipment with the STROBOTUNER and it is usually used to pick up tones and supply an electrical signal to the Input Signal recepticle (4). A contact microphone, or a vibration pick up can be used instead of the air-borne microphone if desired. In some applications, such as tuning electronic organs, an electrical signal can be supplied to the Input Signal recepticle (4) directly without the use of a microphone if desired. The voltage of the signal supplied should be between one millivolt (1/1000 volt) and one volt.

Set the Tone Selector Knob (6) for the tone to be checked. If concert pitch is being used (such as piano, or other instrument in C), the C on the knob is used as the indicator. The Tone Selector Knob (6) can be used as a transposing device also for instruments in the keys of B♭, E♭, or F. For example, when playing the note C (as written) on a B♭ instrument, the B♭ on the Tone Selector Knob (6) can be set opposite C on the panel and the STROBOTUNER will be set for measuring the C (as written) which is A♯ (B♭) concert. Since keyboard instruments such as pianos, harpsichords, and organs are in the key of C no transposition is involved between the written note and the tone sounded so the C on the Tone Selector Knob (6) is used as the indicator to line up with the appropriate letter on the panel.

After the Tone Selector Knob (6) has been properly set for the tone to be tested and the tone signal has been properly fed into the Input Signal recepticle (4) a stroboscopic pattern should appear on the Scanning Disc (1). If the tone being tested is between C_1 (32.703 cps) and B_1 (61.735 cps) the pattern will be on the band nearest the center of the disc (band no. 1).

BAND NUMBER	FREQUENCY RANGE
1	C_1 (32.703cps) — B_1 (61.735cps)
2	C_2 (65.406cps) — B_2 (123.47cps)
3	C_3 (130.81cps) — B_3 (246.94cps)
4	C_4 (261.63cps) — B_4 (493.88cps)
5	C_5 (523.25cps) — B_5 (987.77cps)
6	C_6 (1046.5cps) — B_6 (1975.5cps)
7	C_7 (2093.0cps) — B_7 (3951.1cps)

If the tone being tested is in tune with the equally tempered tone at the pitch standard used to calibrate the STROBOTUNER a stationary pattern will be seen for each tone introduced. If a tone is flat (lower in frequency) to the equally tempered scale frequency the stroboscopic pattern will rotate to the left. The speed at which the pattern drifts is an indication of how much it deviates from the

equally tempered scale. If it is desired to measure how flat the tested tone is, this can be done by turning the Tuning Knob (12) so its Pointer (13) moves to the left (counterclockwise) until the stroboscopic pattern becomes stationary. Then read the number of cents flat from the position of the Pointer (13) on the Tuning Scale (14). Similarly, if the tone being tested is sharp (higher in frequency) then the equally tempered scale frequency the stroboscopic pattern will rotate to the right and it can be stopped by turning the Tuning Knob (12) clockwise.

The Gain Control (5) is provided to adjust the input signal for optimum clarity. If the input signal is too strong for a clear stroboscopic pattern turn the control counter clockwise. If the input signal is too weak turn the control in the clockwise direction and if the signal is still too weak it will be necessary to move the microphone closer to the tone source or make the tone louder.

A simple flute-like tone tends to produce a sharper stroboscopic pattern generally and it will appear distinctly only on one band. If the tone being tested has strong upper partials they will cause patterns to appear on the higher number bands also. For example if A_2 (110-cps) is being tested its second harmonic (220cps) may cause a pattern to appear on the third band from the center of the Scanning Disc and its fourth harmonic (440-cps) may cause a pattern in the fourth band, and so on for octavely related harmonics.

If the partials in a tone being tested are not whole number multiples (harmonics) of the fundamental frequency it will be possible to get a stationary pattern for the fundamental of the tone (its lowest frequency) while the patterns formed by the higher partials are drifting. This will be true generally for piano tones or chime tones.

If the tone being tested is not steady but has a slight variation in frequency, such as produced by vibrato the pattern on the Scanning Disc will waver back and forth according to the variation in the tone. This gives an indication of how steady a tone is and also the extent and the balance in a vibrato.

The Cover (16) of the STROBOTUNER can be raised after it has been opened to remove it from the case in order to use it as a base for the microphone.

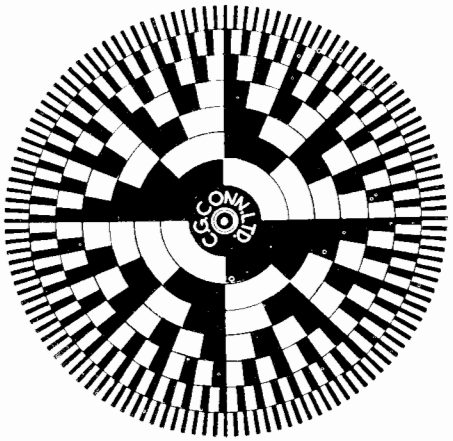
The microphone can be taken from the cover by removing a screw in its base.

PRINCIPLE OF OPERATION

The signal whose frequency is to be measured is amplified after it is introduced at the Signal Input (4) and then it causes neon lamps behind the Scanning Disc (1) to glow in accordance with the frequency of the input signal. If the input signal has 440 alternations per second, for example, the lamps will glow brighter and darker 440 times per second.

The Scanning Disc (1) is driven by a synchronous motor that receives its power from an internal frequency standard. The internal standard is an electronic oscillator that is quite stable with respect to changes in the power supply line or changes in temperature but is adjustable as desired. There are twelve major adjustment settings conforming with the twelve steps in an octave of the equally tempered musical scale. A vernier adjustment to get frequencies between the twelve major steps is provided in the Tuning Knob (12). While the Tuning Scale (14) is marked to plus or minus 20 cents*, which covers most applications, it is possible to turn the Tuning Knob (12) beyond the 20 cent mark if it is required for certain applications.

The Scanning Disc (1) has seven concentric bands of dark and light segments. The band nearest the center has two dark and two light segments. The next band has four dark and four light segments to cover a range one octave higher than the number one band. The third band has eight dark and eight light segments for the third octave range and so on out to the seventh band having 128 alternating segments.



STROBOTUNER DISC

The recepticle on the back of the STROBOTUNER is provided for convenience in checking the instrument during its manufacture or its servicing and is not used during the ordinary operation of the instrument.

SUGGESTED USES OF THE STROBOTUNER

As enumerated above, the STROBOTUNER was designed to measure the flatness or sharpness of a tone against a reference frequency. Many persons or musical groups have need for checking individual notes against the tempered scale such as:

- Bands
- Orchestras
- Vocal Groups
- Individual Performers
- Piano Tuners
- Organ Tuners

*One cent is 1/100 half-steps in the equally tempered scale.

SUGGESTIONS FOR INSTRUMENTAL AND VOCAL MUSIC TEACHING

The STROBOTUNER in music teaching shows 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.

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.

The tone selector knob is provided with markings to aid in transposition. In setting the knob, point the arrow at the concert pitch desired. If the knob is not moved, instruments built in keys other than C will play the tone pointed out for their respective key.

For instance, when B♭ concert is to be measured, the arrow is pointed to A♯ (B♭). Instruments in C play B♭, B♭ instruments play C, E♭ instruments play G, and F instruments play A.

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 in order to allow all 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 recalibration.

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 semi-tone) the tone is sharp. To measure a flat tone the pointer is moved to 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.

SUGGESTIONS FOR PIANO TUNING

If the piano is to be tuned to the Standard Tuning Frequency of A-440, the STROBOTUNER should be calibrated accordingly as explained in the section on calibration. If it is to be tuned to any other standard it will be possible to do so in either of two ways. One method is to calibrate the STROBOTUNER to A-440 and then turn the tuning knob (12)* to the desired pointer setting. For example, if the STROBOTUNER is calibrated at A-440 with the pointer in the zero position, turning the knob to move the pointer to another position will give the following standards: –20 gives A-435, –10 gives A-437.5, +10 gives A-442.5, and +20 gives A-445. Of course, the pointer can be set in between the scale marks as well as directly on them. A second method is to calibrate the STROBOTUNER to whatever standard is to be used instead of A-440. Any source of sound can be used as a standard. When sound is picked up by the microphone remember that the CALIBRATE switch (7) is NOT used when calibrating to an external source. This is explained in the section on calibration. For example, it may be decided that a piano which is rather flat is not to be raised to A-440 tuning and one string on the piano is to be used as a reference standard. In such a case, set the Tone Selector knob (6) for whatever tone is to be used as standard and proceed with the method for calibrating the STROBOTUNER with an external sound source.

After the STROBOTUNER has been calibrated and the piano prepared for tuning, place the STROBOTUNER microphone in a suitable location for best pick-up of the sound from the string being tuned.

*Numbers in parentheses refer to Figure 1, page 6.

Stretching the octaves — Many technicians prefer to start tuning at the "break" in the scale because of the marked change in the inharmonicity of the partials of the tones at this point. The stiffness of piano strings causes the tones produced to have partials that are not harmonically related to each other; that is, the second partial is not exactly twice the frequency of the first partial, or fundamental, of the tone. The third partial is not three times the frequency of the fundamental, and so on. For the partials to be harmonic they need to bear a whole number relationship (1, 2, 3, 4, ...) to the fundamental. The partials in piano tones are nearly always slightly higher (sharp) than the whole number multiples (harmonics) of the fundamental. This has a very important bearing upon the tuning of a piano.

When listening to two piano tones an exact octave apart, the second partial of the lower tone will be sharp with respect to the fundamental of the higher tone. This will cause audible beats to be produced and the listener will not consider the tones to be truly an octave apart even though the fundamental frequency of the top tone is exactly twice the fundamental frequency of the lower tone, as is required for a true octave. In order for the octave on the piano to sound in tune when the two notes are played at the same time, it is necessary to stretch the interval by lowering the bottom tone or raising the top tone. The technique for determining the optimum amount of stretch with the STROBOTUNER will be explained as we go along.

The Temperament Octave — The inharmonicity of piano tone partials is usually smallest in the middle of the keyboard so an octave is chosen there for setting the temperament. Usually care should be taken that the "break", or a marked change in string design, does not occur within the temperament octave.

All but one string per key is muted with felt or wedges so only one string at a time sounds when a key is struck.

Tuning the Treble Strings — Let us assume that C_4 (middle C) is chosen for the starting point as an example. Some other starting point might be preferred and could be used as well. Proceed from C_4 up the scale, tuning one string on each key while watching the fourth ring or pattern band. The STROBOTUNER pointer remains in the position chosen to establish the tuning standard while tuning this octave.

It may be noted while tuning this octave that even though the tension on the string is adjusted to cause the fourth ring pattern to be stopped, the patterns in the fifth and higher rings will move slowly to the right due to the fact that the partials producing those patterns are not exactly in a 2, 4, 8, ... relationship to the fundamental of the tone. If the fifth ring pattern moves to the right for the C_4 string, when the fourth ring pattern is not moving, the tuner can note how far to the right he needs to move the STROBOTUNER pointer in order to make the fifth ring pattern stand still. If this is one cent or more, it indicates that C_5 should be tuned sharp by at least that amount. Therefore, when tuning C_5 the pointer is advanced to the right of the starting position used for tuning the temperament octave. This is the beginning of the octave-stretching process.

It may be that the inharmonicity of the partials in the C_4 string is so small that it is negligible. If that is the case the pointer should be left in the C_4 position while tuning C_5 and this octave is not stretched. Since inharmonicity of partials is caused by the stiffness or rod-like character of the strings, it is obvious the short thick strings will have greater inharmonicity of their tone partials than will a long slender string. Therefore, the degree of inharmonicity will vary from string to string in a given piano and will vary between pianos. The degree of inharmonicity is greater at either end of the piano keyboard than it is in the middle, and it tends to be greater in small spinet pianos than in grand pianos.

As the tuner proceeds to go up the scale from the temperament octave, he gets a good idea of how much to stretch the octave by sounding the tone an octave below the one he is tuning and noting how sharp the second partial is with respect to the true octave. As he goes up the scale he will note a marked increase in this inharmonicity, so he finds that the higher he goes the more stretch is required in the octave. Due to the wide variety of piano designs, no set rule can be stated for stretching the octaves but the STROBOTUNER gives an accurate measurement of the condition that exists to guide the tuner so that he can tailor the stretch to fit each particular piano.

Technique for Tuning C_8 — The STROBOTUNER normally is calibrated so its measurements track the notation indicated by the pointer on the Tone Selector Knob (13). However, it is possible to calibrate the STROBOTUNER so it actually reads a half-step higher than the tone indicated by the Tone Selector Knob. To do this after tuning the B_7, which normally is the top tone on the STROBOTUNER, turn the Tone Selector Knob (13) back to A♯, sound the B_7 tone on the piano, and turn the Tuning Knob (12) clockwise to cause the stroboscopic pattern in the seventh band to be stationary (about ½ turn). Then turn the Tone Selector Knob (13) back to B and sound the C_8 tone on the piano. It can be tuned watching the seventh band on the scanning disc for the STROBOTUNER is now calibrated to read ½ step (100 cents) higher than for its regular use. Turning the Tuning Knob (12) a revolution in either direction does no harm to the instrument.

Optimum Compromises — The fundamental is usually the strongest partial in the tones above C_4, and the higher partials are progressively weaker. Thus, the fundamental and the second partial are the two most important parts of the tone to consider when tuning octaves. However, the meticulous tuner may find that even though the fundamental is exactly in tune with the second partial of the tone a stretched octave below, some beating between tones exists. If such is the case, he is hearing beats between higher coincident

partials, such as the fourth partial of the lower tone and the second partial of the higher tone. These partials can be noted in the STROBOTUNER patterns at the same time the lower partials are indicated. Taking the fourth octave tones as an example, the fundamental is indicated in the fourth band, the second partial in the fifth band, the fourth partial in the sixth band, and the eighth partial in the seventh band. Since the higher partials are relatively weak and die out quite rapidly after the tone is sounded, the patterns for the upper partials usually will not be as clear as the lower partial patterns.

If the tuner finds that objectionable beats exist when the fundamental is exactly in tune with the second partial of the tone, an octave below, he will note relatively strong patterns for the upper partials and can measure how much mistuning exists between the higher coincident partials. He can then stretch the octave even further by the amount needed to reduce the beats between the higher coincident partials. In so doing he introduces beats between the lower coincident partials so the resultant tuning must be a compromise which depends upon the degree of inharmonicity and the relative strength of the upper partials. The degree of compromise is determined by the information revealed by the STROBOTUNER plus what the tuner hears. Compromise tuning is necessary because of the nature of piano tones and is not related to the method of tuning. It needs to be understood that a tuner does not "turn off" his ears while tuning with the STROBOTUNER, for it is quite important that he correlate the information obtained visually from the STROBOTUNER with the information he gains through hearing. The eyes and ears working together can give far more information than either can give alone.

The tuner proceeds up the scale from his starting point following the procedure suggested here for stretching the octaves until he reaches the top key (C_8) which is outside the regular range of the STROBOTUNER. It can be tuned with the STROBOTUNER, however, by using the technique given on page 18.

Tuning the Bass Strings — Return the STROBOTUNER pointer to its original starting position chosen for the tuning standard and proceed to tune downward from the string chosen as the starting point. When tuning in the third octave use the pattern in the fourth band rather than the one in the third band. This tunes the second partial of the third octave tone to the fundamental of the tone a stretched octave above it in the fourth octave.

When tuning the strings in the second octave the tuner can choose which band to use according to the strength of the partials in the tone as indicated by the clarity of the patterns. If the fourth band pattern is the most pronounced the pointer is left in the same position as it was while tuning the third and fourth octave. This puts the fourth partial of the second octave tone in tune with the second partial of the third octave and the fundamental of the fourth octave. This often is the most satisfactory procedure.

In some cases the tuner may find it advantageous to use the third band patterns when tuning the second octave strings. If such is the case he will set the STROBOTUNER pointer at the position that causes the third band pattern to be stationary when sounding the third octave string previously tuned; then tune the second octave string to make the third octave band pattern stationary. This tunes the second partial of the second octave tone to the fundamental of the third octave tone.

The first octave is tuned in a manner similar to the second octave. Usually the third band is used for tuning the first octave after setting the STROBOTUNER pointer in the position that causes the third band pattern to be stationary when the previously tuned third octave string is sounded.

The fundamentals of the lower tones are generally very weak and have very little influence on the tuning. This is indicated by their weak patterns on the STROBOTUNER. Since it is the stronger upper partials that are heard and are of concern to the tuner, he need not be concerned by the weak or missing patterns for the fundamentals of the lower tones. This fact is of importance also in tuning the bottom three strings since their fundamentals are below the range of the STROBOTUNER.

The tuner will quickly discover the best microphone placement and striking technique for obtaining the clearest patterns. On the highest tones, where the sustaining time is short, he may find that striking the key in rather rapid succession gives the best pattern.

It may be noted that if a key is struck in such a manner as to produce a loud tone, that it is flatter immediately after being struck than it is during the remainder of the tone. This characteristic of the piano tone requires the tuner to make a choice as to whether the initial portion of the tone or the latter part is in tune. The difference is small enough that it usually is negligible.

Raising the Pitch — After one string for each key has been tuned, a quick check can be made to determine if the strains produced by a general tightening of the strings caused the first strings tuned to be detuned. If the pitch of the piano has been raised considerably during the tuning process, it is almost certain that the tuner will need to go over the piano more than once because of the added tension on the frame and sounding board. Some tuners make a practice of very quickly tuning all strings (except the highest octave or so) roughly about 10 cents sharper than the ultimate tuning is to be. The strings above the "break" add the most change in tension so that they are done first. Then the strings are accurately tuned the second time over. Getting a uniform over-tension the first time through is simple with the STROBOTUNER. The pointer is moved to the right by whatever amount desired during the first rough tuning.

Tuning the Unisons — The unison strings are generally tuned aurally but the STROBOTUNER can be used in the same manner as on the first string if desired.

These instructions are not intended to serve as an instruction course in piano tuning. There are many principles and techniques that are important to piano technicians which are not touched upon here. The STROBOTUNER serves as a useful tool for the technician. It can give him a better understanding of the underlying principles of piano tones and tuning. It can instill confidence in the tuner and his customers because of its accuracy and because it makes use of both eyes and ears instead of the ears alone. Skill, good judgement, and careful workmanship are indispensable in the use of any tool.

SUGGESTIONS FOR USE IN ORGAN TUNING

Many of the suggestions regarding STROBOTUNER preparation apply also to the tuning of electronic and pipe organs. In these cases the microphone is placed for best results directly in front of the proper speaker in the case of electronic organs, and near the pipes being tuned in the case of the pipe organ. In tuning 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 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 service manual for the make of organ being tuned. Then follow the recommended procedures.

When preparations have been made, adjust the STROBOTUNER gain control to produce the best pattern contrast. 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.

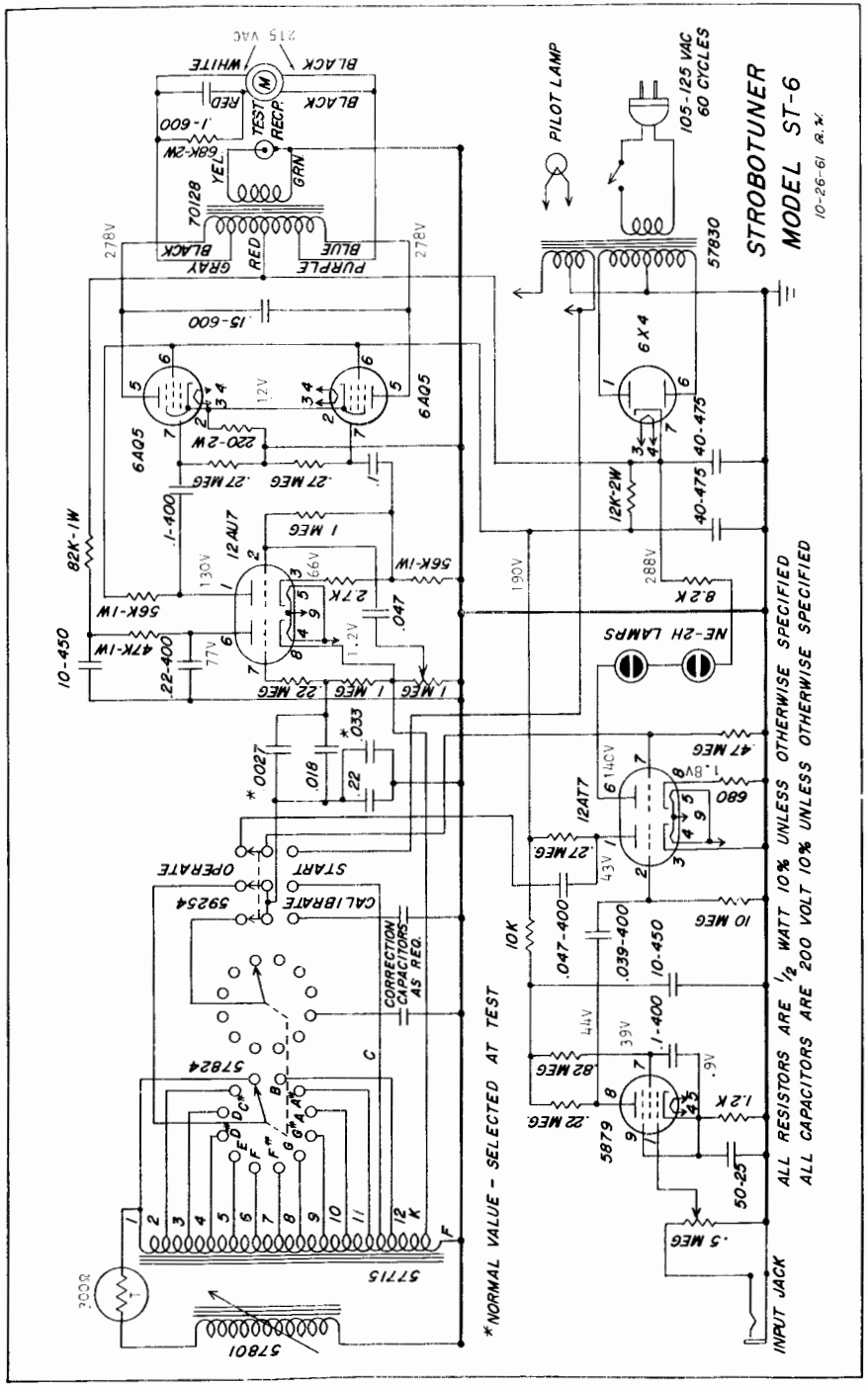
Instead of tuning successive notes in each octave, some tuners prefer to use this alternate method: First, tune the C's in all octaves with the selector switch set at C, and then proceed with all the C♯s, etc. This method reduces the number of tone selector switch settings and may speed the tuning operation. However, we suggest service manual tuning procedure be followed closely in all cases.

REPAIR AND SERVICE POLICY

Service Notes — This precision instrument was designed to give years of troublefree operation with a minimum of service. However, moving parts and electronic components do age. Because of this an effort was made to use many standard components, readily found in any good TV repair shop. In case of malfunction a competent radio or TV serviceman often will be able to make necessary repairs with the help of this manual, and by following the check list below:

1. Tubes:
   A. 6X4 is the most common offender.
   B. Check all tubes and/or try replacement tubes.
2. Motor Capacitor (.1 mfd. 600v: paper capacitor only used here).
   A. If shorted — motor will not run. Cut lead on one end of capacitor, if motor now runs — replace capacitor.
3. Motor:
   A. Clip motor capacitor, if still inoperative check all voltages as shown on schematic drawing.
4. Tuning Coil:
   A. Check resistance of coil. (2600 ohms approximately)
5. Tapped Coil:
   A. Check the continuity of coil and taps.
6. Resistor (.22 meg. in plate circuit of #5879 tube)
   A. Check resistance, replace if out of tolerance.
7. Neon Lamps:
   A. Blinking at high frequency, replace with NE2H lamp (59616).
8. Microphone:
   A. Try another high impedance microphone, if still no results go over items listed above.
9. Output Transformer:
   A. Disconnect leads and check resistance.

Replacement of certain electrical component parts will affect the STROBOTUNER calibration. These are the interval coil No. 57715, tuning coil No. 57801, the capacitors indicated with an asterisk * on the parts list on page 22, or any correction capacitors. Recalibration requires equipment not usually available in the field, and the instrument should be returned to the factory, following the instructions on page 21.



INSTRUCTIONS FOR RETURN

Write a letter to **Conn Corporation, Band Instrument Service Department, Elkhart, Indiana,** in notification that you are shipping the instrument to Conn Organ Corporation, Madison, Indiana, giving as much detail as possible as to the nature of its malfunction. DO NOT SHIP INSTRUMENT TO ELKHART.

Pack the STROBOTUNER carefully in a corrugated carton somewhat larger than the instrument and fill the extra space with corrugated pieces or crumpled newspaper (not excelsior or shredded paper) and ship **Prepaid** by insured Parcel Post or Express to **Conn Organ Corporation, Madison, Indiana.** Be sure to include the microphone. Mark carton "FRAGILE". We will not be responsible for the damage of instruments improperly packed. Allow 30 days from time shipped for return.

All repairs are individually priced on a time and material basis, and costs cannot be determined prior to examination. Estimates can be furnished on request, after examination.

INSTRUMENTS UNDER GUARANTEE

If the instrument is under guarantee, follow the preceding instructions. If it can be repaired locally, send the repairman's invoice, with the serial number of the instrument noted thereon, to **Conn Corporation, Band Instrument Service Department, Elkhart, Indiana.** If the STROBOTUNER registry card is on file and shows the instrument to be less than one year old, refund will be made. This offer is invalid when the instrument has been mishandled. If it is necessary to send a STROBOTUNER back to the factory, it will be repaired at no charge under warranty and returned to you transportation charges prepaid.

NOTE: Do not ship microphones that are out of guarantee to the factory for repair. It is economically impractical to repair worn out microphones. Any high impedance microphone can be used with the STROBOTUNER, or a replacement of the microphone (Part 57-874) is available from Conn Corporation, Elkhart, Indiana, 46514.

ACCESSORIES AND REPLACEMENT PARTS

PART NO.	DESCRIPTION
56759	Capacitor, .1 Mfd., 200 Volt
56649	Capacitor, .1 Mfd., 400 Volt
70110	Capacitor, .1 Mfd., 600 Volt
43632	Capacitor, 10-10 Mfd., 450 Volt
57831	Capacitor, .15 Mfd., 600 Volt
43659	Capacitor, .22 Mfd., 400 Volt
43808	Capacitor, 40-40 Mfd., 475 Volt
44760	Capacitor, 50 Mfd., 25 Volt
57023	*Capacitor, .018 Mfd., 200 Volt
56661	*Capacitor, .033 Mfd., 200 Volt
58669	Capacitor, .039 Mfd., 400 Volt
56762	Capacitor, .047 Mfd., 200 Volt
43591	Capacitor, .047 Mfd., 400 Volt
57025	*Capacitor, .0027 Mfd., 400 Volt
56259	*Capacitor, .22 Mfd., 150 Volt
58691-1	Case Complete
57801	Coil, tuning
57715	Coil, interval
57825	Control, motor drive
55015	Control, signal gain
50357	Disc
59966	Foot, Rubber
70116	Handle
57809	Hub
55052	Jack, input
59689-3	Knob, calibrating
59689-2	Knob, gain
59689-1	Knob, interval
48610	Lamp, Pilot, No. 44
57874	Microphone
56272-2	Contact Microphone
70107	Motor
57810	Nut, hub
71045	Service Manual (this book)
71046	Thermistor, 300 Ohm

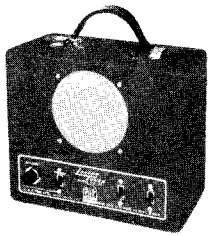
PART NO.	DESCRIPTION
48460-3	Patch cord accessory (clips, microphone and octal Connector)
50891	Resistor, 1. meg ½ watt
43741	Resistor, 1.2K ½ watt
48499	Resistor, 2.7K ½ watt
48487	Resistor, 8.2K ½ watt
50937	Resistor, 10K ½ watt
57832	Resistor, 12K 2 watt
45224	Resistor, .27 meg ½ watt
43847	Resistor, 47K 1 watt
43794	Resistor, 56K 1 watt
48290	Resistor, 82K 1 watt
56245	Resistor, .22 meg ½ watt
48439	Resistor, 220 Ohm 2 watt
45228	Resistor, .47 meg ½ watt
56253	Resistor, 680 Ohm ½ watt
56277	Resistor, .82 meg ½ watt
55176	Resistor 10. meg ½ watt
58150	Resistor, 68K 2 watt
57803	Shaft and Pointer Assembly
70117	Stud, handle
59254	Switch, Calibrate-operate
57824	Switch, interval selecting
57775	Switch, power
70128	Transformer, output
57830	Transformer, power
57837	Tube, type 6X4
57836	Tube, type 5879
57835	Tube, type 6AQ5
57834	Tube, type 12AT7
56306	Tube, type 12AU7
57828	Window, lucite
59616	Lamp NE2H
Performance Charts (State Instrument)	

*Selected in production, replacement of these parts or the interval and/or calibrating coil will destroy the instruments calibration.

other CONN electronic instruction aids

STROBOCONN

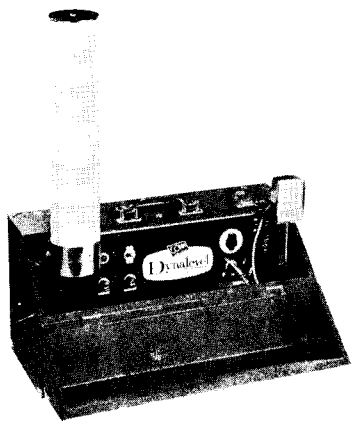
Most accurate pitch measuring instrument available. Tuning in 84-note (7 octave) range is visible by full octaves to 1/100 of a semi-tone. Easy to operate. Unexcelled for teaching tuning of instruments, piano and organ tuning, vocal instruction, physical study of sound. Plugs into standard outlet of 110 volts, 60 cycles. Complete with carrying case.



LEKTRO-TUNER (B♭ and A)

Far more dependable than tuning bars or forks. B♭ and A sound continuously so listener can hear tone the entire time of tuning. Adjustable range from A435-A445. Plugs into standard outlet of 110 volts, 60 cycles.

Dynalevel



—PLUGS INTO ANY STANDARD OUTLET OF 110 VOLTS, 60 CYCLES. COMPLETE WITH MICROPHONE.

WHAT IS IT?

The Dynalevel is an entirely new instrument that transforms the loudness of sound into light. The degree of loudness is indicated over a range of 40 decibels in steps of 4 decibles each. Sensitivity of the Dynalevel may be varied to measure sounds in a wide range of intensities, and measurement is practically instantaneous.

HOW DOES IT WORK?

The light column extending from the top of the Dynalevel does the measuring. This column is divided into eleven sections from bottom to top. Each section is illuminated by a different color light, and each represents 4 decibels of intensity. As the sound becomes louder, successively higher lights become illuminated up the column. As it diminishes, the lights go out down the column.

See Your Local Dealer For Prices.

CONN CORPORATION, Elkhart, Indiana