# FIDELITY AND THE AMPICO*

Newly Revised and Updated

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**1993 Publisher's Note: This excellent article on the Ampico was originally written by Nelson Barden approximately 24 years ago. It has appeared twice in the AMICA Bulletin, once in the November, 1969 issue and again in the March, 1976 issue. This version (May-June 1993) has been extensively edited and updated by Jeffrey Morgan and Richard Howe, with permission from Barden, to reflect new information which has become available during the past 20 years. Barden is currently president of Nelson Barden Associates, restorers in residence at Boston University.*

The musical validity of the reproducing piano has been a subject of controversy since the preliminary efforts of Welte at the turn of the century. It has always been difficult for pianists, critics or the public to accept the idea that a machine could "make music." Despite extensive advertising campaigns and rapid improvements in the fidelity of performance, these pianos have been considered sophisticated toys, divorced from Art by virtue of their mechanical nature.

Inasmuch as Art is a function of human elements and direction, a machine of itself cannot create Art. Mechanical means are nonetheless involved in the realization of most art forms, and in piano playing the performer's body is literally a machine operating another machine. It is at least theoretically possible to substitute a completely mechanical device for the performer machine so that his key and pedal movements are precisely duplicated. Although the artist will not be present at the keyboard, the sounds of his performance will be re-created.

In the case of the reproducing piano, such as the Ampico, Duo-Art and Welte-Mignon, we must establish not only the machine's potential for fidelity, but also the extent to which that potential was realized. It is toward both these ends that the writers, dissatisfied with a patchwork of rumor, started gathering firsthand information (in 1969). Much of the preliminary information was gleaned from personal interviews by Nelson Barden with Adam Carroll, Dr. Clarence Hickman, Julius Chaloff, Emse Dawson and Angelico Valerio. (Note: All but the Chaloff interviews are contained in "The Ampico Reproducing Piano", edited by Richard Howe.)

**Theory of operation**

Reproducing pianos are operated by means of a partial vacuum, usually created by an electrical pump. The roll passes over a tracker bar having a hole for each note and expression track on the roll. Suction is sustained in the holes until a perforation in the paper roll admits atmospheric pressure which causes valves to admit suction to a pneumatic. The pneumatic is shaped like a partially open book with the space between the covers wrapped in a flexible, airtight cloth. When suction is applied the covers snap together and the movement is transmitted to the key of the piano. The set of pneumatics, one for each key to be played (83 in the case of Ampico), make up the stack, which in a reproducing piano is divided in two (bass and treble) near the center so that varying suction may be fed to each side without affecting the other. A higher degree of suction will close the pneumatics with greater power, and result in louder playing.

Expression tracks (coding) on the margins of the roll control not only the suction level on either side of the stack by means of various expression mechanisms, but also operate the dampers and the hammer-rail or key-shift of the piano action. A recorder was necessary to create the rolls, as mechanically arranged rolls are generally unrealistic. A note recorder made pencil marks on a moving roll while the pianist played, and expression tracks were usually added later to create the dynamics (loudness of each note) until the playing seemed realistic. On Ampico rolls the dynamics were referred to as intensities.

The method of dynamic control employed by Ampico throughout its history entailed a unique combination of fixed steps (intensity stages) and smooth progression (crescendos) of volume; a sort of combined digital and analog system, to state it in contemporary technical terms. The stages could be locked on or canceled at will, and the crescendos could be raised or lowered at either of two available speeds. Generally, the intensity stages were used for accents and rapid changes in volume; the crescendos employed for overall and gradual adjustments of volume. This unique combination of dynamic control was deemed so important by American Piano Company that a U.S. patent application was filed on April 27, 1920. Indeed, U.S. Patent No. 1,409,481 was finally issued to Charles F. Stoddard on March 14, 1922 and specifically covers the *concept* of such a combined system of dynamic control.

Initial development of the Ampico was done by Stoddard during the latter part of the first and very early part of the second decades of the twentieth century. The early pianos and rolls were known as Stoddard-Ampicos. This term has become generic and, hence, ambiguous! It has been used by contemporary collectors and historians to incorrectly denote any pre-model A Ampico. Actually, a true Stoddard Ampico is a pre-type 2A Ampico! (See **The Evolution of the Ampico** by Howe and Morgan, The AMICA News Bulletin, March-April 2003.) This would include Ampicos produced from 1912 through 1914. The transition, which occurred sometime during 2A production, entailed the addition of an amplification system. Ampicos produced circa 1915 through 1919 would more accurately be labeled *Early Ampicos*. By 1920 Stoddard's work led to the development of the mechanism now referred to by collectors as the Model A Ampico. Dr. Clarence N. Hickman, a physicist, who joined the AMerican PIano COmpany in 1924, redesigned the Model A with Stoddard. The result was the Model B, introduced in early 1929. (Note: The 1929 Ampico Service Manual is dated May 1, 1929.) Dr. Hickman also

constructed the first and only recorder for the dynamics. This recorder came into use in 1926.

**Ampico Popular Rolls**

Normally, Ampico popular and classical rolls were not made by the same process. For most popular rolls, the dynamics were not recorded, even after the advent of the Hickman dynamic recorder in 1926. A basic music arrangement was hand-played into the note recorder which generated a very accurate pencil line recording. On this roll, wrong notes were erased and additional notes and figurations penciled in as necessary, a process known as "correcting." Further corrections and additions might be later hand-cut into trial copies of the perforated rolls.

Until at least 1931 all rolls were hand-played, though frequently under pseudonyms, or "noms de piano." This practice, universal among piano roll companies, was designed to fatten the artist roster. Particular pseudonyms were assigned a definite style of playing in order to preserve their tenuous identity and to save the real artist's reputation for a higher class of music.

Selections of Ampico titles and artists (or pseudonyms) was a function of J. Milton Delcamp. Delcamp joined American late in 1921 as General Manager of the Recording Department at Ampico, a position he held until 1928. Delcamp previously had a similar position with Republic Player Roll Corporation, a subsidiary of the Auto Pneumatic Action Company which was part of Kohler Industries. Republic stopped producing 88-note rolls at about the same time as Delcamp moved to American.

Adam Carroll, who was responsible for a large percentage of the popular Ampico rolls, also worked at Republic. He followed Delcamp to American in 1922, about nine months later. At Ampico, Carroll also recorded under the pseudonyms Victor Lane, Harry Shipman and Corrine de Bert, though the latter was usually Edgar Fairchild. Mr. Fairchild, Editor-in-Chief of the Recording Department until 1926, also used his original name, Milton Suskind, and others.

Recordings by the real artist and one of his pseudonyms (such as Carroll & Lane) were in this case played by Adam Carroll and Edgar Fairchild, though occasionally Delcamp or Victor Arden took the second part. Recordings by two pseudonyms (such as Shipman & Lane) were accomplished in the same fashion. Four-hand arrangements requiring only occasional figuration in one part might be recorded by only one artist and the rest penciled onto the note roll or cut into the trial roll.

Edgar Fairchild did much of the dynamic coding ("editing") for Adam Carroll's recordings, and all of it for Fairchild & Carroll rolls. He was also responsible for the editing of much of the better classical work of the period, including all the Chaloff and pre-1926 Rachmaninoff recordings. According to Adam Carroll, other editors were: Emse Dawson, Marguerite Volavy, Mortimer Browning, Arnold Lackman, Egon Putz and Angelico Valerio.

After the pencil roll had been corrected it was hand-perforated at the start and end of every note and dynamic marking. This roll was then read by vacuum in the ordinary manner on the automatic stencil machine, which was designed by Charles F. Stoddard. It was an enormously complicated device, with about 700 valves for the tracker bar reading alone. (Note: Clarence Hickman later redesigned the device, using only about 500 valves.) This machine generated the typical slot-and-dot note perforation from the hand punched roll. It not only created several trial rolls for playing and editing, but the master stencils and duplicate master stencils as well. These were cut at triple spacing so that while the trial roll showed a slot, the Master had spaced, single perforations. The master stencils were also read by vacuum on the production perforators first located at Rythmodik Music Corporation in Bellville, New Jersey; later (circa 1922-1930) at Amphion Piano Player Company (Ampico's pneumatic component manufacturing division) in Syracuse, New York; and, finally, at the main American Piano Company plant in East Rochester, New York, where they remained until the early 1950's. These high speed production perforators produced the familiar Ampico rolls sold to the public.

Within limits, the playing rhythm was relatively unimportant on the original note roll. By an extremely ingenious combination of capabilities, the Stencil Machine facilitated the correction of faulty rhythm so the rolls could be used for dancing. This combination included: A floating tracker bar; Stoddard's patented air sprocket (often confused with the floating tracker bar), which made possible highly synchronized punch-for-punch duplication from one, or the other, or both simultaneously of two sources; a precise instant-stop; the ability to couple/decouple (during instant-stop) either of the two sources with/from the cutting field . . . or each other, without loss of synchronization; 100 pneumatic three-way switches which controlled the input for the entire cutting field. The three-way switches could signal each individual interposer pneumatic (which determined whether each individual punch in the cutting field would punch, or, not punch in a given cycle of the Stencil Machine's perforator ram) to: punch continuously; punch from either (or both) source(s), i.e., tracker bars; not punch at all.

With such powerful editing tools, the Stencil Machine operator could adjust rhythm and phrasing to accommodate the editors' corrective instructions both marked and punched on the trial roll. Such rigid rhythm correction was not used for ballad rolls, which had to be perforated as played in order to have "soul." It was also not used for the classical rolls.

Starting in 1931 many Ampico popular rolls were produced by the Duo-Art artist Frank Milne (mispronounced Mill-Knee by so many that he finally gave up and accepted this pronunciation himself) who was a highly skilled pianist and arranger. He was the chief editor after 1932, and after 1935 or 1936, recorded and/or edited virtually the entire Ampico output until production ceased in June of 1941. He used his own name as well as a wide variety of pseudonyms singly and in combination: Robert Farquhar (Farquhar was the first name of Mrs. Milne's father), Bob Edgeworth (Edgeworth was Mrs. Milne's uncle), Noel Sherry, the Sherry Brothers, Jeremy Lawrence, Ralph Addison (the name of a friend from Newark, NJ), and Ernest Leith (the name of another friend). Many latter-day collectors believe that Milne's rolls constitute some

of the most sophisticated arrangements and nimble dynamic coding of the Ampico popular library.

Profits for both the American Piano Company and the Aeolian Company, (producer of the Duo-Art and longtime competitor), were falling long before the Stock Market Crash of 1929. To avoid a disastrous bankruptcy, Ampico was reorganized in May of 1930 to become the American Piano Corporation, and merger negotiations were instituted with Aeolian, eventually resulting in the Aeolian American Corporation in 1932.

**The Ampico Classical Rolls**

Before 1926 the classical rolls were also recorded only on the note recorder without dynamics. The process of editing was not only to improve the playing as much as possible, but to slowly build up realistic intensities from notations made on the music during the recording session. Aside from removing wrong notes and making minor corrections on the pencil roll, all editing was done on a trial roll cut by the stencil machine, and played on an Ampico.

Dynamic coding was hand punched onto the blank trial roll, first the intensity stages then the crescendo coding, until the playing became musical and realistic. Note perforations were lengthened by hand punching or shortened by taping over as necessary, and from this roll the stencil machine made corrected trial rolls for further editing. Eventually a completed roll was played for the artist who, though encouraged leave rough sections as examples of his individuality, might make further corrections. Eventually, a master stencil was created to match the artist-approved trial roll and used to operate the production perforators.

**The Note Extensions**

A unique and controversial feature of Ampico rolls was added during the editing. These were the note extensions, which were covered by patents granted to Stoddard in 1911-12. The technique was originally designed to improve the playing of mechanically arranged rolls, and consisted of over cutting (lengthening) the melodic notes, causing them to sustain through succeeding harmonies. A "singing" melodic line was created, and the technique was so successful that it was immediately extended to chords as well. On the Ampico rolls this meant that perforations were arbitrarily lengthened past the end of the note(s) as played by the artist. Chords and arpeggios were usually extended coincidental with damper pedaling.

For a company to purport they reproduced the artist's playing and yet to deliberately change the recording, was indeed peculiar. As late as his 1927 Tuners' Convention talk, Stoddard argued the practice at some length. He used the standard Ampico thesis that the extensions only duplicate the artist's half-pedaling-the quick and usually incomplete damping of the piano strings to control the amount of blurring between chords.

This effect is not easily obtainable by the damping of the Ampico mechanism, which is either on or off. Another way to approximate this effect is through the use of *selected* note extensions. These are also referred to in the article title "Recording the Soul of Piano Playing", which appeared in the November, 1927 issue of **Scientific American**, as "tone coloring extensions."

Though an important pianistic technique, half-pedaled effects are not easy for the performer to control. And, while the technique of half-pedaling has long been recognized as useful for sustaining a melodic line, few realize that it has also been employed to sustain harmonic continuity. It seems unlikely that even a very accomplished pianist would half-pedal as much of a melodic line as indicated by note extensions on the rolls. Considering the constant extensions of single notes as well as chords, Stoddard's argument may have constituted an inadequate and unsophisticated justification. But, his argument might also have been founded in historic practice.

Based upon interviews with and recollections of great keyboard artists of the period, it would appear that the use of half-pedaling as a means of sustaining harmonic continuity without blurring melodic structure was much more accepted during the early part of this century than it is today. We must be careful not to fall into the trap of basing aesthetic judgments of historic practices solely upon the fashionable opinions of latter-day musicologists and performers.

Since a preponderance of the chord extensions duplicate the damper pedal action, an 88-note piano would be certain to sustain these notes whether the damper pneumatic worked from the roll or not. Ampico rolls cut without expression do occur as 88-note rolls, and on these pianos the extensions do produce a smoother sound. Dr. Hickman, Mr. Stoddard's assistant, was anxious at the time to get rid of the technique, but was overruled by Stoddard for this reason only.

From a mechanical point of view the extensions were undesirable. The note sheet was weakened, and it was a waste of suction to bleed so many pouches at the same time. Worse yet, a reproducing piano holding down 10 or 15 notes at the same time obviously exceeded the capabilities of a single pianist, and made questionable the fidelity of the performance.

Actually there were two reasons for the Ampico roll extensions. The first was that the artists themselves felt the sound was somehow preferable if the sustaining was done by holding the keys down instead of only using the damper pedal. According to Julius Chaloff, Dr. Hickman thought differently, and won numerous bets using a roll he had perforated with selections played both ways.

More important was that at least the melodic extensions do make the playing smoother and allow more latitude in editing. Almost all Ampicos were installed in pianos, 6'11" or less in length which, because of the size, could be rather short-toned. By means of arbitrary melodic extensions a small piano could be made to "sing" with some of the elegance of the 9' concert grand normally used by the artist. Considering the disadvantages of the chord extensions, it is not surprising they were largely discontinued in the late 1920's and that A to B roll conversions show a great reduction. But melodic extensions were always used, even in the Jumbo rolls and by Frank Milne until he left the company in June of 1941.

The musical justification (if any) was that the editors could capture on a small piano the half-pedaling as well as the superb

legato effects of such artists as Josef Lhevinne. Comparison of Lhevinne's seemingly choppy early Welte Vorsetzer rolls to his graceful 78 rpm disc records and Ampico recordings would seem to bear this out. For the playing of a "dry" pianist such as Rachmaninoff, this kind of editing was perhaps not as necessary. His accuracy of attack and control of the piano was phenomenal. Julius Chaloff told Nelson Barden that Rachmaninoff was the only Ampico artist consistently able to trigger large chords so that each note would record with the same dynamic level and at precisely the same time. When Rachmaninoff's pencil-line record came off the recorder, the notes of large chords lined up so perfectly that "you could lay a ruler across them." Chaloff went on to say that on "rainy Thursday afternoons" the editors themselves often attempted this feat, but "not one of us was ever able to do it."

The moot point of the extensions was that of fidelity. The editors could and did use the extensions to "warm up" the playing of lesser artists. However, a comparison of such rolls as the Julia Glass and Josef Lhevinne versions of "On Wings of Song" indicates that the practice was perhaps not as prevalent or even as effective as might be thought.

Chaloff explained another editing process that was called "setting back." One of the editing operations was to locate soft notes surrounding loud notes, and to move the loud notes back on the roll by one, two, or three squares. When the Hickman dynamic recorder came into use, the setting back scale was expanded to seven squares. Chaloff did not know why this was done, except that it made the playing sound more natural. (In his interview, which has now been published in "The Ampico Reproducing Piano", Angelico Valerio explained this process.) The actual reason involved the speed of closing of the Ampico pneumatics on varying suction. Playing a loud note on high suction caused the pneumatic to close quickly. When playing soft notes on low suction, the pneumatic closed more slowly, and the notes played later. The difference was slight but perceptible: loud notes seemed to "jump the gun" on the soft chords. In the art of musical accenting, it is well known that "early is weak, late is strong," and the setting back process compensated for the incorrect accenting. Setting back altered the impact of the hammer on the string only by a fraction of a second, but it made the playing smoother and considerably more realistic.

Dr. Hickman's dynamic recorder was first used in 1926. Rolls made on it were intended for eventual use on the Model B piano, and most were coded accordingly. However the 1926-27 rolls hardly utilize the capabilities of the Model B. Possibly the coding was still thought of in terms of the Model A, and for a while Model A pianos were still used by the editors. The only Model B initially available to them was the Research Laboratory prototype, which was used predominately for the classical editing by Emse Dawson and Marguerite Volavy.

Many rolls later issued as Jumbos or with Model B labels were recorded between 1926 and 1928. Old Model A rolls could also be re-coded for the new machine with comparative ease by utilizing the old coding and the inherent musicianship of the editor. Since the recording piano did not have an Ampico mechanism, it was not possible to re-record or over dub, nor was it necessary to do so.

The recording piano itself was a medium sized grand, and certainly an American Piano Company product. But the actual make had been open to question, as every identifying mark was removed. Major artists usually contracted to endorse and play only one brand of instrument, thus potential legal difficulties were avoided. The fallboard carried only the word "Ampico." However, recent research by Jeffrey Morgan has revealed that it was a Model 59 (5'9") Chickering.

Rolls made for the Model B piano were coded in such a way as to also operate the Model A piano; in fact, both kinds of rolls do reproduce on the other model, though somewhat unrealistically. Both utilize similar intensity coding configurations, yet there are major differences in their expression systems.

**Model A Expression System**

On the Model A, for instance, slow crescendo is eleven seconds and fast crescendo is two seconds. (Model A crescendo timing indicates how long the dual crescendo mechanisms require to increase the suction available to their respective bass and treble sides of the stack from minimum to two-thirds maximum suction or vice versa.) The Model A crescendo timing specification is determined with the "amplifier", which is described next, inactive (disabled).

Additionally, the Model A is equipped with a variable pump spill controlled by suction levels in either side of the stack. This "amplifier" is engaged automatically as stack suction levels exceed a predetermined threshold. As stack suction increases beyond this threshold, the pump spill is increasingly closed resulting in a "bootstrap effect" on pump suction available to the expression systems. This Model A amplifier affects pump suction from two-thirds maximum to full suction. Crescendo timing becomes compressed to a certain extent as this amplifier is engaged (resulting in a net crescendo timing of approximately 1 second fast, 7 seconds slow). With the amplifier active, the Model A crescendos have the ability to affect their respective stack suction levels from minimum to full suction. Under the same condition, the intensity stages of the Model A (two-four-six bass and treble tracker bar holes) can also affect their respective bass and treble stack suction levels from minimum to maximum.

Stated another way, the crescendos and intensity stages on the Model A are controlled by roll perforations; in terms of supplying stack suction, each has the capability to totally override the other. The Model A amplifier, moreover, is automatically engaged by suction levels in either side of the stack.

**Model B Expression System**

On the Model B, slow crescendo is much faster, being four seconds, and fast crescendo is reduced to 1/2 second. (Model B crescendo timing indicates how long the single crescendo mechanism requires to increase pump suction available to both bass and treble intensity stages from one-half maximum to full suction or vice versa.) The Model B crescendo timing

specification is also determined with *no* amplifier activity but should, in theory, be best compared with the net crescendo timing of the Model A as opposed to the actual Model A crescendo timing specification (see previous section). This still results in a crescendo speed increase of almost two-to-one in the Model B over that of the Model A.

Full suction to both intensity stages can also be supplied by a three stage lock on the pump spill (amplifier) which is operated by an additional perforation on the bass margin of the roll. The bass and treble intensity stages of the Model B (operated by the 2-4-6 bass and treble tracker bar holes in a manner identical to that utilized by the Model A) can affect their respective stack suctions from minimum to one-half maximum unless expanded by a crescendo or the amplifier. Therefore, the intensity stages are, to a certain degree, dependent upon the crescendo and amplifier. However, by merely acting upon the suction supply to the intensity stages, the crescendo and amplifier completely depend on the intensity stages for transference of their effects. Hence, intensity coding must be utilized to convey, to appropriate sides of the stack, effects generated by the crescendo and/or amplifier.

Moreover, the Model B crescendo and amplifier are mechanically combined, but independently operated by separate roll perforations. These separate perforations must be multiplexed in order to increase a locked amplification stage. Yet, no perforation multiplexing is required to decrease an amplification stage previously locked upward. Because of this mechanical integration, a Model B amplifier locked at midstage will raise the bottom end of the crescendo travel, hence, cutting its effective range in half. A Model B amplifier locked at its highest stage (full pump suction) will render the crescendo totally inoperative!

Additionally, the Model B stack is equipped with two spill valves (bass and treble) automatically operated in conjunction with their respective number six intensity stages. Unless their respective bass and treble number six intensity stages are engaged, these spills remain open and induce a predetermined amount of atmospheric leakage into their respective sides of the stack. The main (but not exclusive) purpose of such a spill valve is to allow almost instantaneous return to minimum stack suction levels upon cancellation of any previously locked intensity stages. It also has the ability to facilitate rapid changes between transient stack suction levels!

Stated another way, the crescendo, intensity stages, and amplifier in the Model B are all controlled by roll perforations; in terms of supplying stack suction, the intensity stages can partially function without any crescendo or amplifier activity, but the crescendo and amplifier *cannot function effectively* without some intensity stage activity. Additionally, a "sub" stage can lower suction in either side of the stack below minimum for very soft passages.

**Incompatibility**

To compare the two, Model A crescendo activity immediately and directly affects stack suction. Model B crescendo activity, however, must have some intensity stage coding in order to effectively transfer its effects to stack suction. Moreover, the Model A stages are relatively large steps and the crescendo will have less effect for a given length of perforation. The Model B stages are smaller and the crescendo will have much greater effect. Though the stages and crescendo tend to balance out, it is immediately apparent that A and B rolls are not compatible on the other system if the full potential of the roll is to be realized.

**Early Ampico Pianos**

A possibility also exists for incompatibility between later rolls (Models A and B) and Early Ampico pianos and vice versa. Early Ampicos have the same crescendo and intensity coding configurations as the Model A. Crescendo timing is also identical in both systems (contrary to popular notions derived from observations of Model A net crescendo speeds). However, while sharing a similar, automatically operated "bootstrap effect" amplifier affecting pump suction at nearly identical levels to the Model A, the Early Ampico amplifier is engaged exclusively by suction levels in the treble side of the stack. Suction levels in the bass side are totally ignored by Early Ampico amplifiers. Early Ampico rolls are, of course, coded with this idiosyncrasy in mind.

Furthermore, because all Early Ampico and Model A crescendos directly affect their respective stack suction levels without benefit of any step intensity coding, the theory of "platforming" (championed by some as a viable coding technique) would be difficult if not impossible to implement on such instruments.

Finally, while the effect of Early, Model A and Model B amplifiers is similar, the method of their activation is radically different when one compares the three systems. And, when one considers crescendos, Early and Model A systems contain true crescendos acting directly upon stack suction. The Model B crescendo, on the other hand, is merely a pump amplifier capable of being operated by roll perforations in two separate ways (i.e., steps and smooth progression). The B crescendo does not have the ability to raise stack suction levels to maximum without assistance from the intensity stages. In this manner the Model B departs conceptually from its predecessors!

**A Rolls on a B Piano**

A rolls on a B piano will almost always exhibit certain detrimental characteristics. Staccato notes played at very low intensities or fast tempos occasionally skip because at very low suction the single valve system of the Model B is slightly less responsive to the single perforations so common to A rolls. It will be noted that many A to B roll conversions often have single perforations lengthened to oblong slots.

A rolls have independent coding for the Model A dual (bass and treble) crescendo systems. The single crescendo system of the Model B will only respond to the treble crescendo and diminuendo perforations on A rolls. Hence, all A roll non-coinciding (independent) bass crescendo and diminuendo perforations will not be recognized by the Model B and, therefore, their effects will be lost. This is a serious flaw as any A roll note activity relying upon the bass crescendo for

sustenance or effect will fall flat (unless, by mere chance, adequate coincidental crescendo activity occurs in the treble margin of the roll.)

In addition, the A roll treble crescendo and diminuendo perforations will over stimulate the B mechanism, resulting in a constant and annoying seesawing between soft and loud playing (this phenomenon is often mistaken for intentional dramatic effect by the inexperienced listener). Moreover, this phenomenon will be further aggravated by the effect of A roll intensity stage coding (intended for use with stacks having no spill valves) upon the Model B stack spill valves.

Because the three-stage lock on the pump spill (amplifier) will not be signaled and, hence, not latch up to its higher settings, intensity stages 2-4-6 together (bass and/or treble), which on an A piano would yield the loudest playing, will produce only mezzo-forte. In part this will be compensated for by the overacting crescendo, but passages which depend on the stages to sustain high suction, such as the conclusion of many rolls, will be too soft. Furthermore, because they will not be signaled, the "sub" stage capabilities of the Model B will not be utilized. The overall impression is what might be called lumpy expression.

**B Rolls on an A Piano**

B rolls on an A piano will tend to sound better than vice versa. All the notes will play. Because, for the sake of compatibility, editors duplicated the B roll crescendo and diminuendo perforations (read only from the treble margin of the roll by the single crescendo system of the Model B) in the bass margin as well, the Model A dual crescendo systems will both respond simultaneously to B roll crescendo and diminuendo perforations. However, these crescendo and diminuendo perforations will be of insufficient length for proper expression but the effect is not objectionable.

Because the Model A is equipped with an amplifier automatically engaged by stack suction, the B roll 2-4-6 intensity coding will often result in over-expression; and, particularly, the melody lines will be too sharply defined and, usually, too loud. (This phenomenon is often cited as proof of compatibility when, in fact, it is an indicator of incompatibility.) For the same reason, the Model A will tend to handle B roll fortissimo passages (coded for amplification steps) unrealistically. And, without the "sub" stage, some of the softest effects will be lost.

**Early Rolls on A and B Pianos**

Early rolls will tend to perform more realistically on the Model A than on the Model B. When played on Model A pianos, some Early Ampico rolls could contain levels of bass expression coding (intensity and/or crescendo) high enough to engage amplification (if coinciding with insufficient levels of treble coding, such bass coding would not have engaged amplification in Early Ampico pianos). In Model A pianos this situation of incompatibility would result in significantly higher levels of suction in the bass and slightly elevated levels in the treble than called for by the Early Ampico roll. The effect on treble suction levels would be limited by the lower levels of treble expression coding necessary for this phenomenon to occur. However, this phenomenon is rare because the above mentioned high bass coding situations are, usually, accompanied by sufficient treble coding to have engaged amplification on Early Ampico pianos anyway. Naturally, any coding used on early rolls to achieve amplification in Early Ampicos will similarly achieve amplification in the Model A. When played upon a Model B piano, early rolls will exhibit the same problems as previously described under the heading "A Rolls on B Piano.

**A Rolls on Early Ampicos**

It is probable that some A rolls exist coded so as to engage the Model A amplifier solely by means of suction levels in the bass portion of the stack. Such rolls will not engage the amplifier when played upon Early Ampico pianos (unless by mere coincidence, sufficient suction was also present in the treble portion at the time of needed amplification). The above stated situation would severely limit the dynamic potential of A rolls played on Early Ampicos!

**B Rolls on Early Ampicos**

The most extreme problems of compatibility will be encountered when playing B rolls on Early Ampicos. In addition to the crescendo and diminuendo perforations being of insufficient length, the situation could occur where some level of amplification is required for bass expression needs and subsequently not delivered by an Early Ampico piano. The B roll might signal some level of amplifier stage lock to accompany whatever bass intensity coding is employed. For example, let's say the amplifier is coded to lock in second amplification (full); and the bass intensity coded with tracker bar holes two, four and six, resulting in a number seven bass intensity. The Early Ampico piano will not respond to amplifier lock coding on the B roll. And, if treble expression coding is insufficient to raise treble stack suction levels above the predetermined threshold on the early Ampico piano, no amplification will result. Pump suction will, therefore, remain at normal; bass stack levels will merely be a result of the intensity coding. This situation will result in the Early Ampico having a bass stack suction level nearly half of that indicated by the coding on the B roll.

Additionally, even when no amplification is signaled by the B roll, its treble expression coding will often engage the Early Ampico amplifier and result in over-expression somewhat similar to that described previously under the heading "B Rolls on an A Piano".

**Roll Characteristics**

Another point of consideration is the difference in coding styles between the early and late rolls. The change is gradual but sure: early editing emphasized crescendos; late editing emphasized stages. Extremes of crescendo usage are seen in some pre-1920 Early Ampico rolls which exhibit only rudimentary use of the stages, with a heavy reliance on crescendos.

It has been observed on several Early Ampico rolls that were subsequently re-coded to B configuration that some effort was made to retain coding utilized exclusively by earlier systems but not necessary for B operation. However, it appears

this re-coding practice was limited to selections deemed volume sellers. More importantly, rolls issued exclusively as B, as well as some late A to B conversions, have been observed that contain passages of sustained high suction utilizing B pump amplification coding; yet these rolls lack the necessary treble coding required to fully engage the amplifier on Early Ampico pianos! From this observation we can conclude that while some effort was exerted on these late B rolls to make them compatible with the Model A, no such effort was made regarding compatibility with Early Ampicos. In more than a few cases such efforts as were made for roll compatibility merely amounted to expedient compromises.

Since the familiar Art-Deco Model B label was not introduced until late 1929, rolls made before this time bear the typical Model A labels but are actually Model B rolls if cut after October, 1927. Fortunately, both popular and classical rolls of this period can be identified by the use of the word "London" on the lower right hand corner of the box label. Additionally, many have red or black stars in the lower corners of the box label and sometimes on the roll leaders. Since some of the labels do not contain stars, rolls having stars on their leaders may more reliably be distinguished from earlier "A" rolls. Yet, the absence of stars on the leader does not necessarily preclude a B coded roll. However, the earliest Model B rolls contain intensity coding very similar to that previously used for the Model A, and some collectors consider the later efforts (in the high 68000 classical series upward for instance) as the only rolls issued under "A" labels that are true Model B rolls.

Model B expression coding may be easily recognized by either the pump amplifier coding in the extreme left margin, "sub" intensity coding in the extreme right margin, and (though not infallibly) by duplication of the fast and slow crescendo perforations on both treble and bass sides. Another typical pattern is a slow treble crescendo with occasional single perforations in the fast crescendo position. While many Early Ampico rolls also used this coding technique, its use was greatly reduced during production of rolls during the Model A era (1920-1928). After 1928, it was again used extensively. Though a few "A" rolls did use this pattern, it is seen largely prior to 1920 and after 1928.

Though Model B development was well under way by 1927, the changes in the coding were gradual. Initially the editors were working with Model A pianos, though these were soon replaced. More importantly, the editors at first thought only in terms of the Model A, and were slow to take advantage of the opportunities offered by the Model B system. Many collectors feel the Model B intensity coding culminated only in Frank Milne's latest rolls, cut between 1935 and 1941.

**Milne "Kitchen Table" Arrangements**

One intriguing puzzle concerns the near-total absence of surviving 3-to-1 Ampico paper master stencils from the so-called Milne "graph-paper era". It is obvious to the interested coding watcher that Frank Milne's rolls are more heavily coded than almost any others. His daughter says she watched him draw out masters on their kitchen table, the notes in red pencil and the expression in blue. With a chart of the Ampico intensities probably the same thing could be done today. The first Milne Ampico roll known to the authors is number 213141, **What's the Use?** released in January, 1931. How the production rolls were made form the "graph paper" masters is not known but they seem to date from 1932 on.

A plausible explanation for this is that Milne did all of his "kitchen table" arranging on 3-to-1 cardboard masters which were read mechanically by a key frame on the Duo-Art perforators. These masters could have been easily duplicated and re-coded, expressionwise, to produce Ampico rolls using a second key frame perforator re-fitted with dies containing no themodist punches (snakebites). Such a melding of technology would have been possible after the 1932 merger between The Ampico Corporation and Aeolian (producer of the Duo-Art).

It is known that in the 1970's Mrs. Frank Milne gave a collector who has since disappeared at least one of these Duo-Art 3-to-1 cardboard masters which had been marked in red and blue pencil by her husband. She also gave the collector some of the pencils!

The fact that many, but not all, Ampico popular rolls produced in the 213000 series and beyond appear to bear the signature of the Duo-Art perforators supports the above hypothesis. (They are also 0.069 inches in diameter, the same as Duo-Art.) The appearance of the Ampico, Duo-Art, and Welte-Mignon "twins" and "triplets" during this same time period also supports this hypothesis. This would have also been a good way to drastically reduce the costs of producing three types of rolls.

It is important to note, however, that quite a few Ampico popular recordings issued from 1931 to 1935 (213000, 214000 and 215000 series), continued to be cut on the Ampico perforators in the normal way, using Ampico 3-to-1 paper master stencils. The few Ampico paper masters which do survive from this period do not contain selections which appear as "twins" or "triplets". This, of course also supports the above hypothesis.

**Surviving Ampico Masters**

It is a curious fact that while many of the Ampico classical master stencils still exist (almost all of the surviving masters and the original production perforators are now owned by the Keystone Music Roll Company of Bethlehem, Pennsylvania), there are much fewer surviving popular master stencils. One explanation for this is: all roll companies had known for years that, for the most part, popular music was a highly perishable commodity. Very few of the popular issues became "standards". Although 3-to-1 Ampico master stencils made from roll paper were used to produce all Ampico rolls into the 1930's, it appears that almost all the popular masters were burned for boiler fuel, sent to the dump or dumped into the legendary "Ampico Lake" or "Ampico Swamp".

American, and perhaps Aeolian American after them, seemed to have the attitude that "some day we might find a use for the classical masters as they have historical value, but these popular masters have got to go; we need the space!" Interestingly enough, most ballad-series masters did survive, probably because they were considered the "standards" of that day. The few popular Ampico masters that do survive at

Keystone are in chronologically random clumps. This leads one to surmise that the popular survivors were somehow buried amongst the classical masters when they were cleaning house, and hence, eluded detection.

If Harold Powell had not negotiated a deal for the surviving Ampico masters with Aeolian American in the early 1970's, they would probably have either been discarded or made the long trip across the Pacific by now.

**The Soul of the Artist**

Those of us who have at one time or another tried to add expression coding to an 88-note roll know how tedious and unrewarding the effort can be. One of the authors (Barden) can only admit to results which, despite high hopes and great care, sound more like a typist than a pianist, whether the expression mechanism of the piano is on or off.

Yet if we turn off the expression on a reproducing piano and play a reproducing roll, there still seems to be some dynamic variation remaining. While the propaganda of the reproducing piano companies would have us believe the artist somehow has fingers, or soul, enmeshed in our pianos, the actual situation is somewhat more involved and much more fascinating.

In music, a series of beats advance at a relatively even rate. We feel each beat not as an isolated pulse, but related to the one which preceded it. We also predict, if only unconsciously, the timing of the pulse to follow on the basis of the pattern we already perceived. In mechanically arranged 88-note rolls or dance music rolls, our unconscious predictions will be perfectly correct because the beats are absolutely even.

However in hand-played music the beat patterns are not even; there are tiny variations in the placement of the pulses. Though we do not necessarily perceive the unevenness of the rhythm on a conscious level, we do find it more interesting than a mechanical beat. And in some cases of artifice or accident, uneven rhythm produces a very interesting auditory illusion. Our perception is not necessarily that the pulses of the music fall ahead or behind the true beat, but that they are louder or softer, that is, more or less intense. Ampico Model B owners may encounter an annoying example of this phenomenon in the process of Note Compensation, i.e., setting the minimum playing intensity of each note using a test roll made for the purpose. The success of the adjustment depends on making all the notes sound with precisely the same intensity at the lowest suction. Therefore, it is of utmost importance to use either an original Note Compensation test roll or one made from a 3-to-1 master stencil. Conventional recuts are not accurate enough to use for this purpose. Fortunately, Keystone has such an original 3-to-1 master.

Devices of rhythmic variation have always been used as a means of musical expression, the ritard being a conspicuous example. Agogic accents and rubato are terms for two of the more subtle devices. An agogic accent consists of playing a note or chord a little off the beat to achieve a heightened musical effect. Rubato is the same technique applied to a series of beats in a melodic line or phrase, to give them shape or definition. Agogic accents and rubato are of enormous importance in expressive pianism. The sweep and elegance of a great keyboard technique is as dependent on these subtle rhythmic alterations as it is on dynamic variation.

Pianists use both agogics and rubato almost constantly. It is stylistically correct for all music of the Romantic Period to be expressive in this way, and to a lesser extent, all music. For example, A Viennese Waltz would sound like any other waltz unless played with an early second beat in each measure (an agogic accent) to give lilt and drive to the music. Chopin's melodic lines "sing" because of the acceleration or relaxing of the rhythmic pulse (rubato). Patterns of subtle beat misplacement make music personal and interesting. To delay or hurry the pace by a minute amount, to shape a phrase with tiny rhythmic variation, to pause only just perceptibly before a decisive note or modulation, and to do all these things boldly and definitively, is a necessity of any artistic keyboard technique.

Thus, if a reproducing piano handles note placement with accuracy, it goes far toward reproducing the artist's playing. The "soul" of piano music so highly touted in the advertising of the period was almost as dependent on rhythmic effects as on dynamic variation. In a quiet selection not requiring wide dynamic range, most of the "expression" was captured on the note role alone because the artist used a wide variety of non-dynamic techniques to enhance his playing.

**The Note Recorder**

The note recorder must be quite accurate to record these subtleties, and the Ampico recorder designed by Charles Stoddard was just that. Key contacts in the recording piano were connected to the solenoids of the recording machine. These operated a series of styli resting on the note sheet, which ran over a drum coated with carbon paper. To indicate a note, the stylus had only to move a few thousandths of an inch for a mark to appear on the under side of the sheet. This process was covered by patents granted to Stoddard from 1914 to 1921. Great accuracy was possible not only through the speed of the tiny movement, but also because the key contacts were set high. It was hardly necessary to more than brush a key for the note to record.

Madeline Gaylor, the girl shown in the November, 1927 **Scientific American** article over the captions "Transferring Measurements" and "Wrong Notes are Eliminated" states that at the time she could not understand why such great pianists made so many mistakes. She was a budding pianist herself, but did not realize the recorder was somewhat overly sensitive. Wrong note "blips" were of course erased.

**Editing and Expression Coding**

In addition to accuracy of note placement, reproducing piano fidelity depends on the efficacy of the editing and coding techniques, which can result in either fantastically lifelike performances or meaningless sequences of notes completely devoid of feeling. When we look at the finished product, the coding and editing of a classical roll may seem nearly impossible to duplicate. Certainly it is a time-consuming operation, and one must have unbounded admiration for those

who have recently produced new reproducing rolls with credible expression.

Much of the better editing before 1926 was the work of Edgar Fairchild. Compared to later efforts, when the Hickman Recorder gave an incredibly accurate dynamic record of virtually every note, rolls edited by Mr. Fairchild sometimes lack vitality. But considering the method of expressing them, largely from memory and his notations on the music as the artist played, many rolls are great monuments to his good taste and musical ability. Given a talented editor like Fairchild, who was aware of the potential of the machine, there is little reason to doubt the rolls were as faithful as it was practical to make them. The same can be said of the excellent editing work done by Theodore Henrion on some of the early Ampico rolls. Tragically, Henrion's career was cut short by his death in the flu epidemic of 1918. As we shall see later, the overwhelming number of coding perforations necessary to achieve "perfect" reproduction would have slowed the roll making to a standstill.

It is known that the artists were not always pleased with the rolls, and despite an immense amount of painstaking editing, could refuse to approve them. Though the faults were not infrequently those of the artist, whose subjective response while playing was inferior to the objectivity of the recorder, it nonetheless became the editor's job to please the artist at almost any musical cost so the selection could be released. The editor might employ a gentle program of persuasion and capitulation.

Julius Chaloff has stated: "Some of these things (editing effects) were done artificially. They had to be. George Proctor would say the playing sounded dry, so I would tell the girl to extend the notes here and here. 'That's better' he would say. But I would reply, 'You didn't play it that way! Electricity travels 186,000 miles per second. You put the pedal there, or it wouldn't be there, because electricity is faster than you are.' That was my argument all the time." (Note: Actually, light travels at 186,000 miles per second, electricity considerably slower, but still much faster than the artist.)

The editing and re-editing as seen on trial rolls is extensive and fascinating. Much of it is concerned with correction of the crescendos and with separating the melody note and its coding from the rest of a chord in the same register. Because the Ampico stack was divided in two, varying suction could be supplied to notes playing at the same time if they occurred on either side of middle E on the keyboard. But notes on the same side requiring separate intensities had to be separated on the roll enough to give the expression mechanism time to change the suction level.

Although the recording pianist might have made some separation unconsciously in the playing of the melody note against the chord, it was a special headache for the editor to manage the effect without creating the impression of sloppy playing or a broken chord. In most cases the melody note is left in position and the remainder of the chord is taped one increment (termed a "square") back on the roll. This spacing is quite obvious to the attentive listener, and occasionally quite objectionable, though at tempo 85 there is only 1/13 second between the playing of the two notes, if the difference in playing the note is 1/8" of paper. Frequently the spacing is much smaller and therefore much less conspicuous.

A constantly recurring problem in fast playing was to be able to leave enough space between repeated notes for the valves to reseat and the pneumatics to work. Usually the first note was shortened to give the action time to get back into position, but if the spacing was still too close the music was rearranged. Julius Chaloff says that passages in his **Chopin F minor Ballade** recording are rearranged for this reason. It is interesting to note the great subtlety with which this was accomplished, particularly in this instance.

If the intensity coding was going to be crowded, it was necessary to use faster roll speeds to give better resolution. This was impossible on very long rolls which approached the limit of the take-up spool flanges, which in turn caused various types of roll transport problems.

**The Hickman Dynamic Recorder**

The dynamic recorder was put into operation in 1926, and gave such an accurate rendering of the intensity of nearly all the notes that the editing was not only simpler but much quicker. The dynamic sheet did not give the intensity of every note played, as three adjacent notes and several octaves were tied together and recorded on the same segment of the machine. (See *AMPICO'S REORDING PROCESS*: by Thomas E. Kimble, AMICA Bulletin, May/June 1996, p. 133, for additional detail – RP) But interpolation was easy in the case of overlapping, and for the first time it was possible to record in permanent form enough information to make a substantial improvement in the quality of the Ampico playing.

The operation of the recorder is fully covered by an article written by Dr. Hickman entitled, "Spark Chronograph Developed for Measuring Intensity of Percussion Instrument Tones" and published in the October 1929, issue of **The Acoustical Society Journal** and in a Barden interview with him which appears in "The Ampico Reproducing Piano".

Additional contacts to operate the dynamic recorder were added to the recording piano. The dynamic roll, nearly a yard wide, showed remarkably accurate measurements of the speed of the piano hammer travel for each note as it was played. Since the loudness of the piano string vibration depends almost solely on the speed of the hammer as it hits the string, precise indication of the loudness of each note was recorded.

It is easy to imagine that with an accurate note recorder and a super-accurate dynamic recorder, all the problems of fidelity would be solved. If the notes and dynamics were recreated just as the artist had recorded them, the Ampico dream of perfect fidelity would finally be achieved.

But it was not so! Dr. Hickman himself encountered the first problem on an early Model B roll recorded by E. Robert Schmitz:

"It would drive you out of the room, it was so loud! We went back and checked the dynamics over, but they were right. We finally came to the conclusion that when Schmitz was there in person, the force of his personality permitted him to use a very loud fortissimo. But if you took Schmitz away from the

piano, it was too much. We had to tame the record down because you simply couldn't have sold it the way he actually played it."

Also, Julius Chaloff has stated that the playing of the Ampico was not always successful because the artist was not present...that without a human pianist making appropriate gestures at the keyboard, the playing seemed flat and uninteresting, or even completely unrealistic. This phenomenon can be observed in today's feeble attempts to record contemporary music for roll or disc-actuated pianos without the *necessary* editing to make it listenable. For this reason, Mr. Chaloff says that he always tried (as did the other great artists) to *slightly* overemphasize the agogics, crescendos, and rhythmic expressive devices during the recording session, if it could be done without distorting the music.

The result was that, although the dynamic recorder gave the intensities and made the editing quicker and more accurate, the subjective human element was still necessary to produce a musical performance. Musicality proved once more to be too complex and elusive to reduce to cut-and-dried rules, and the Model B system only demonstrated again the old principle: The mechanism of artistry does not readily lend itself to analysis by machine.

**Conclusions**

Probably the playing of the Ampico was never significantly better than that of the artist. The editing process was too time consuming and never easy. The difficulty of working with a punched roll precluded any except the most mechanical of corrections. Consider only one roll of the thousands issued: the Schulz-Evler arrangement of the **Blue Danube Waltz** played by Lhevinne. Mr. Stoddard, in his Tuner's Convention talk of 1927, which was published in the August 1927 issue of **The Tuners Journal**, stated that this single selection contained 7,915 notes. (There is no reason to doubt this figure; but by actual count this arrangement has 1,217 notes in the treble figurations preceding the first entrance of the waltz melody.) Stoddard went on to say that 71,235 operations were necessary before the roll was first heard, and over 100,000 operations were required to bring it to completion. Editing of this roll and many of the other late classical records was the work of Emse Dawson, a fine pianist and musician.

Naturally the editor would correct slight rhythmic faults, blurred pedaling and wrong notes before the artist ever heard the roll. But these changes were insignificant ones and would add little to the actual effect of the music. Changes and corrections on a larger scale could lead to *worse*, not better results.

Julius Chaloff said, "If the artist wanted to try to change the interpretation, I would help, and skillfully you could sometimes make rough places a little better. But more often than not, you couldn't do it. Listen to the Godowsky records – the top notes of those cadenzas and passages aren't even; the note placement is very bad. But if you changed one (chord) you threw the next one off, and if you changed that you were in trouble with the next. You got in more and more of a pickle. It was like a photographer retouching a picture of a man with a big nose and a wart on the end. Naturally he could make the wart disappear. But what could you do with the nose? It was better to leave it alone. We used to say to the artists 'a little imperfection makes it sound more human.' Listen to the records – you'll hear the imperfections, there's no question of that!"

Early, Model A and Model B Ampicos are capable of reproducing the nuances of a human pianist. The mechanisms are accurate, well designed, and the intensity systems operate with incredible rapidity. Only a few pianistic effects cannot be literally reproduced, and these too may be simulated.

Modern critics do not object to machine reproduction per se; they are now accustomed to hearing reproduced music of excellent fidelity via LP's, cassettes and CD's. Unfortunately, many adverse conclusions about the quality of reproducing piano rolls have been based on erratic performances by reproducing pianos which were poorly restored, voiced and tuned. Too often such instruments are paraded in front of modern day musicologists who then become justifiably skeptical! There is certainly no shortage of poorly played and coded rolls, but neither is there a shortage of poorly restored and regulated reproducing pianos.

Another point of recent curiosity, (or animosity in the case of a few) has been the editing, because it has been incorrectly assumed that editing could easily produce a great piano technique. This was not true. Neither dubious editing nor any other spurious means could have produced such stunning pianism as can be heard from The Ampico. The Lhevinne **Blue Danube Waltz**, the Rachmaninoff performance of the Chopin **B Minor Scherzo**, Chaloff's reading of **Islamey**, or Levitski's **Symphonic Etudes** are only four of the enormous number of artistic performances available to us on piano rolls. These performances were created by the artist on the original recording just as easily as he created them in his day-to-day concert career. It is also important to remember, however, that poor editing, particularly as related to the dynamics, could convert a great performance into a mediocre one.

The piano roll editing techniques correspond to little more than modern day editing of magnetic tape masters. Artur Rubinstein admitted in an interview in the September, 1969 issue of **Clavier Magazine**, that he is generous with wrong notes, but that they were removed on his RCA releases by his recording supervisor, Max Wilcox. We have only to listen to "undoctored" discs such as the Horowitz Carnegie Hall series to realize how prevalent modern editing has become.

It was as true of RCA and Columbia in the 1960's as it was of the Ampico in 1925, as it is of the CD's today. A recording company must do the best it can with the available resources. Thus for the reproducing piano, musical veracity can be convincingly demonstrated by playing the bad rolls! There are many unrhythmical, unmusical and completely uninteresting rolls played by a host of fortunately forgotten pianists. If it had been either a general practice or even a remote possibility to create great artists out of every pianist by "silk purse" editing, these "sow's ear" rolls would not exist. Instead, all would play with the fire and style of the headliners.