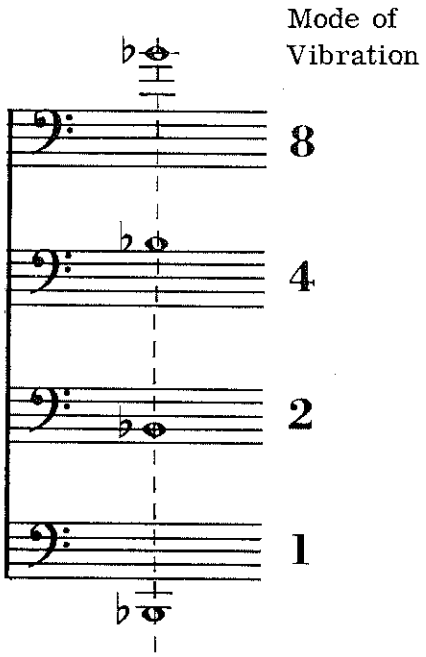
Chapter 17
Intonation

The trombonist has two general intonation problems. One problem is caused by the construction of the instrument itself. The second problem is related to the different intonations of scales (equal temperament, just intonation or Pythagorean intonation) and even if the instrument were perfectly in tune with one of these scales, it would be out of tune with the others.

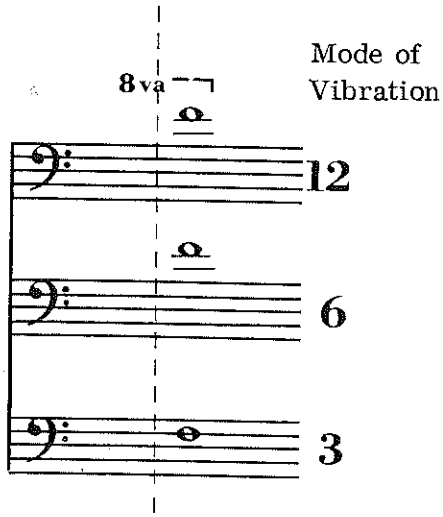
Intonation of the Overtone Series

No trombone is perfectly in tune with itself. This is not the fault of the manufacturer and the finest instruments generally have the same deficienceis at the same places in the various registers of the instrument.

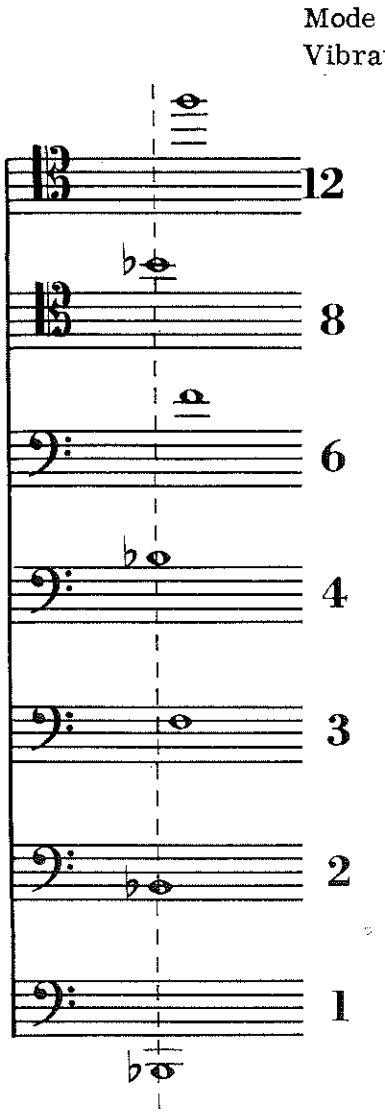
All trombones usually have octave B flats in first position that are fairly close to being in tune although some adjustment may be necessary, particularly if an oversized or undersized mouthpiece is being used. For the purposes of this book, the B flats will be considered to be in tune, and if you are observed from the right side, it would appear that you play these B flats (first, second, fourth and eighth mode of vibration) in first position without lowering or raising the slide.



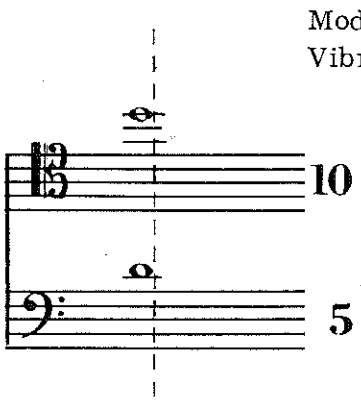
The third, sixth and 12th modes of vibration tend to be sharp and have to be lowered slightly. This lowering can be done by humoring the pitch down with the lips and throat or by moving the slide. Moving the slide is suggested. You achieve a truer tone with less chance of a missed attack if the slide is adjusted. In first position the third, sixth, and 12th modes are Fs and when observing you from the same location as above (the right side) it will be noticed that you play these notes slightly below first position. (The dotted line indicates the normal placement of first position.)



Combining the notes discussed so far, a chart of the slide positions would appear as follows:

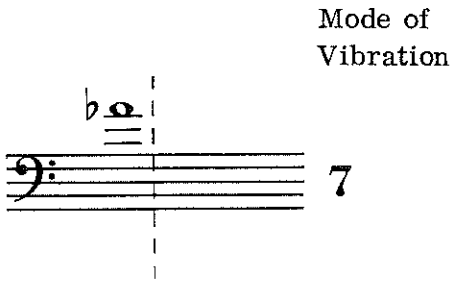


The fifth and 10th modes of vibration (both of these notes are Ds) tend to be flat and have to be raised.

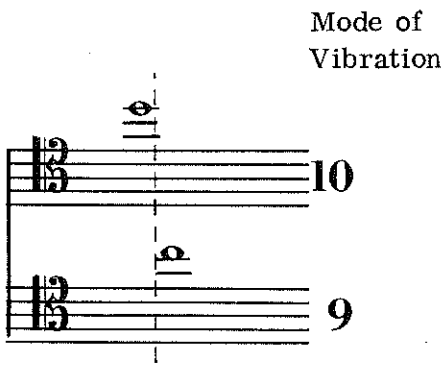


If the trombone has cork or felt bumpers in the receivers, you will have to lip up the notes in first position or else use an alternate position. If the trombone has spring bumpers, you can compress the springs about half of their extension and thus play the Ds slightly above first position.

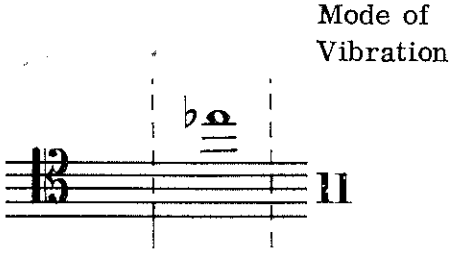
The seventh mode of vibration (A flat) is very flat and is usually so flat that it is unusable in first position unless the springs are compressed completely and the lip raises the pitch of the note also.



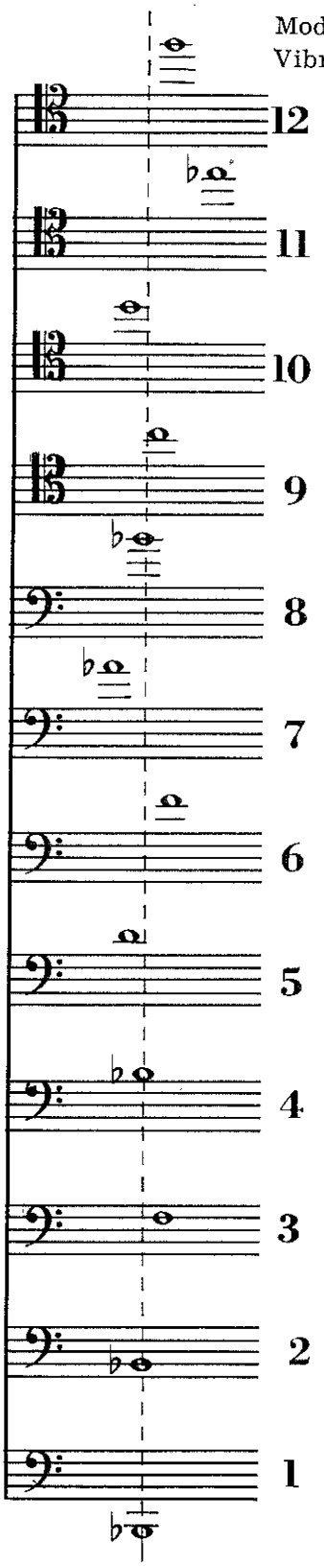
The ninth mode (C) may be slightly sharp. The tenth mode (D) is flat.



The 11th mode of vibration is so sharp or so flat that an in-tune note is found almost midway between the two slide positions. Thus a high E flat is played with the slide placed between first and second positions.



Thus the intonation of the first position would be:



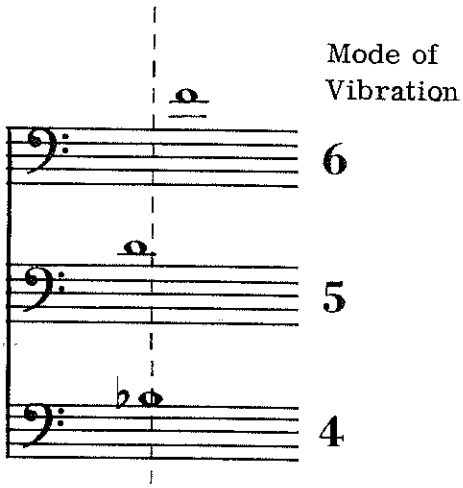
Intonation of the Slide Positions

Complicating this intonation problem is the fact that the intonation differences are magnified as the slide is extended. A larger percentage of the trombone becomes cylindrical when the slide is extended while the conical section (the bell joint) remains fixed in length. As a result, the adjustment for tuning is increased in the longer positions. The D above the staff is played only slightly higher than a regular first position, whereas the same partial in sixth position (the A on the top line of the bass staff), must be played nearly three-fourths of an inch higher. The flat partials get flatter and the sharp partials get sharper as the slide is extended.

The entire slide position chart would appear as: (See Fig. 46 Trombone Intonation Chart, Page 79.)

The dotted lines indicate the normal placement of the slide position and the notes are written either on, to the left of or to the right of the dotted lines to indicate the placement of the note on the slide. (You are at the left and the slide is being adjusted through the positions to the right. If the note is written to the left of the dotted line, it indicates that the note is played higher on the slide than the normal placement of that position). When testing these adjustments play with a straight and centered tone. Do not lip the note one direction while moving the slide in the other.

Learning the entire chart at one glance is impossible and I recommend that you study the chart in sections. For instance, note the relative positions of the notes of the B flat arpeggio above the bass staff:



The B flat is in tune, the D must be pulled slightly sharp (above the dotted line) and the F must be flatted below the first position.

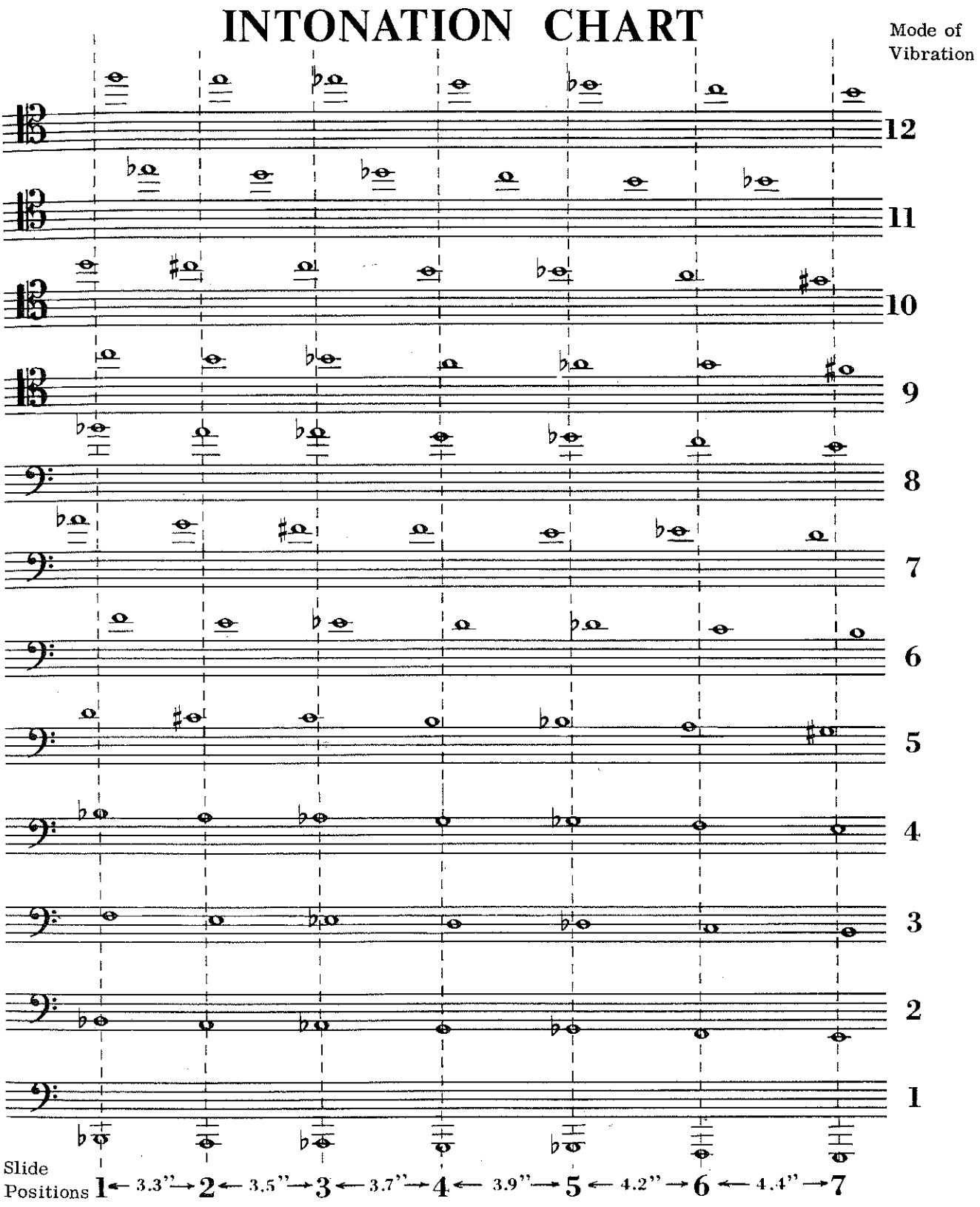
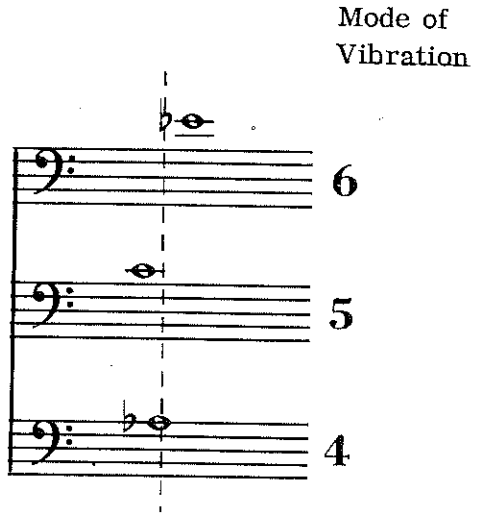


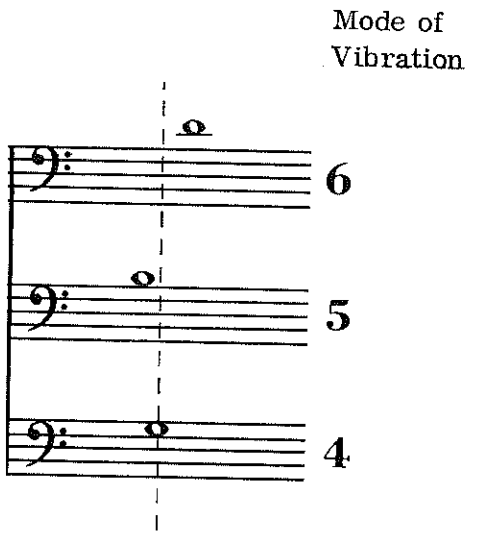
Fig. 46 Trombone Intonation Chart

Now study the same modes of vibration in the third position:



The A flat is in tune, the C must be raised and the E flat lowered from the normal third position.

Thirdly, study the same modes in the fourth position:



The G is in tune, whereas the B natural must be raised slightly and the D must be lowered a noticeable amount.

The most common intonation error of too many trombonists, is playing the seventh partial in the second, third and fourth positions too low. By not playing the high G, the high F sharp and the alternate position high F natural high enough, probably through carelessness, you begin to accept the flatter pitch as correct. It takes only a few months for the incorrect pitch to be established in your ear. After this, the poor intonation sounds like good intonation. Take care that poor intonation does not become a habit.

Remember that this chart only shows the tendencies of most players on most trombones. The positioning of the notes will vary, but usually in the same general direction. **ALSO,** the ear is primarily responsible for and the final authority as to the proper intonation of a note. The chart is only a way of visualizing the pitch discrepancies so that you can improve your aim when trying to locate the proper pitch.

Intonation of the Scale Temperaments

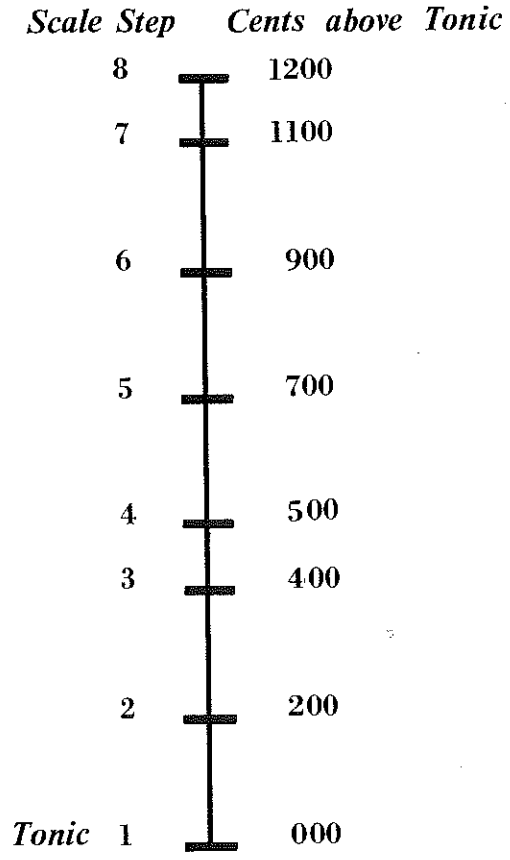
In addition to the problems of playing the trombone in tune with itself, you must be concerned with the intonation of the various scales of music. There are at least three tunings of the major scale in common use today. These tunings are called temperaments or intonations and the three most common ones are: One, equal temperament, two, just (diatonic) intonation and three, Pythagorean intonation. Though some experts believe that everyone should play in equal temperament (as the piano is tuned for *one* octave) the richness of the overtones of a trombone makes playing in equal temperament almost impossible or at least undesirable.

Equal temperament equalizes all of the intervals of a scale by making all half steps the same size and making all whole steps equal to two half steps. Before the development of equal temperament, the half tones and whole tones in a scale were larger and smaller, depending on the color that the player wanted to add to his performance. To add brilliance to the melodic line, the performer could use Pythagorean tuning which enlarges the size of the whole steps and decreases the size of the half steps. If the player wanted to blend the intervals of a chord when playing with an ensemble, he decreased the size of many of the whole steps and increased the size of the half steps. As long as the members of the ensemble agree on the blend and color they wish to achieve, the pitches can be altered momentarily, but it is not possible to tune a harpsichord or a piano to more than one temperament or intonation at a time. Also, these other intonations change when the key changes and the attempts to build a piano that could modulate were never successful.

Note that when playing with ensembles without a piano, you will probably humor the intonation away from equal temperament in order to get a better sound. Below is a diagram of a major scale which is equally tempered. Each whole step contains 200 cents and each half step contains 100 cents. (A cent is a unit of measurement which has become a standard in the field

of musical acoustics. The stroboscopes are graduated in cents, and it is not possible to determine the number of vibrations per second in a cent without doing some mathematical calculation or consulting a table. At A = 440 Hz, a cent is approximately equal to one-quarter of a vibration. One octave lower, a cent is equal to one-eighth of a vibration. For further explanation of the cent, consult a book on the acoustics of music.)

A diagram of an equally tempered major scale would appear as:



Equal temperament when played as a scale by one trombone will sound fairly good, but when played in harmony it creates problems. If two trombonists play an equally tempered interval of a perfect fourth or a perfect fifth (500 cents or 700 cents), a slow *beat* will be heard. This beat sounds the same as when two players attempt to tune a unison and are very nearly, but not exactly, in tune. The harmony sounds better if the beat is removed and flatting the fourth by two cents or sharping the fifth by two cents will eliminate it. Professional trombonists have difficulty playing an equally tempered fifth. They will hear the beat, and one of them will move his pitch slightly so that the interval will blend and the beat will disappear.

An equally tempered third is a compromise between the other two intonations. For the best possible blend, the equally tempered third should be lowered nearly 14 cents (just intonation). For brilliance, the equally tempered third should be raised nearly eight cents (Pythagorean intonation). Note on the chart below how the intonation of the just and Pythagorean scales differ. The small hack mark indicates the placement of that note in equal temperament. The large mark indicates the actual placement of that note. On that large mark is a number which indicates the number of cents in that interval. To the right of the mark is a positive or negative number which indicates the difference between that note and the same note in equal temperament. To locate these notes using a Stroboconn, the dial of the Stroboconn would be set sharp (+) or flat (−) as indicated on the chart which appears on page 82.

This chart need not be memorized nor even remembered when attempting to play in tune. The point to be made here is that what sounds best or blends best is the standard for how the intonation should be played. You should not be afraid to adjust the tuning of a note up or down ten or more cents, if it produces better intonation. Remember, no letter names were placed on the chart because when the music modulates the notes will change to fit the new intonation.

Intonation with a Piano

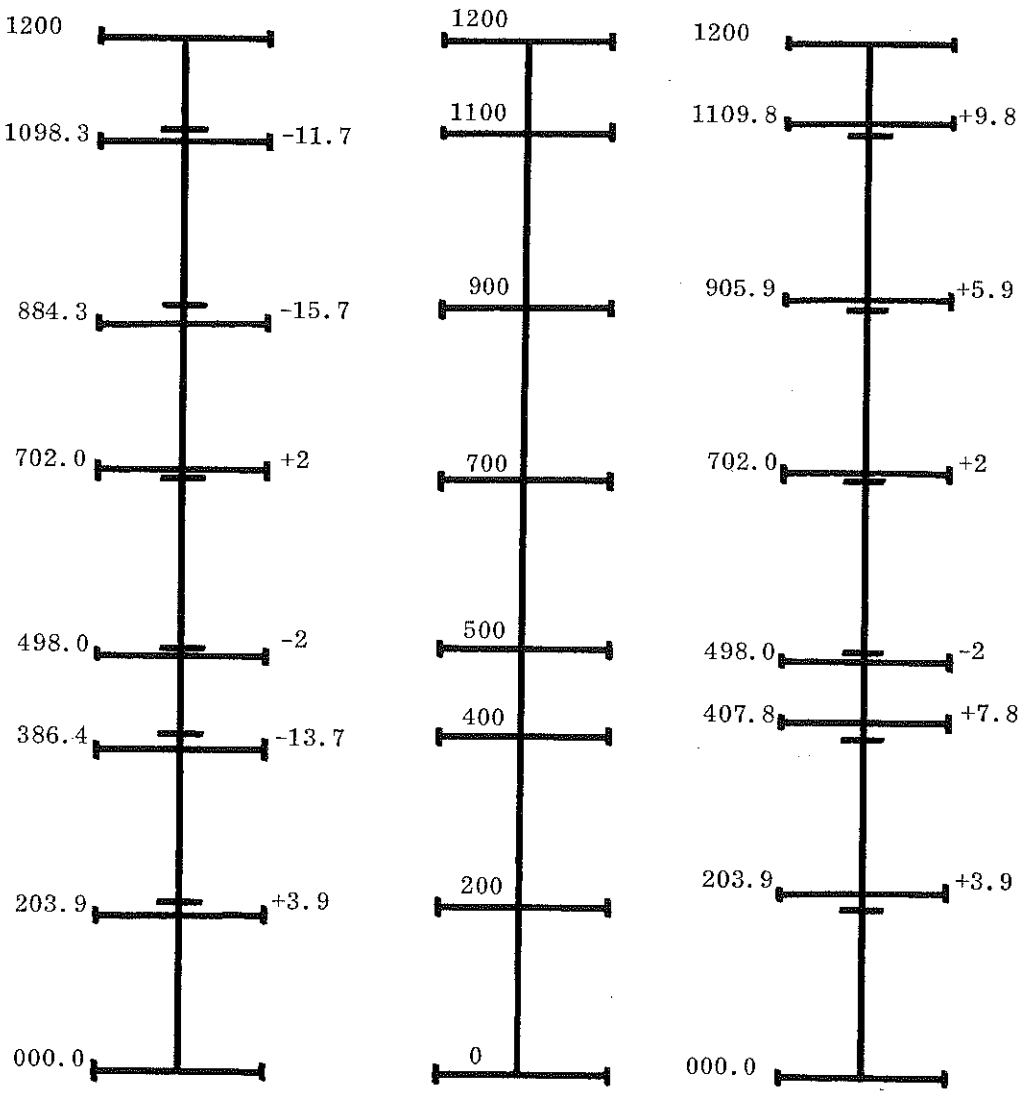
Though the piano is supposedly tuned in equal temperament, the acoustical construction of the piano makes this possible in one octave only. Because of the tension on the strings, the overtones are sharp and when the tuner adjusts the piano, he tunes the upper octaves sharper than A = 440 and the lower octaves flatter than A = 440. Therefore you cannot play at one pitch level when accompanied by a piano. You must adjust your tuning depending on the register in which the piano is playing and the note of the chord that you are playing.

Both the theory and practice of playing the various musical intonations are beyond the scope of this book, but in general you should be aware that:

1. Though the piano is tuned in equal temperament, the octaves are stretched, and the intonation of the trombone note will have to be adjusted either up or down from exact equal temperament.

2. When playing with other instruments than a piano there is a tendency to blend chords and brighten melodic

Comparison of SCALES (measured in cents)



Numbers on the left of each column indicate distance in cents of each scale step above tonic.

Numbers on the right of each column indicate differences in cents from the equally tempered scale steps.

Small hack marks indicate the position of the equally tempered scale step.

Fig. 47 Comparison of Scales in Cents