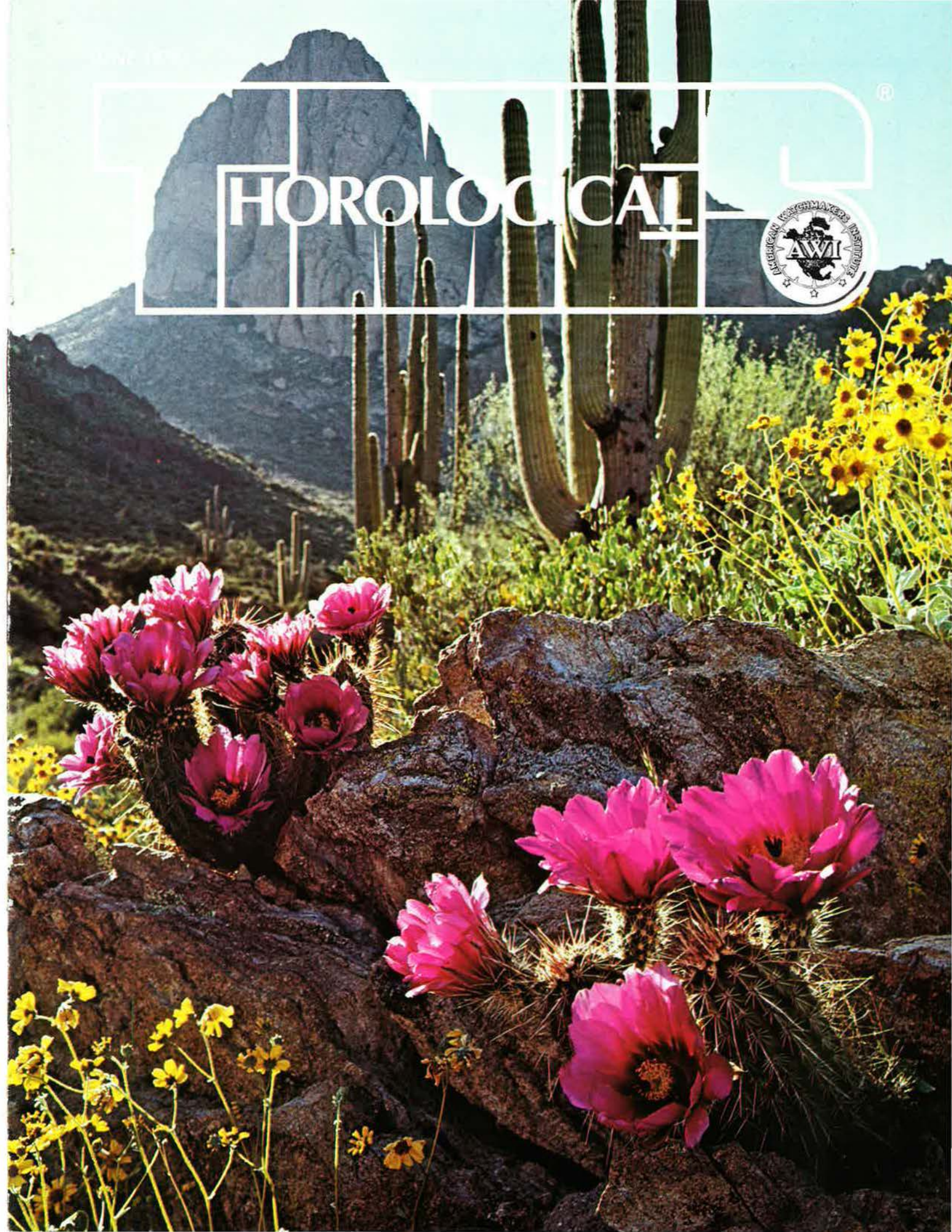
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HOROLOGICAL TIMES®

Volume II, Number 6 — June 1978

Official Publication of the American Watchmakers Institute

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EXTRAS

Editorial

When a customer enters a jewelry store to purchase an item for a gift or for himself, he approaches the shopping with happiness. Most of the time, a jewelry item is for someone close to him. A jewelry gift in itself generally indicates something special for a special friend.

When a customer enters a jewelry store for repair service, his attitude is not that of happiness. Something has gone wrong with an item generally of some value. Special tact must be displayed by the repairman or salesman in handling the situation. Patience must be utilized to hear the customer fully before comments are made concerning servicing or repair. Then the repair should be explained to the customer, even to the point of what steps will be taken to return the piece as close as possible to its original condition. Terms of warranty should also be completely directed to the customer before the repair job is accepted. Too often, when warranty terms are neglected until the item is delivered, a misunderstanding occurs which can end customer relationship for future sales.

Tact and patience in this area of our industry can complement sales. So don't approach the repair customer with the same attitude of dismay with which you may be approached. Use your personality and intelligence to build other portions of your business.

ABOUT THE COVER

The cover of the June issue features cactus and flowers in bloom in Arizona.

OUR READERS WRITE

I enjoy being a member of AWI and our Horological Times is outstanding.

Frank A. Ecker
Spokane, Washington

Thanks for sending two books I asked to borrow from the AWI Library. It's a pleasure and I benefit much from being a member of AWI.

Salvatore Cino
Long Beach, California

I attended the bench course presented by the AWI with the cooperation of the Seiko Watch Co. on April 9, 1978 in New York. Mr. Les Smith gave a wonderful and most informative presentation.

I hope you continue this program of getting the new technology and techniques to all of us who are interested in keeping up with our rapidly changing trade.

Marvin Krassner
Long Island City, New York

Without AWI truly there are times I'd not know where to turn for valued information such as you offer your membership.

Hubert L. Warr
Nashville, Georgia

Please allow me to congratulate you on a wonderful publication! The Horological Times has got to be the most informative trade publication in our field. It is so refreshing to be able to find something of value in each and every issue. Don't change anything! You have already achieved perfection. Being an avid amateur photographer I appreciate the cover photos and would appreciate a couple of extra words in regard to the exposure info, etc., if the space can be spared. The covers are marvelous. I especially enjoy the space devoted to us "black sheep" of the trade, the clockmakers. The articles such as *Inside the Clock Shop*, by James L. Tigner and *Essence of Clock Repair* by Sean C. Monk fill a need supplied by no other publication.

James W. Dowell
Dana, Illinois

CALIBRATING TIMING MACHINES © 1978

by Louis A. Zanoni

The following is additional information concerning Mr. Zanoni's recent article (April 1978, pp. 18-23)–ed.

The Canadian National Research Council, Time and Frequency Section, reports that a telephone time service is available on the normal telephone toll lines. The numbers to call are (613) 745-1576 in English and (613) 745-9426 in French.

In each of these, the voice announcement of Eastern Standard Time is followed by a marker, the beginning of which gives the time accurate to one millisecond. This is repeated every 10 seconds and the service cuts off after 30 seconds.

A time signal is also provided to the Canadian Broadcasting Corp. and they broadcast the signals across Canada at 1 PM EST on the English network, and at 12 noon on the French network.

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The Presidents' Message

by James H. Broughton

Why do we feel that customers who buy a watch or have a watch repaired are any different from a customer who buys a new car or has one repaired? The watchmaker or jeweler did not make the watch, the same as your new car salesman did not make the car.

If you return your new car to the dealer for repair, who pays? I can assure you that the dealer seldom does; it usually is the motor company who made the car or the customer who bought it.

There is no reason why the watchmaker or jeweler should absorb repair charges that are warranty repairs. What would happen if every watchmaker and jeweler in the United States were to send all watch warranty work back to the company which made the watch? I can tell you one thing: after a while there would be some changes made. The factories could then get a good picture as to the quality of watches they were making. Or, they may find that their quality control is not up to par. Now may be the time for all watchmaker associations and retail jewelers associations to begin thinking about some sort of program along these lines.

With everything we look at rising in price, it becomes more difficult for the jewelry business to make the profit necessary to keep the doors open. Expenses are unavoidable, but some can be controlled; maybe this could be one of them. In-store service for warranty work is service that should be the expense of the manufacturing company.

Let us look at a few figures; maybe this will give a better idea about what is being said. A watchmaker making an average salary of $12,000 to $15,000 a year is asked to take care of warranty watch repair work. You will probably ask the watchmaker to take 25% of the working day or year for warranty work. Now you can plainly see this will figure about $3,000 to $4,000 a year. Now we are talking about some money.

This is just food for thought. Who knows, maybe in a few months or years we may see this as being possible.

Hope to see you at the annual AWI meeting later this month.

James H. Broughton

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Storage temperature:	−20°C - + 70°C
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Temperature coefficient in the range 0°C to + 60°C:	<5 x 10^{-7}/°C
Aging:	<3 x 10^{-6}/a
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AWI NEWS

By Milton C. Stevens

MATERIAL DISTRIBUTORS AID AWI MEMBERSHIP

Each year watch material distributors across the country aid the American Watchmakers Institute in our drive for new members. Membership is the key ingredient in any organization which derives its income from members' dues; this is true of the American Watchmakers Institute. The more members we have, the more income we have; this results in more programs and benefits for those members.

We have designed a new membership brochure which will be used as stuffers by a group of cooperating watch material distributors. We salute these distributors for their efforts and ask that you support them with your patronage. The cooperating distributors are:

Aguilar Jewelers Supply, San Diego, California
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A specific example.
The Fabrique d'Horlogerie de Fontainemelon created a calibre, the 96 Standard – and sold 90 million of them, worldwide. Can you imagine anything surer than that?
Then one fine day, the first quartz watches appeared. The Swiss are very careful, we know that. So they eyed this new development with a certain skepticism, but with a certain interest as well. Because one of the first questions that a Swiss will ask in such a case is: "How can we make it better?"

The 96 Standard calibre is used in 90 million watches. The 11½‴ 960 Standard Quartz was designed to top that record.

Right then, he starts thinking about it.
Then he acts. He makes some trial runs, he keeps improving and improving – until he is finally satisfied with the result. That's the kind of approach it takes to make a calibre which is already used in 90 million watches. And, on the strength of that, to create a new quartz calibre:
The 11½‴ 960 Standard Quartz.
It took some waiting? Well, yes. That's the very reason it will go so far.

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Essence of Clock Repair

by Sean C. "Pat" Monk
CMW

THE MORBIER

Part XXXIII

The name *Morbier* was derived from the city of that name situated in the French Jura region near the Swiss border. The people of this region were farmers and ironworkers; therefore, it was not surprising when, along with the manufacture and repair of farm equipment, they branched into the manufacture of clockworks having iron parts. Naturally the Morbiers were made with iron components and iron movement cases. In addition, much of the work was hand forged. As far as we know the Morbiers were first manufactured during the reign of the French monarch Louis XIV, around 1660. Since that time they have been made with production ceasing during the first World War. Today, however, Morbiers are back in production on a limited basis in France.

The name of the clock, Morbier, is in correct usage. However, the term Comtoise is more commonly used on the European continent. The term *comtoise* was probably derived from the French word *compteur* (feminine, *compteuse*) meaning one who counts. The morbier, or comptoise, does indeed count the hours. Not only does it count the hours once, it performs the ceremony a second time on a sharp bell within approximately two minutes of the first sounding. This repeating hour was arranged probably as a loud reminder to the farming people that the time had come to perform a certain chore. One hears the term monastery mentioned in relation to these clocks. The double hour strike perhaps was a reminder to the monks that the time had come for certain prayers; however, there is little in history to support this surmise.

As mentioned, in construction many of the parts were hand forged in iron, the wheels generally being made of brass. The typical French dials consisted of porcelain on brass; however, ceramic materials and pewter have also been used. The dial numerals were generally done in Roman lettering, somewhat raised or embossed, and known as *cartouches*, from the French noun meaning escutcheon, or shield. After 1840 the headpieces, called *couronements* (as in a crown or wreath) were usually brass and repoussé. The term *repoussé* means pushed back and/or out. This seems like a good description of the pushed in and out crinkled effect of so many of the Morbier headpieces of the period. After 1840 the pendulums were also often brass and repoussé.

The oval design, as in our clock shown in Figure 1, was very popular for the headpiece, or couronement. However,

Figure 1.

a considerable number of motifs and designs were used through the years, not only for the headpieces, but also for the pendulums. After 1840, the latter (as in Figure 1) were usually lightweight but large, the pendulum bob diameters ranging from approximately 8 to 15 inches. One reason why so many rural scenes and characters were used as motifs for the headpieces and pendulums may be that this was originally a provincial clock. Harvest scenes were certainly very popular, while other headpieces bear the French monarchial *fleurs de lis, la soleil* (the sun) in extravaganza, religious motifs, courtship, flowers, hunting scenes, eagles, roosters, and many animals, etc. However, it should be remembered that the large, fancy repoussé brass pendulum did not come into being until about 1840.

Because the Morbiers have been manufactured for over 300 years, it is often hard to date them. The one-handed variety was of very early manufacture, the minute hand not

being added until sometime after 1700. Most of the nineteenth century Morbiers have the maker's name and/or his town or location on the dial. Before this time the clock dials were usually unmarked.

In Figure 2, it will be observed that the clock's suspension is in the front and set over a large hour wheel. At the top left of this photo it may be observed that the

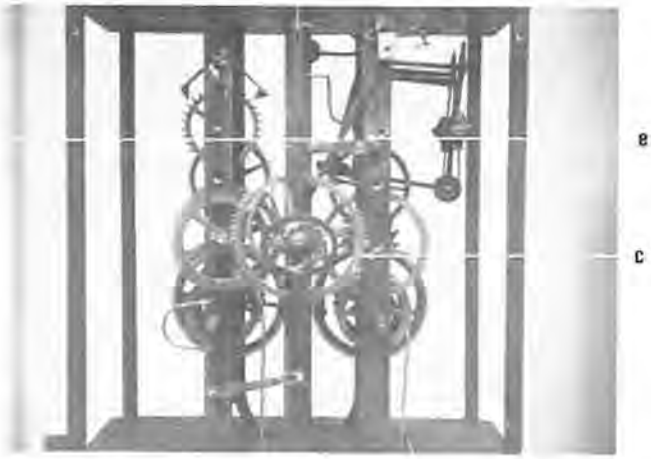

Figure 2.

escapement is virtually square recoil. For a simple explanation let us say that the axes between the pallet points of entry and the pallet and escape wheel centers approximate a square.

The inside face of the entry pallet and the outside face of the exit pallet are flat and at right angles to the pallet arms. Only the outside face of the entry pallet is slightly curved to permit the necessary recoil. The arrangement is a near perfect anchor recoil, using a standard 31-toothed escape wheel embracing 8½ teeth. With this arrangement, working with a correctly calculated time train, we have established a one-second pendulum beat. Earlier Morbiers were not so fortunate in having this anchor recoil, as they were built either with a pin wheel or a crown wheel escapement, neither of which compared with the recoil anchor for efficiency. For the record, however, the anchor escapement itself was not in use within the Morbier until after 1850. Our particular clock can therefore be dated somewhere between 1850 and 1900. The dial is marked *Bonhomme à Condom,* which is most interesting inasmuch as in translation it means "good-natured man." Therefore, we must assume that in English his name would be just plain Goodman. Condom is undoubtedly the name of his locale at the time of manufacture. However, to further research this, or any other combination having such dial markings, presumably it would be necessary to study the *Dictionnaire des Horologers Français* (Dictionary of French Horologists) which was published in two volumes in 1973.

A point of interest to all is that, for the most part, these clocks were sold by *colportuers,* clock peddlers, who took them on horseback and on foot around the countryside

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without cases. Cases, if required by the purchaser, were made locally by the cabinetmaker of one's choice. Otherwise, they were simply hung up as is. Why not, of course for with their repoussé headpieces and pendulums they were not only attractive, but the subject of much conversation and envy. Sometime after 1860 when the railroads of Europe were

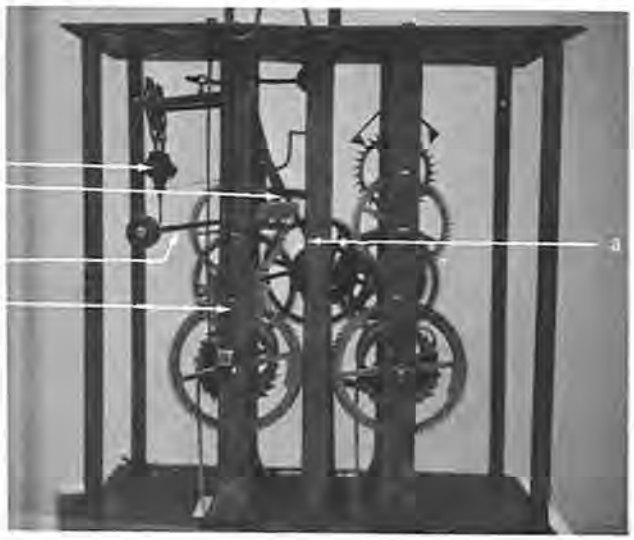

Figure 3.

developed and when the Scotsman, Macadam, had introduced the macadam (tarmac, or tarred) roadway, many later Morbiers became enveloped in woodwork. Whether this transition was beneficial from the esthetic standpoint, or otherwise, is certainly a matter of personal opinon.

Our particular Morbier, by *Bonhomme a Condom,* is keywound both for the going time and for the strike mechanisms. The key is used to wind the two weights of approximately 11 pounds each, onto the two barrels provided for

(Continued on page 44)

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In the Spotlight

by Orville R. Hagans

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THE GEBHARD ASTRONOMICAL AND WORLD CLOCK

by J.E. Coleman and Mrs. Josephine Hagans

From the Manuscript and Photo Library Orville R. Hagans, CMW, CMC, FBHI

A Technical History of One of the World's Timekeeping Masterpieces

Christian Gebhard, maker and builder of this clock, gave it that name. For the personal background and history we are indebted to material compiled by his eldest son, R.L. Gebhard, now deceased.

Christian Gebhard was born June 29, 1829, in Ruchsen Baden, Germany, and here spent the early years of his life–as his father was a shepherd of small means. Young Christian got much of his education out of the "book of nature" around him and what his eyes beheld in the heavenly dome, studded with stars above him; this went far toward implanting things in his mind and heart to be taught to the world by his efforts in later years.

The common school was all his parents could afford, and even that was cut short by the early death of his father, leaving a widow with eight children. By strict economy, the widow, with the assistance of Christian, her eldest, then only fourteen, managed to rear the family on the old homestead. To assist his mother, young Christian was apprenticed to the village smithy.

Four years later, when the second brother had reached the age to be of assistance to the mother, young Christian left home to seek more lucrative employment. After traveling over a good part of Germany and Switzerland, he finally located in Marseilles, France, taking up the watch and clock making business. Feeling a great need for more education, he put his mind and muscle to work at every spare moment and late into the night, delving into his favorite subjects of math and astronomy. By these untiring efforts and self study he made such progress that later he was employed as a professor in one of the universities of Marseilles.

It was here that the ideas were born for building a clock useful in teaching young minds astronomy and science. He served as one of the faculty of the school in Marseilles until 1870.

During these fifteen years he also made numerous astronomical appliances, planetariums, etc. and presented them to various schools of learning. From the making of these various instruments he became well known throughout Europe.

He did not stop with these separate and distinct astronomical instruments, as he felt he could create a combination of scientific mechanical movements that would at once give many astronomical facts and their relation to our time as well as compare our reckoning to sidereal time, etc. So, in the year 1865 he commenced a task which required thirty years of hard and patient labor to complete–the Gebhard Astronomical and World Clock.

Faithfully he worked upon his ideas from 1865 to the outbreak of the Franco-Prussian war in 1870. He along with his wife and three children–two boys and a girl–were forced to return to their native land. After having spent a short season at the home of his youth, he settled at Aglaster Hausen, in the same state. Here Mr. Gebhard embarked in the jewelry business and clockmaking, continuing to work on his astronomical clock.

In 1878 his eldest son, R.L. Gebhard, also a clockmaker, began to assist the father and together they labored until 1880. Then, the younger son, L.K., was enlisted and the three labored together until its completion in 1895.

Honors were bestowed upon Christian Gebhard, by the government. For four years, with his wife, he traveled all over Europe to display the results of his life's labors. In November of 1899 he passed away to his rest from this busy life.

In 1900 the eldest son, R.L. Gebhard, brought the Gebhard Astronomical and World Clock to his home city, Louisville, Kentucky. Thus ends the record he (Mr. R.L.) left to us.

Describing a wonderful and complicated clock, like the Gebhard Astronomical and World, (Figure 1) imposes a unique if not grave responsibility simply because it has been written up perhaps a hundred times in the past 70 years. In this instance it is hoped that a more vivid as well as detailed picture will emerge. Apparently, former writeups were by "inquiring reporters" after a brief interview or a quick look-see at it while upon exhibition. We hope to correct some former

Figure 1. Front view.

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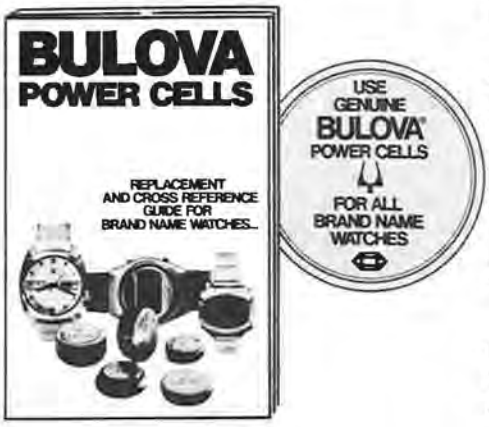

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errors as well as mention points neglected or overlooked.

There were some "press notices" but apparently the first full article in the USA appeared as a "cover story" on the front page of the Jewelers' Circular, for April 8, 1903—no by-line. One of its gross errors comes in the second paragraph, " . . all ingeniously propelled by one weight,"—oddly enough, it has been repeated in many subsequent articles, in one national publication as late as 1955.

The cold facts are that instead of being driven by "one" weight, the various divisions of this clock are propelled by several weights and mainsprings. There is one mainspring for the crowing cock: wound once weekly. One spring for the Bugler—one winding will announce New Year for ten years. There are two auxiliary springs driving the big globes—wound once weekly. The calendar has a spring that must be wound once per month; there are two additional springs on the Chronological Cycles and the year of the calendar; plus five large weights that require daily winding and two counterweights that have to be unwound weekly, one on the Apostles carriage and the other on the calendar. A grand total of 14 separate drive powers instead of "one weight."

The clock is encased in a massive quarter sawed oak case that stands ten feet high, ten feet wide, and three feet deep. There are 26 separate and distinct mechanical and astronomical movements made up of thousands of parts. With the exception of the striking mechanism, these movements are so constructed that the hands, indicators, or step actions all move forward at once at the end of every thirty seconds.

The precise origin of the mechanical clock is lost in antiquity: it is logical to assume that its creation was born of man's desire for a more accurate way of keeping and recording time as he (man) had observed the apparent motion of the stars and the sun for many years. No doubt among the first problems of early timekeeping mechanically was that of an "even" or constant driving power. No sooner was it solved by application of the descending weight than the converse, i.e., an uneven work load became just as big a problem—to this day, clocks of a high order of precision perform no other function but timekeeping because if the hour strike or other periodical work were added, it would create an uneven work load. It is most interesting to observe how Christian Gebhard devised mechanical means whereby his clock could carry many additional weight loads and impose almost no additional work upon the timekeeping mechanism. He simply constructed a separate train mechanism to do the work of operating and for performing the different things he wished his clock to show, keeping that device to the correct time by having it controlled by the clock (timekeeper) proper.

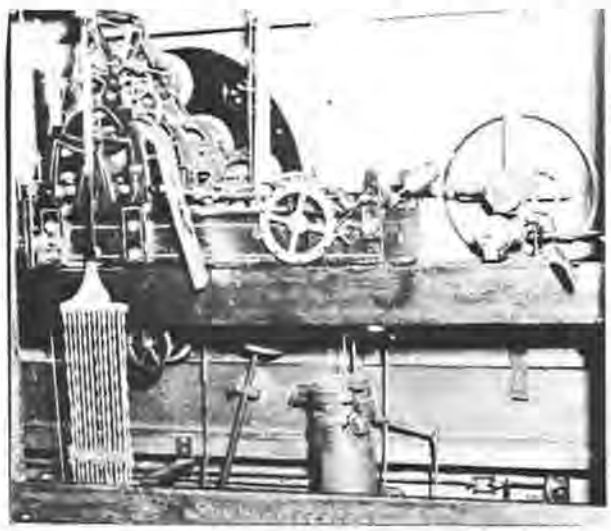

Figure 2. Right section main frame (from back). Hour strike train at right end—clock is directly back of pendulum.

Basically, the clock is the flat bed type. (See Figure 2). That is, built upon a table-like frame. After the fashion of the flat bed tower clocks, this bed is 37 inches long, allowing for approximately a seven-inch clearance between frames. The timer portion is located near the center; at the right as one views it from the back, is the strike and chime train, and to the left of the timer is the big drive train.

The clock (timer) is fairly "standard"—has a Royal or seconds beat pendulum, a thirty tooth escape wheel giving one complete revolution of the escape arbor with sixty beats (60 seconds) shown in the front view photo (Figure 1). In the very center is the "main" (meantime) clock dial, surrounded by nine smaller dials with a slightly larger dial just above the XII; this is the seconds bit and the seconds hand is mounted directly upon the end of the escape wheel arbor.

On the escape arbor—between the plates, is a double, 180 degree cam; riding this cam via a polished, round pin, is a small lever free to drop by gravity every thirty beats. Refer to the sketch (Figure 3), let off drive mechanism, pin 1.

The big train drive is held inactive by a "butterfly" let off escapement, so named because its stand-up pallets resemble the wings of a butterfly at rest. As shown by the sketch, one cam has already raised the lever almost to the drop point while pin 2 holds the let-off by the pallet A-1. At the next tick, pin 1 will release the lever; as it drops, pin 2 is carried down the face of pallet A-1 and below it allowing the butterfly pallet to revolve clockwise until the face of pallet B-2 comes to rest against pin 2. The gravity lever is now being raised by the next cam; as pin 2 travels up the face of pallet B-2 and beyond its end, another slightly forward motion of the butterfly escapement is had as pallet B-1 comes against pin 2—again the lever drops, permitting another half turn; coming to a lock-rest against pallet A-2. Thus, the cycle is repeated every thirty seconds advancing all the hands and indicators, etc., with only the additional load of the small gravity lever upon the timekeeper.

The clock shows and keeps four different times: Mean Time, Solar Time, Star (Sidereal) Time, and Decimal Time. Mean Solar Time is the universally accepted system of the world. All our clocks and timepieces are made to run upon this basis; twelve o'clock on tomorrow falls on the same second as it did today. Solar Time or Sun Time is too irregular for daily use, as it loses and gains during the year—as much as thirty-five minutes and for that reason no timepieces are set by it. Four times in the year only is Sun Time the same as our Mean Time, viz., April 15, June 15, Sept. 1, and Dec. 24. Upon all other days, it is either faster or slower than our Mean Time.

Sidereal Time or Star Time advances daily over Mean Time three minutes, fifty-six and one half seconds, and as each and every day is that much longer than our Mean Time day. The year calculated by this system has always the same num-

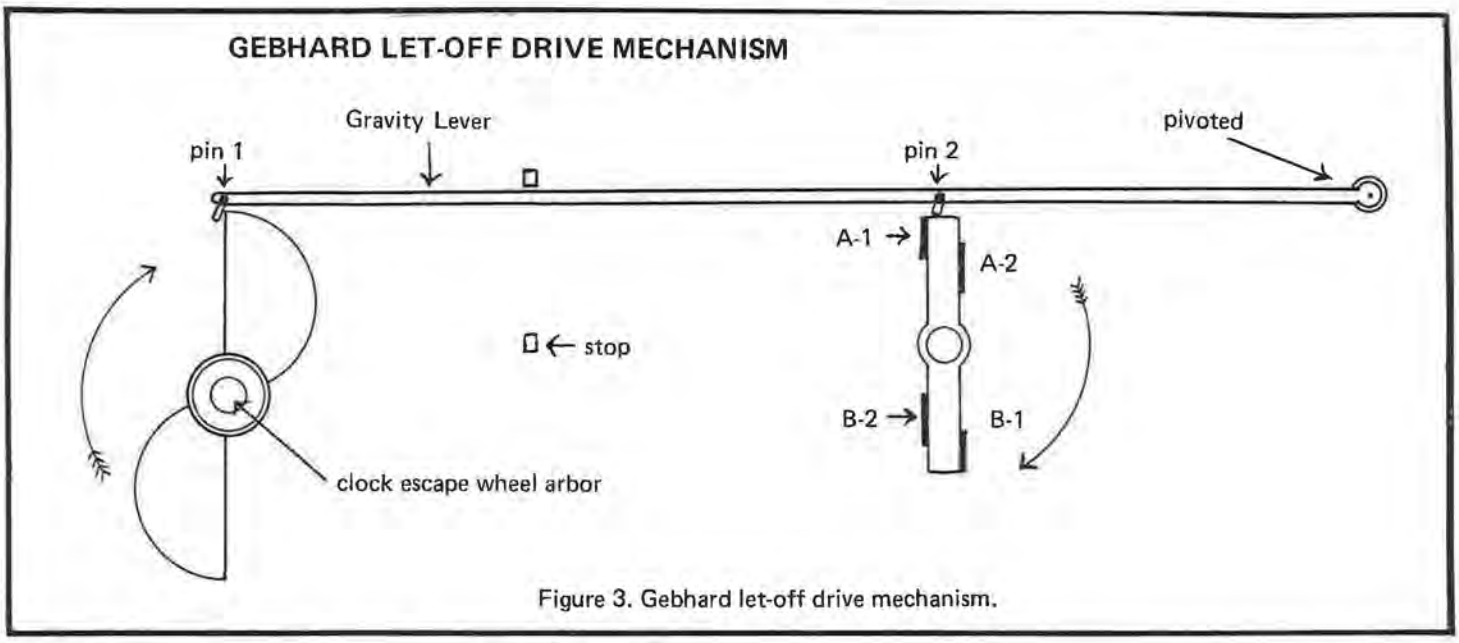

Figure 3. Gebhard let-off drive mechanism.

ber of days, 366, whereas Mean Time divides it 365 days, 6 hours, 9 minutes and 9 seconds, necessitating a leap year, or one more day every four years to make it correct. The Sidereal Time dial appears in Figure 1, left of center dials.

Decimal Time, at one time considered more practical than our Mean Time, largely because it eliminated AM and PM, is calculated on 100 seconds to the minute instead of 60; 100 minutes to the hour and twenty hours to the complete day. The dial (Figure 1) right of center dials runs from one to twenty. It originated in France shortly after the Revolution and was vigorously advocated by some of the prominent horologists of the day. No doubt Mr. Gebhard became familiar with arguments for it while in Marseilles.

In the very center of the front of the clock is located the Mean Time dial circled by nine slightly smaller dials showing the time in nine principal cities of the world. At the top or XII position and a little above the nine dials is located the seconds dial.

On the right side and outside the case proper is a large globe with an earth map–driven on its own axis–west to east, one revolution every 24 hours. A band or scale, placed along the equator position, shows the time at any point on earth any instant you choose to look at it, and shows the correct position of the earth to the sun.

On the left side is a matching globe with a star and constellation map. This globe also revolves in 24 hours, but from east to west, or just the reverse of the earth globe. It is driven on Sidereal Time and so gains three minutes, 56½ seconds, daily on the earth globe.

At the center of the lower section of the clock there is a perpetual calendar showing the day, the date, month and year, changing automatically at 12 o'clock midnight to the new day and date, and the changes at the end of the month and end of the year. Leap years are designated at the proper time, when February 29 follows February 28; on other years the following date automatically comes up March 1 (Figure 4).

On either side of the calendar, the following chronological cycles are shown: Golden Number, or Lunar Cycle, Epact, Roman Indiction, Solar Cycle, Dominical Letter and

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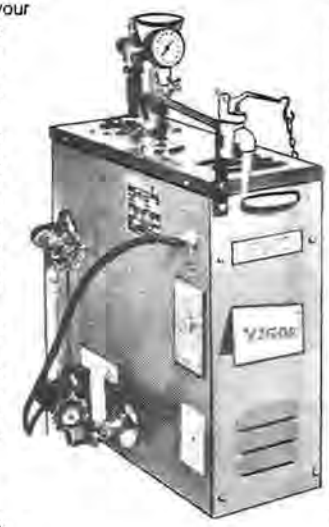

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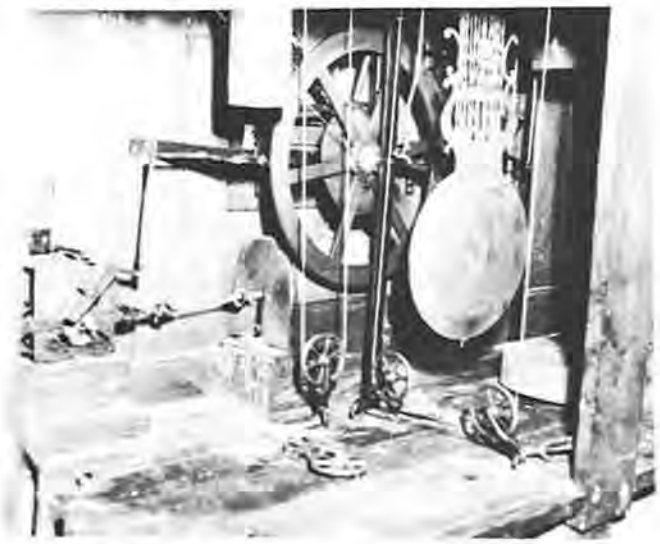

Figure 4. Inside case floor: showing pendulum and calendar gearing; main wheel: 14¾ in. diameter.

the variable Easter date (month and date). As an index to many not familiar with the chronological cycles, the following will be of interest. The Golden Number or Lunar Cycle is a period of nineteen years. For instance, if the full moon should appear on January 1, it would not occur again on the same day until a lapse of nineteen years, in which case full moons would again occur on the same days in the same consecutive order as they did nineteen years before. Also the eclipses of the moon would all occur in the same relation as nineteen years before, to the day, the date, and the minute.

The recurring of these changes is designated as the Lunar Cycle or Golden Number. Golden Numbers so termed by the Greeks were introduced into the calendar about the year 530—calendar makers give this rule: "add one to the date (1965), divide the sum by 19, the quotient is the number of cycles elapsed and the remainder is the golden number for that year." In 1965 plus 1, 1966 divided by 19, gives elapsed cycle of 103 and a remainder of 9—the Golden Number for this year.

The Solar Cycle is a period of 28 years, after which the days of the week again fall upon the same day of the month as during the first year of the previous cycle; thus, if January 1 falls upon a certain day of the week and consecutive days follow on certain days these same dates will not again follow on the same days and in the same order until a lapse of 28 years. The simple rule applied here is: from February 29, to the next February the 29, is four years—known as the intercalary period—times the seven days of the week, 4x7 = 28; twenty-eight years is therefore a period which includes all the possible combinations of the days of the week with the commencement of the year. To ascertain the Solar Cycle for 1965, add nine; divide by 28; a quotient of 70 is obtained denoting the number of cycles with a remainder of 14 which is the Solar Cycle for 1965.

The Dominical letter indicates the date on which the first Sunday in the year fell. For instance, if the first Sunday in the year fell on January 1, the Dominical letter for that year would be A; if it fell upon January 2, the letter would be B, etc. The first Sunday of 1965 fell upon January 3, so the Dominical letter for 1965 is C. Leap years are shown by two letters (double) until February 28, when the second letter is dropped and the last one is used for the remainder of the year.

The Roman Indiction was a period of fifteen years appointed AD 312 by the Emperor Constantine for the payment of certain taxes (*A History of Watches and Other Timekeepers* by J.F. Kendal). Being obsolete, it has very little use save in some instances it may be an aid to calculating certain historical facts dated by or with the Indiction.

Here, we come to what is perhaps the most used feature of the odd portions of the calendar; Easter Sunday, as we all know, falls on a different date each year, and it is calculated as the first Sunday after the first full moon occuring after the spring Equinox (March 21). In 1965, the first full moon following the spring Equinox was Thursday, April 15, and the following Sunday, April 18, was Easter. At midnight December 31, when the clock's calendar changed to January 1, 1965, all the chronological cycles changed and the Easter window read April 18.

Lest these brief descriptions seem tedious, we point out that it is necessary for a basic understanding in order to appreciate the tremendous amount of work Mr. Gebhard put into the construction of the calendar portion of this

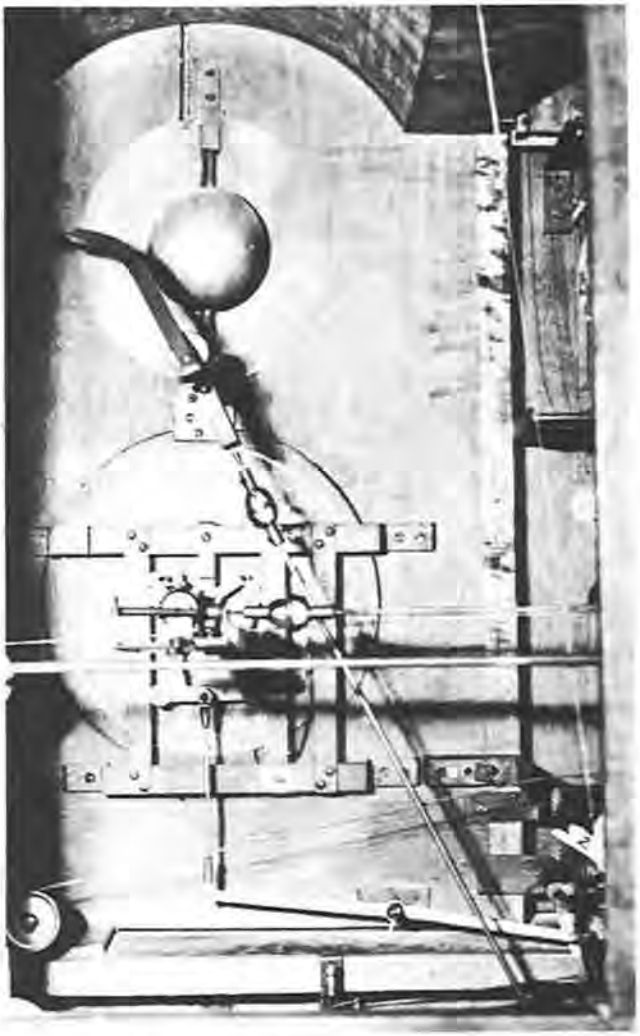

Figure 5. Top: Moon. (Back view). Lower: Sunrise—Sunset control.

clock; remember that each and every one of the calendar devices is driven by toothed gears, actuated by the drive mechanism and accurately timed by the clock itself. Every gear had to be of a precise size, have the exact number of teeth, then, be actuated the correct number of times by the clock to make the calendar function perfectly. We moderns in our everyday life find very little use for many of these calendar features, but they are necessary to calendar makers and of exceptional aid to historical researchers since by these features certain very ancient dates may be related to our calendar and dates, despite the many changes in the calendar over the years. The grand or overall cycle of our calendar is a four-hundred year period from one Great Leap Year to the next; Gebhard's calculations and mechanisms completely cover that period and thus only require human attention and correction once every 400 years. Being both a researcher and an astronomer, Mr. Gebhard must have wished his "Astronomical and World Clock" to show at a glance these various dates and cycles.

The moon, located on the upper right of Figure 1 is portrayed by a small globe sunk within the dial to the halfway point; one half (180 degrees) of this globe is black and the other half gold. As the Moon starts to rise a little streak of the gold side appears, next day a tiny bit more and on until at exactly the right date, the full gold side will announce "full moon," then it diminishes daily until the next New Moon. The moon globe revolves upon its axis once in 29½ days.

Just beneath the moon dial is the Sunrise-Sunset dial, Figure 5, which correctly shows every day the hour and minute of sunrise and sunset by two pointers or hands; thus the scale between these two hands shows the length of that day, etc. While this is crystal clear and needs no further explanation, the mechanism is quite complicated and required many, many hours of calculation and hard work to perfect it.

Opposite the moon at the upper left in Figure 6 is a standard barometer; it is the aneroid type merely actuated by pressure changes, naturally not connected in any way with the clock or its drive mechanism.

Just below the Barometer is a small Planetary System portraying the sun and the first six planets. According to the information left by Mr. R.L. Gebhard, it was this feature of the clock which required the most work and consumed the most time. Christian Gebhard made and remade it or various parts of it with tireless patience at least one hundred times over a thirty-year period until it correctly showed the heliocentric movement of six planets. The sun at the center (Figure 7) turns upon its axis once every 25½ days. Then Mercury makes her trip around the sun in 87 days; Venus in 225 days and the Earth revolving in 365 days, 6 hours 9 minutes and 9 seconds; March in 686 days; Jupiter in 4,332 days (11¾ years); and Saturn making its trip in 10,759 days or 29½ years. Each planet is shown in its relative size and by making its

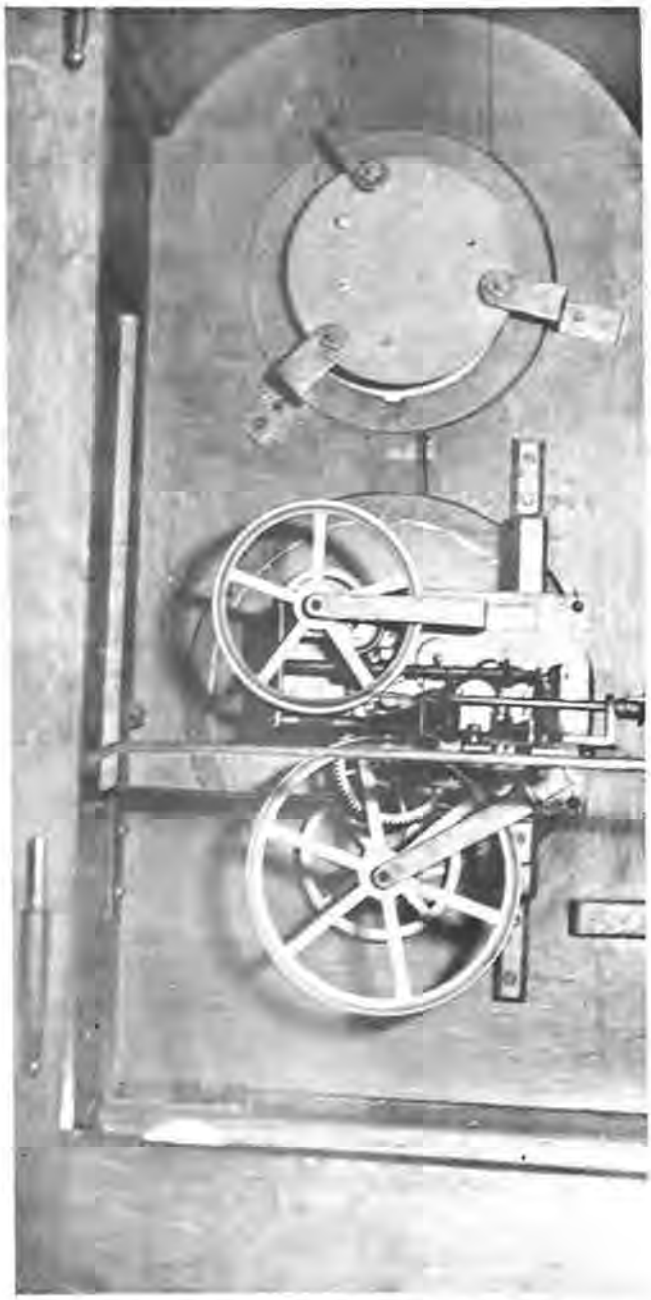

Figure 6. Top: Barometer. Lower: Planet system gearing.

orbit about the sun in precise time, therefore always maintains its correct relationship to the position of its sister planets in their course about the sun. On the planet dial's outer edge are the twelve signs of the zodiac so that a hand or pointer indicates at all times the position of the sun's path in the zodiac belt of the universe. The accurate working of this single

(Continued on page 44)

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Questions and Answers

by Henry B. Fried

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GLASS CRYSTAL ALTERATIONS

Q. Can you tell me if instructions on grinding glass crystals are available? I have never seen a published article on this subject.

On occasion I have needed to grind an available glass crystal *slightly* to fit a case; at times a slight nick on a glass crystal could be ground off and the crystal used. Clocks, too, with *beveled* glass sides, need altered or fitted new glass. This is something that has received little or no published attention, as far as I can ascertain.

Are there *any* elementary instructions on proper equipment, methods and techniques to be used in grinding glass watch crystals and beveled clock glass available? Can you recommend other sources to contact on this subject? Your answer will be sincerely appreciated.

William G. Kavanagh
Farmington, Connecticut

A. Today, few people grind watch crystals or clock crystals; plastics seems to be the word. However, we used to do much of glass fitting years ago and very old repair manuals or articles did carry some items on the repair or "adjustment" to size.

A simple way in which you can still cut a glass crystal to a watch's round bezel to make it fit. . . . . that is, make it slightly smaller, is to take two of those vacuum cup darts that get shot out of an air gun. Mount one (the cylindrical part of the vacuum stick) into a lathe chuck. Center up the crystal while it is under the moistened vacuum cup. Then, mount the other point of the stick of the second vacuum cup so that its point rests in the female taper of a tailstock. Bring the tailstock up to and close to the headstock so that this vacuum makes contact with the other side of the watch glass. Then you can use a carborundum stick or india oilstone stick whetted and grind it down while the lathe spins. My sketch below should help.

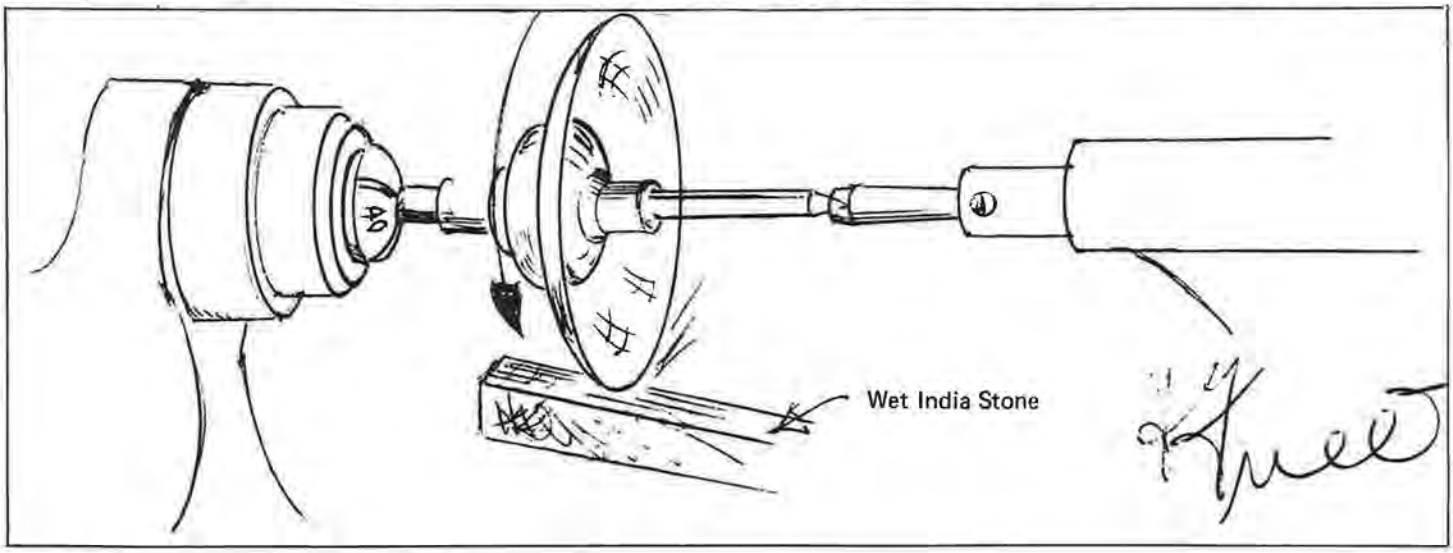
Other methods use shellac or wax warmed to adhere to the glass and the glass centered while the lathe slowly spins with the warmed glass held partially by the plastic (yet) wax, allowing it to harden when and while the lathe and glass slowly spin and guided to remain concentric.

As for beveled glass, I had better turn you over to that fine instructor, Jerry Jaeger, as he is an expert on beveling glass and can tell you better than I.

(The following response was provided by Jerry Jaeger.)

Your letter was referred to me by Mr. Henry Fried to answer your inquiry as to the beveling of clock glass.

You ask about equipment and technique. Unfortunately the equipment required makes it practically impossible for the watch and clock repairman to fabricate a new



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City _____ State _____ Zip _____

beveled clock glass from glass stock.

It will be difficult to give you a brief description of how a glass is fabricated, but I will attempt to in as few words as possible.

Step. 1. Rough out bevel–this requires a high speed, flat soft iron horizontal wheel fed with a mixture of water and fine grained carborundum as the grinding abrasive.

Step 2. Refine bevel–this requires a low speed fine finish flat stone, horizontal wheel with an ample water supply as a coolant.

Step 3. Rough polish–this requires a vertical cork flat wheel turning in pumice and water.

Step 4. Finish polish–this requires a flat vertical *felt wheel dressed with a black rouge suitable for polishing glass. This felt wheel must also be kept wet to avoid heating of the glass.*

Step 5. Trim and fit–this requires a flat vertical or horizontal fine stone wheel. This wheel would be similar to the type we use in fitting glass watch crystals to a bezel.

The only alternative to this seemingly crude method is to obtain highly sophisticated automatic equipment. I'm sure you are aware that these types of glasses do not lend themselves to mass production methods. The bezels they are being mated to are seldom concentric and in most cases, the glass requires considerable trim to fit properly.

Time permitting, I will at a later date do an in-depth article in Horological Times *on custom beveling, including tips on how the bench man can help himself.*

Sun Dial

Q. Enclosed you will find a picture of an 18 size 7 jewel Sun-Dial pocket watch. We would like any information that you

could give us as to the date and maker and so forth. On the barrel plate, it has written Sun-Dial USA, Serial number 7482877, Case number 74162.

Leon C. Payne
Lubbock, Texas

A. The Sun Dial Watch was an inexpensive product of the Elgin National Watch Company. Your watch was made in 1897, and is listed as a Grade 178, 18 size full plate, hunting, nickel case, 2nd to 4th model, seven jewels.

These were mostly made to satisfy the catalog and mail-order houses of that time. It is a regular Elgin model.

Suggested Price List

Q. I enjoy your most informative articles.

Where can I get an updated "Suggested Minimum Clock Repair Prices" that the Michigan Watchmakers Guild put out several years ago?

Their prices seemed to be the most fair to the customer and the clockmaker.

Joe Verunni
Wayne, Pennsylvania

A. The Michigan Watchmakers Guild does have a complete new set of suggested minimum 1978 price cards, *covering retail and trade watch repair, clock repair, grandfather clock repair and retail jewelry repair. There are five cards in all, printed on different colored fine cardboard, for ease of identification. The set costs $5.00 and is a bargain. We don't try to operate without it. Write to Michigan Watchmakers' Guild, Inc., Suite 201, Greenfield Plaza, 21700 Greenfield Road, Oak Park, Michigan 48237.*

(Answer provided by Sean C. (Pat) Monk.)

Clock Theory

Q. I would like for you to recommend some books that I can study to improve my theory understanding.

I wish to take the certified clockmaker's test in the near future. Any information you can send me will be much appreciated.

H.E. Keithley
Bel Air, Maryland

A. For the theory or deeper technical parts of horology, especially clockmaking, I would highly recommend that you obtain all of the articles in the AWI's Horological Times *authored by W.O. Smith, Jr. on clockmaking. Read them again and again. They are very fine and well to the point. Also, read Mr. Tigner's articles in the same journal.*

For other studies, obtain the following books: The Science of Clocks and Watches, *by Rawlings;* Horology, *by Haswell;* Watch and Clock Escapements, *by Gazeley; and* Watch and Clockmakers Handbook Dictionary and Guide, *by Britten.*

As for studying for a certified certificate in clockmaking, write to the AWI and tell them that you plan to apply for certification. They will send you the prospectus and how to prepare for it and suggested reading.

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Inside the Clock Shop

with James L. Tigner

CMC

REPAIRING WOODEN MOVEMENT CLOCKS

Part 2

Traditional clock cleaning solutions, whether water or petroleum based, were never formulated for cleaning a wooden movement clock, any more than they were for cleaning a fine old Windsor chair. And as we learned in last month's article, neither was soap and water. From time to time clockmakers have tried a mixture of turpentine and linseed oil but usually report that, while it cleans fairly well, it leaves critical areas like pinion leaves, wheel teeth, and pivot holes sticky.

So over the years the method most commonly used has been dry cleaning. It's safe, and it's simple. All that's required is to peg out the pivot holes and brush off the rest of the clock. A stiff watch brush is used, with particular attention paid to pinion leaves and wheel teeth. However, in spite of vigorous brushing, there usually remains a thin skin of black grime on the teeth and leaves, which accumulates from dust, the attrition of moving parts, and the oily vapors that are a part of kitchens and heating systems.

This black deposit seemingly has little effect on the running of the clock, and most clock repairers ignore it. It can be scraped off with a bench knife if so desired, but scraping off every tooth and pinion leaf in the clock is a time-consuming job.

Some 10 or 12 years ago George Davis of Delmar, New York, a good friend and a master clockmaker, introduced me to his method of cleaning wooden works clocks. I've been using it ever since and would like to share it with anyone who would like to give it a try.

He uses a commercial clean and wax solution designed for use on hardwood floors. There is a number of such preparations on the market, all of them containing a petroleum solvent, but each varying in the amount and kind of wax used.

My personal preference is Bruce Deep Cleaner for Wood, which contains only a small amount of wax. In the New York State area, nearly all hardware stores carry it. It does a fantastic job of cleaning and reviving old wood, particularly where the clock has been mistakenly greased or oiled. Yet it must be considered faster even than the old dry cleaning method since, at the same time, it completely removes the black build-up on wheel teeth and pinions, and flushes out pivot holes, which reduces pegging-out time.

Even though the amount of wax in the preparation is small, it's not a bad idea to do all the gluing jobs before cleaning. There may be just enough wax to temporarily affect the bonding surfaces.

When all is ready for cleaning, pour about a half cup of the solution into a bowl. To apply the cleaner I use a 1-in. wide, stiff bristle, oil painting brush available at artists' supply houses, but just an ordinary, narrow paint brush will do. Most of this stuff has naphtha in it, which I'm not keen about having on my hands. Thin rubber gloves are a good precaution.

Brush the cleaner over one plate at a time, spreading it around lavishly, daubing it into the pivot holes to flush out the dirt. Before the plate can dry, wipe it off with a clean rag. This will leave the plate clean as a whistle. Peg out the holes. Give the plate a final brushing with a stiff watch brush, which will bring out a soft sheen and leave the plate dry and hard. Do the same with the other plate.

Next, apply the cleaner to the wheels, pinions, and the rest of the parts, doing no more at a time than can be wiped off and brushed before drying. On the pinions and wheel teeth, use your cleaning brush with a little more authority, and you will be rewarded with immaculately clean gearing—with no trace of stickiness.

That's it. And isn't it simple?

Bruce also makes a preparation called Clean and Wax for Wood, which has a higher wax content. It makes a satisfactory cleaner for wooden movement clocks, but the cleaning action isn't quite as strong as their Deep Cleaner. Furthermore, to be certain of a thorough removal of the additional wax, an extra going-over is required with a fresh clean watch brush. Johnson's Beautiflor can also be used, but its cleaning action is even weaker, and it too requires the extra brushing. There are other satisfactory clean and wax preparations, I'm sure, but these are the only ones with which I've had experience. The important thing is that they must be formulated for wood.

The verge and the brass escape wheel shouldn't be cleaned by this method since they require oiling, which the wax might contaminate. I dry clean them with a rag and a watch brush. To brighten the escape wheel, I usually go over it with a small rotary wire brush held in a flexible shaft machine. A lathe will serve just as well. Wear marks on the verge are taken out in the usual way with emery sticks. The wooden arbor and pinion of the escape wheel are, of course,

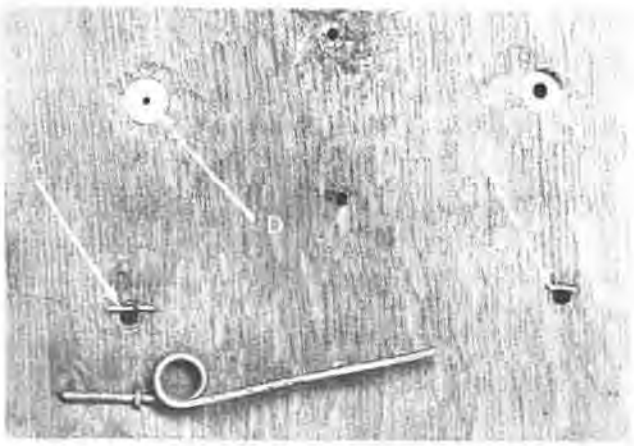

Figure 1.

given the same clean and wax treatment as the rest of the clock.

The large majority of these early American wooden movement shelf clocks were not bushed—their pivots were simply turned in holes drilled in the wooden plates. But a small percentage of them did have brass bushings, and a still smaller percentage had ivory ones.

These old clocks practically always require at least some rebushing, and how to do it has occupied the attention of repairmen ever since the clocks were made—and undoubtedly will continue to do so as long as there are differences in individual philosophy, equipment, and experience. In last month's article I told of a bushing job where two ordinary straight pins used by tailors and dressmakers had been crossed and pushed into the walls of pivot holes to support the pivots.

Figure 1 shows an inside section of a wooden movement top plate. Arrows A and B point to a somewhat more

Figure 2.

The gauge is used to determine the correct KWM bushing, and the size of the reamer to use. Center and ream out old bushing and press in new KWM bushing. The new bushing fits the pivot correctly and the wheel will have the correct endshake.

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sophisticated way of bushing the two main wheel pivot holes. Figure 2 is an interesting blow-up of A, showing not only the brass staple driven into the plate to close up the worn hole, but how grubby these areas can be before cleaning.

A bushing of this sort is comparatively short-lived, in spite of the heavy grease with which the hole was packed. But at least the staple was brass, not steel, which would have cut the pivot. At one time this method must have been quite the vogue, since a good many such examples have crossed my bench.

Figure 3 shows a modern brass bushing kit for wooden movement clocks. It sells for $5.00, and in these inflated

Figure 3.

times is just about the best buy I know. One of the most ingenious things in it is the two guide bushings which insure the exact positioning of the brass bushings over the original holes.

There's no point in a full description of this kit, since it comes with a detailed instruction sheet, together with a price list for replacement parts. Figure 4 illustrates at A a

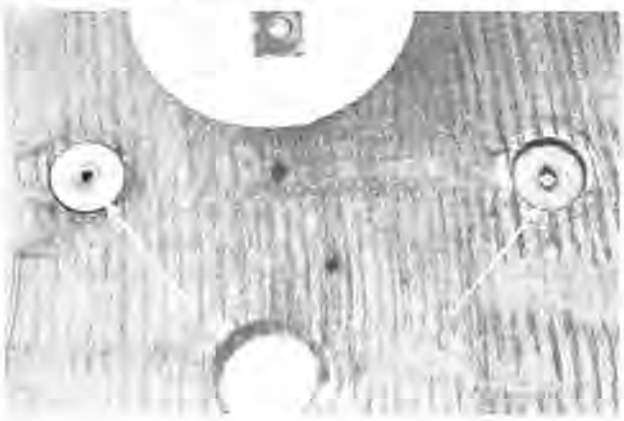

Figure 4.

recessed sink drilled by one of the piloted counterbores in the kit. At B we see one of the brass bushings pressed into place in a similar sink.

The counterbores, of course, are best used in a drill press, but this is a kit designed for a man with a minimum of equipment and it is almost self-contained. The counterbores are fitted with stop collars, and they can bore a satisfactory sink when chucked up in nothing better than a pin vise. A hand drill works fine, squareness with the plate being the only thing that needs to be watched. If anyone is interested in this little kit, the address is Versage Machine Works, Cuddebackville, New York 12729.

Among the clockmakers I know, brass is the usual material for bushing wooden clocks. Nylon, Delrin, and Teflon are also used, but to a lesser extent. Some clockmakers stick to wood, but favor such kinds as lignum vitae or maple, which have superior bearing characteristics, rather than oak which is the wood of the original plates.

My personal preference is oak. I like it first because an oak bushing maintains the original character of the clock as nearly as it can be. Secondly, I like it because it makes a good bearing, as evidenced by the age of these old clocks, some of which are still running with their original bearings.

I make this declaration because I know there are more than a few clockmakers who have drill presses, and who might like to try bushing with oak plugs. Even more, I know there are others who are thinking of moving up to one of these highly versatile machine tools. If you acquire one with a micrometer stop, bushing with oak is just about as fast as bushing with the little brass kit we've been talking about.

I cut my plugs from a ½-in. oak plank. From each plug two bushings are turned and drilled in the lathe. Figure 5 shows a 3/8-in. counterbore with an interchangeable pilot

Figure 5.

and a matching 3/8-in. plug cutter. With these tools all holes can be bushed, except those for the main wheels, in either shelf or grandfather clocks.

Turning back to Figure 1, the arrow C points to the bushing recess bored by the 3/8 in. counterbore. Once the micrometer stop on the drill press is set to the depth of this initial recess, it takes only a couple of minutes to bore out all the rest of the holes in the clock. The arrow D points to an oak bushing glued into place. Before counterboring, I hand ream all the pivot holes to the size of the counterbore pilot, drifting the holes by eye, where needed, to the center of the factory bored sinks on the outside of the plate.

Figure 6 shows the inside of the top plate with the hole bored and the bushing turned for one of the main wheels. The hole is stepped by first drilling halfway through with a 5/8-in. counterbore, and then from the other side all the way through with a ½-in. counterbore.

Here the bushing is the full thickness of the plate, while the 3/8-in. bushings are only about one-third the plate thickness. For this reason, I feel the through-hole should be stepped as described. The plug for the bushing is cut on the

Figure 6.

drill press with a 5/8-in. plug cutter, and then stepped with a ½-in. shoulder on the lathe, to match the hole.

Brass bushings in a wooden movement have two strikes against them, in my view. First, they rob the clock of part of its authenticity. Second, they require oil, and it has been my experience that oil in a wooden movement spells trouble. The oil at the bushing tends to creep back along the pivot until it reaches the shoulder of the wooden arbor. There the chemistry of brass, steel, oil, old wood, and old oil combine to form a waxy gunk that stops the clock long before it would have with an unoiled wooden bushing.

All anyone can do is the best he can with the best he has. Credit goes to the fellow who does the most with the least. It won't be the least for long.

Next month *The Shop* closes its series on the wooden movement clock with a discussion on tooth replacement, pivot restoration, and a few other odds and ends. □

RESEARCH AND EDUCATION COUNCIL TO MEET

The annual meeting of the Research and Education Council of the American Watchmakers Institute will be held June 19. In-service training will follow for instructors of REC Schools at the Diamond Oaks Campus, Cincinnati, Ohio on June 20, 21, 22.

Gerald Jaeger, Chairman of the REC, has arranged for the school instructors to receive training on solid state watch repair as well as the latest in training in the repair of analog watches.

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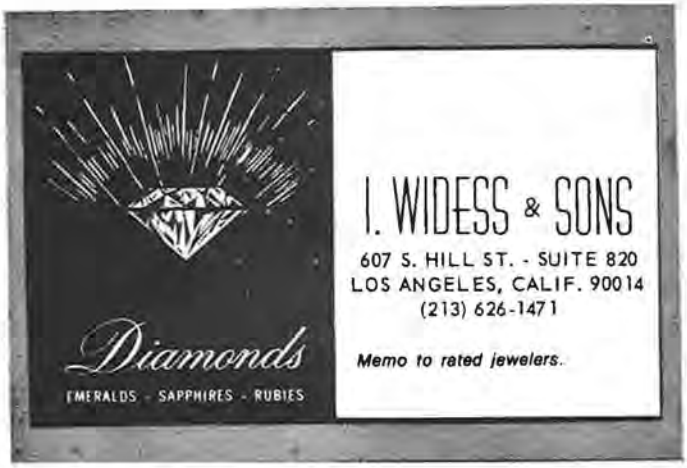

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TAX GUIDE AVAILABLE

The 1978 edition of "Tax Guide for Small Business" (Pub. No. 334) has been released by the IRS. The publication includes a section on the new jobs tax credit created by the Tax Reduction and Simplification Act of 1977 and a summary of many tax law changes and extensions enacted during 1977. The guide is available at local IRS offices.

(From the RJA Bulletin.)

RATE COMMISSION TO CONSIDER PRESORT DISCOUNT

Retailing representatives have filed a brief with the Rate Commission, supporting the two-cent reduction in First Class rates for presorted mail. Readers will be informed of any developments.

(From the RJA Bulletin.)

No man can be considered great who does not move until he is pushed.

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FUNCTIONAL DESCRIPTION

This section gives a description and history of the chronometer construction, how it functions, and the factors which affect its operation. Specific features of individual parts and assemblies will be discussed in later articles.

As with conventional mechanical watches and most clocks, the pillar plate is the foundation for the movement. The other plates and bridges which support moving parts are fastened to the pillar plates by pillars. The movement is very similar to the old full-plate watch with the balance wheel outside of the back plate. A ship's chronometer, like other timepieces, consists of four assemblies: the power, the transmitting, the controlling, and the indicating mechanism.

The plates and bridges are of brass, approximately 3/16 inch thick and are often beautifully finished with wavy lines, bars, circles, or figures. This ornamentation is called snailing or spotting, although it is often referred to incorrectly as damaskeening.

The barrel bridge, train bridge, and balance cock perform functions similar to those in a watch or clock except that in some makes the barrel bridge also holds the fusee in addition to the barrel, while in others, the train bridge also holds the fusee. An additional bridge–the lower balance bridge (potense)–supports the lower balance cap and hole jewel and in some models the fourth wheel upper setting. A lower train bridge contains the lower third and fourth wheel settings.

Figure 1. 8-day Richard Hornby 130/18593.

Eight-day chronometer movements are approximately 3½ inches in diameter by 1¾ inches in depth as compared with 3¼ inches in diameter by 1 inch in depth for the standard or 56-hour type, and the balance wheels are smaller and lighter. See Figure 1.

The movement is fitted into a brass bowl with a screw type bezel with a movable dust shield located on the bottom of the bowl which is turned to one side to permit insertion of the winding key. When the key is removed, the shield springs back over the hole.

The dial has either Arabic or Roman numbers, graduations, and letters generally in black on a silver white background. Some chronometer makers in the early 1700's chose to fit their instruments with enamel dials. Most dials are held in place by either top screws, or flat-headed screws through the pillar plate and thread into the underside of the dial, or by taper pins which run through the dial feet. A winding indicator scale marked UP-DOWN is located below the 12-hour mark with graduations in multiples of 6 or 8, from 6 or 8 to 48 or 56. At the numeral 6 position is a seconds scale divided into 60 parts with graduations in multiples of five, from 5 to 60.

Although one of the duties of the navigator was to make certain that he wound his chronometer daily, there was no visual means of knowing the extent to which the main spring had been wound up or had run down without removing

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the instrument from its bowl. The UP-DOWN indicator first made its appearance on an 8-day chronometer constructed by Thomas Mudge (1715-1794) in 1774. However, it did not receive general acceptance until sometime later. By the end of the 18th century several different designs appeared and shortly thereafter it was adopted in all chronometers. After 1820 practically every chronometer made was fitted with such an indicator.

The hour, minute, and seconds hands in most cases are of blued steel. Hands on some of the earlier chronometers were even made of gold, while others were very ornate, since lacework and its embellishments were fashionable in the early years.

The first Hamiltons were fitted with a plain Gothic type dial with a dull white silver finish. Then a change was made from the plain Gothic to a modern Roman style, beginning approximately with chronometer number 340. The ground finish was also modified from a dull white silver plate to a vertical brush, fine line, white silver finish.

At the request of the U.S. Naval Observatory, several Hamiltons were fitted with special dials. One, No. 3E031, was fitted with a black twenty-four hour dial with white numerals and hands. The winding indicator was engraved on the dial in the reverse of the conventional style, inverted, up( ) down.

Another chronometer, No. 3E019 (only ten were made), had a white marked 4-Orbit Dial designed to aid the navigator in the Pacific Ocean where his ship crosses the International Date Line. The outer circle was marked in minute graduations, an hour circle at nine o'clock, the up-and-down dial at the twelve o'clock, the seconds dial at three o'clock, while at six o'clock, there was a dial that showed each day of the week starting with Sunday at the top right. This dial showed the day of the week at Greenwich or "Greenwich Date."

As mentioned previously, a requirement of celestial navigation is the availability of accurate predictions of the positions of the celestial bodies used. The positions of various celestial bodies for each day of the week are published in the Nautical Almanac to the nearest 0.1 at hourly intervals. Thus, it is essential for the navigator to know the day of the week at Greenwich so that when he refers to the Almanac, he selects the correct day regarding the various celestial bodies he will "shoot" with his sextant when determining his latitude.

Certainly most navigators would have no problem in dealing with this situation in the ordinary manner. However, this dial was designed to lessen the possibility of error due to distractions or from being in a hurry in selecting the incorrect Greenwich date and thus, wrongly calculating the ship's position.

Unlike a watch movement, the barrel does not drive the train wheels. Instead, they are driven by the great or fusee wheel which is connected to the barrel by means of the fusee chain. Hence, in winding, the square top of the fusee arbor is turned counterclockwise with the winding key which winds the chain off the barrel onto the fusee and, in doing so, winds up the mainspring in the barrel. One would expect that this would interrupt the transmission of power to the time train, thus stopping the chronometer. However, to prevent this, a maintaining spring device in the fusee provides maintaining power to the train which obviates the danger of the chronometer stopping while being wound.

"Fusee" is derived from the Latin word, fusata, meaning a spindle full of thread. The fusee is a conical shaped brass spool with a concave profile on which spiral grooves are cut around it. (See Figure 2.) A small chain which will lie in this groove when wound is fastened to a small pin near the wheel teeth of the fusee. The other end of the chain which looks like a boat hook, hooks into a hole near the top of the mainspring barrel. (See Figure 3). As the fusee is turned, the chain is wound off the barrel onto the fusee. When the chain approaches the topmost narrowest groove on the cone, a stop bar or snail hook comes into play, preventing overwinding.

The fusee, designed to equalize the power, has been

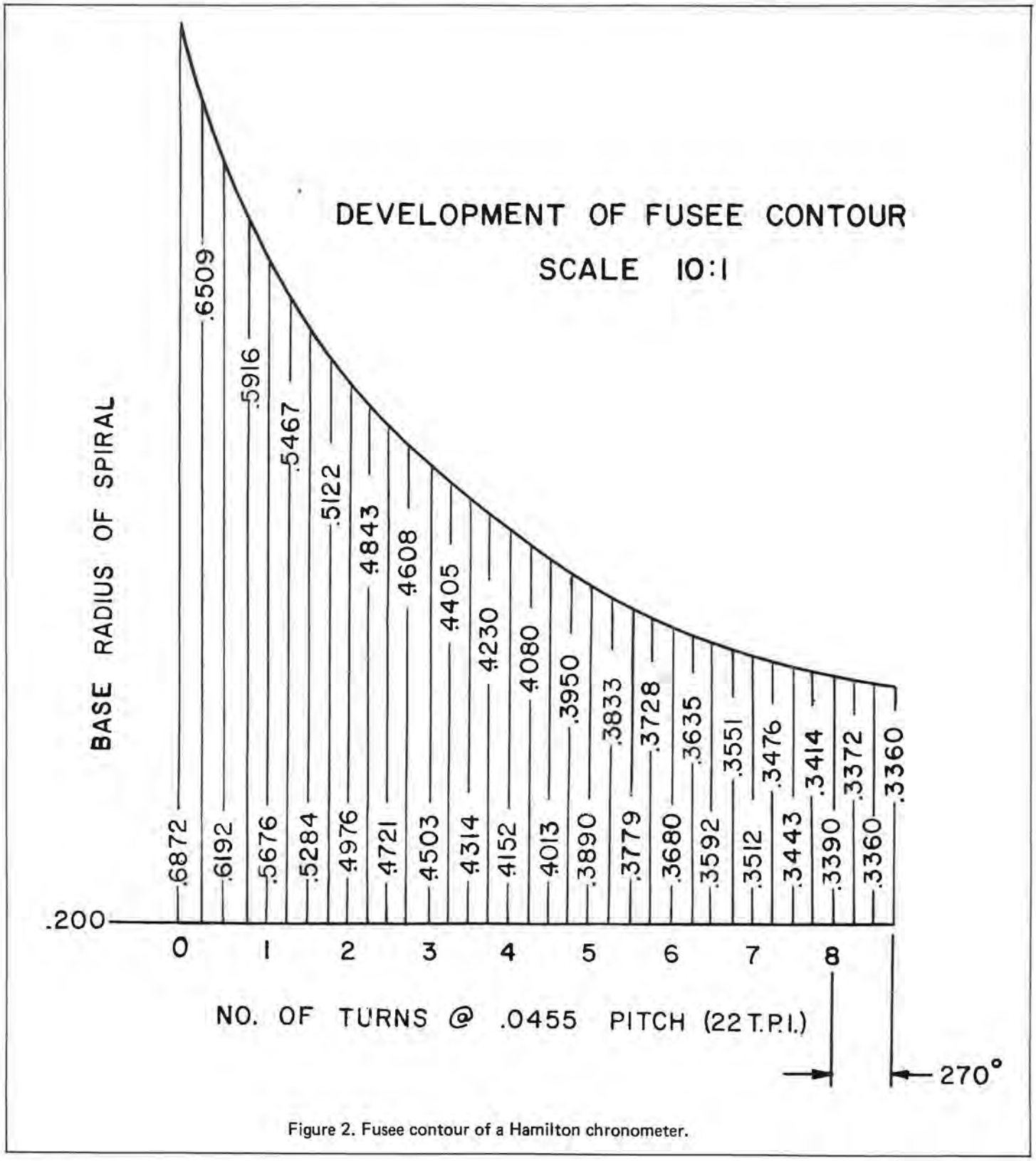

Figure 2. Fusee contour of a Hamilton chronometer.

Figure 3. Left—hooks to pin in fusee; right—hooks to pin in hole in barrel.

used in chronometers since their inception. The true inventor of the fusee is unknown, which is a shame, for it is an ingenious mechanical device and enables the horologist to achieve greater success in the performance of his timepieces. Many give credit to Jacob Zech of Prague for inventing the fusee in 1525. But this premise is questionable since the fusee is mentioned and sketched in the notes of Leonardo da Vinci as early as 1485.

As the chronometer runs, the mainspring causes the barrel to turn, winding the chain onto it and thus, causing the fusee to rotate, driving the time train. (See Figure 4.) The

Figure 4. Barrel nearly fully wound.

fusee equalizes the pull of the mainspring by being conical. When the mainspring is pulling with the greatest force, the chain is on the smallest portion of the fusee, hence, the leverage is not as great. As the mainspring continues to unwind, the pull of the mainspring decreases but the leverage of the fusee increases proportionally, causing the power to remain relatively uniform. Thus, if the fusee is accurately cut for a given mainspring the torque on the fusee or great wheel would be fairly constant.

But it must also be remembered that the physical properties of the mainspring will inevitably change with age. Mental fatigue and also the deterioration of the oil in the barrel and stiffness of chain in due time will to some degree affect this so-called "constant torque," no matter how accurately the fusee is machined.

The fusee assembly consists of the arbor, the spring stop-bar (used in the Hamilton and Nardin) or the stop hook or snail (used on most other makes) which is part of the uppermost portion of the fusee; also the fusee, fusee ratchet wheel, maintaining wheel with click and spring or sustaining ratchet wheel with click spring and click (Hamilton), maintaining spring, fusee wheel, fusee key or end plate and the tapered pin. The maintaining spring is located under the fusee to keep the train running during winding. The maintaining power or sustaining ratchet wheel and click prevent the spring effect of the maintaining spring from coming into play until the force from the mainspring is removed from the fusee wheel during winding.

The maintaining device was invented by John Harrison (1693-1776) and is entirely automatic, coming into play as soon as the winding key is turned. The following explanation describes how the fusee and maintaining assembly is assembled.

The fusee arbor is driven into the grooved fusee, and in a recess on the large end of the fusee is attached the ratchet wheel. The fusee wheel rides loose on the arbor, as does the thin maintaining wheel, which is positioned between the fusee and fusee wheel. To the maintaining wheel are fixed two clicks and click springs which work into the ratchet wheel, thereby establishing connection between the two parts. The C-shaped maintaining spring is fitted with two pins, one on the ball end and the other near the tail end of the spring, and fits into a recessed fusee wheel. The pin on the ball end fits into a

Figure 5. Component parts of a fusee.

(Continued on page 46)

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THE MAINSPRING BRIDLE

by Harold J. Herman
CMW

Part 2 and Conclusion

Explanation is due from last month's article on what to do with the riveted or peened barrel and the sealed standard snap barrel when it needs adjustment. Both of these barrels do not have a cap opening for access for our new adjustment technique. In the case of the peened or riveted barrel, the lathe can be used with a drill measuring approximately 0.40 mm. The center punch should lightly dent the area to be drilled. Estimate the thickness of the barrel wall and aim the punch at the inside of the wall. Drill a hole at that spot through the brass cap, but be careful not to apply great pressure so that the drill does not burr the bridle or mainspring. Figure 1 shows the hole drilled and the excess brass removed from around the

Figure 1. Riveted or peened barrel.

hole that is raised during the drilling process. The removal of this burr is important because on most watches the barrel cap rides very close to the hour wheel and a random burr raised when the barrel moves around to the hour wheel could catch and stop the watch. Granted, the aforementioned method is not an ideal one, but the only answer other than a complete unit replacement.

Figure 2 shows a sealed barrel regular snap type barrel cap that has a V slot filed into it with a triangular file. Figure 3 shows the same cap after a rat-tail file has ovaled the slot. The triangular file was used first in order to make a groove for the rat-tail file to fit in. If you are especially skilled and decide to use the rat-tail file only, be careful that the file does not randomly slide around the perimeter of the lid, reducing the diameter and snap quality before it bites into the cap. After the filing is completed, the burrs raised on both

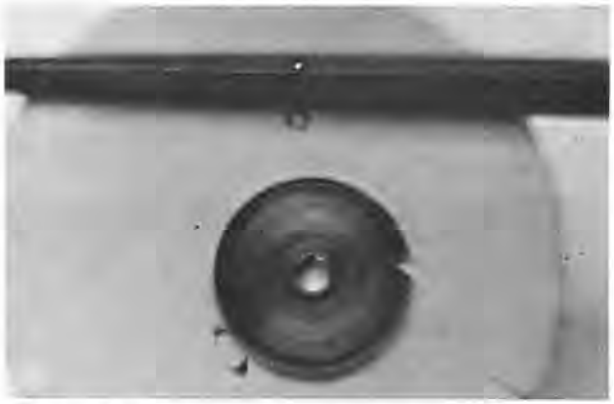

Figure 2. Sealed barrel snap type cap with V notch.

Figure 3. Sealed barrel snap type cap with oval file out.

sides of the barrel cap must be removed. Work tweezers skin the burrs off nicely. The cap is replaced as in Figure 4 and access is available to this barrel bridle now just as it is in Figure 1.

Figure 5 shows a self-winding watch that has a square cut out of the cap at the factory. Using the assembled cleaning and lubricating methods, if the barrel bridle does need adjustment, consider yourself fortunate if the barrel stops at this position. If it does not and is hidden, drop the pallet

Figure 4. Sealed barrel snap type cap with filed access opening.

fork and a slight wind will bring it to an accessible position. Replace the fork.

At this point, there have been described three different style barrels that all need adjustment from checks made by the wide bladed screwdriver and covered in Part 1. The bridles in these barrels are either too tight, causing re-

Figure 5. Self-winding watch with factory cut out.

banking or galloping, or too loose, causing overnight stopping and less than ideal balance motion, causing undependable timekeeping qualities.

Figure 6 shows two items found at your local supplier. On the left is No. 0 oilstone powder and on the right is bridle grease or bridle lubricant. These two items will properly adjust bridle tension in almost every barrel that needs adjust-

Figure 6. No. 0 oilstone powder and bridle lubricant.

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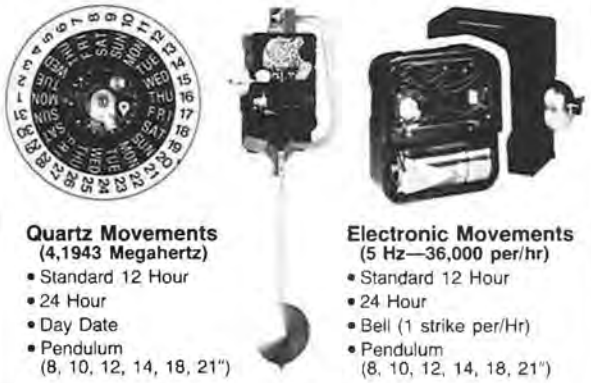

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ment, *without removing the mainspring and bridle from the barrel.* If a bridle is slipping around the inside circumference of the barrel, use a jewel screwdriver (0.50 mm diameter), dip it into watch oil, wipe the blade with a towel, and place the tip into the oilstone powder. A minimum amount of oilstone powder will be held to the blade. See Figure 7. Remember, a very small amount of powder is going to do a lot for a slipping bridle. If the bridle still slips add a ittle more powder between the *bridle and the barrel wall.* Special care should be taken that the powder is placed there. It is not hard to be fooled and errantly place it between the bridle and outside

Figure 7. Screwdriver 0.50 mm diameter after being coated with oilstone powder.

coil of the mainspring. If this should be done, upon testing the bridle slippage, you will find no change in the error. See Figure 8.

If a barrel bridle is too tight, a clean screwdriver blade is used to place bridle lubricant between the bridle and the wall of the barrel.

The great advantage of using oilstone powder and bridle grease is that they can be used together. The too loose bridle that had been given the oilstone treatment and grabs

Figure 8. Placing oilstone powder between bridle and barrel wall while barrel is held by pin vise "full wound."

or becomes too tight can be retreated with bridle lubricant to aid slippage. In reverse, the too tight bridle that was treated with bridle lubricant and becomes too loose can be retreated with oilstone powder to stop slippage.

The question that must arise in the reader's mind is what damage oilstone powder will do to the bridle or barrel wall and what length of time this treatment will last. After many watchmakers used this method for 18 years, no appreciable wear was noted either at the barrel wall or at the bridle. It is believed that the oilstone powder imbeds itself in the softer material which is the barrel wall. The relatively thick steel bridle showed no wear. The consistent tension of the bridle lasted as long as bridles adjusted by other methods.

In recent years, manufacturers have been using the anodized barrel. Their development of this barrel has drastically reduced the number of barrels needing adjustment. Hats off to the progress of the watch companies. But as we all know, we will be seeing the older brass barrels for many years to come.

A word of caution when working with oilstone powder is that special care should be exercised that it be placed only between the bridle and barrel wall. Careless use will cause damage.

Direct all questions to Horological Times, P.O. Box 11011, Cincinnati, Ohio 45211. □

NEW AWI CERTIFICATION

The American Watchmakers Institute now offers certification in the repair of Electronic Watches. The new title offered is AWI Certified Electronic Watch Specialist (CEWS).

Marvin Whitney, chairman of AWI's Certification Committee, announced that this new examination became necessary when electronic watches captured a large segment of the watch business in recent years.

Candidates for CEWS must repair a balance wheel electronic watch, a tuning fork watch, and a quartz analog watch, and must also complete a comprehensive four-part written examination. The candidate may use his own watches, or watches supplied by AWI.

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WMJDA ELECT NEW TREASURER AND DIRECTORS

A new Treasurer and several new directors were elected to the Board of the Watch Material and Jewelry Distributors Association. The elections took place at the Annual Convention in Boca Raton, Florida, March 28–April 1, 1978. The results are as follows.

President: Morris Beresh, M. Beresh, Inc., Oak Park, Michigan
1st VP: John Cassedy, Cas-Ker Company, Cincinnati, Ohio
2nd VP: Bernard Nest, The Nest Company, St. Louis, Missouri
3rd VP: Karl Esslinger, Esslinger & Co., St. Paul, Minnesota
Treasurer and Immediate Past President: Kenneth Weil, The Gould Company, Dallas, Texas
Past Pres: Arthur Bush, United Tool & Material Co., Denver, Colorado
Past President: Robert F. Kilb, Kilb & Company, Inc., Milwaukee, Wisconsin
Past President: Max Fargotstein, S. Fargotstein & Sons, Inc., Memphis, Tennessee

Director: Skip Apple (exp. '81), B. Rush Apple Company, Tampa, Florida
Director: Mark Borel (exp. '80), Jules Borel & Company, Kansas City, Missouri
Director: Edward Endman (exp. '80), Marshall-Swartchild Company, Chicago, Illinois
Director: Denis R. Gaber (exp. '79), Ray Gaber Co., Pittsburgh, Pennsylvania
Director: Ray Harris (exp. '80), Fried & Field Co., Inc., San Francisco, California
Director: Mike Langert (exp. '79), Langert Bros. Company, Phoenix, Arizona
Director: Robert E. Mahar (exp. '80), Mahar & Engstrom Co., Inc., Boston, Massachusetts
Director: Dominic Priore (exp. '79), Niagara Jewelry Supply Corp., Buffalo, New York)
Director: Edward Soergel (exp. '81), The E & J Swigart Company, Cincinnati, Ohio

Pictured from left to right: First row (kneeling): Skip Apple, Ed Soergel, Edward Endman (standing), Art Bush, Karl Esslinger, John Cassedy. Second row: Denis Gaber, Mike Langert, Ken Weil, Ray Harris, Morris Beresh, Max Fargotstein, Bob Mahar, Robert Kilb, Mark Borel. (Not pictured, Bernie Nest).

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AFFILIATE CHAPTER COLUMN

by Willard Blakley CMW

By the time you read this article, our Annual Affiliate Chapter meeting will only be a few days away. I am looking forward to that meeting, and hope all of you are too. You delegates who have been to our past meetings know what to expect at the meeting, but we always have some new delegates and visitors bringing with them new ideas. Let's all make an effort to meet and greet those who will be coming for the first time, and make them feel welcome. I don't think anyone who has ever come to these meetings has gone away without having made some new acquaintances. Please make an effort to meet the new arrivals and make them feel like they are among friends. We have fine watchmakers coming together and putting their heads together to express new ideas and thoughts with one purpose: to make the field of watchmaking better for all of us. It never ceases to amaze me that even though we are all widely separated geographically, we can come together for this meeting, discuss our ideas, and because we are united in purpose, we can go back to our respective guilds better informed for having been at the meeting. This not only is a benefit for those who are fortunate enough to be able to attend, but also helps everyone involved in the profession.

Thursday night, June 22, a good many of you will register and get name tags. This is an excellent opportunity to talk over the ideas you have brought with you for the meeting. You may be surprised to find out that others may have the same ideas you do to share with the body at the Chapter meeting.

I hope by the time you read this article that all of you will have mailed in your reports and have received your packet of reports in the mail.

Delegates, please do not forget to bring your state flag to the meeting so we can display them around the meeting room. It will be the first time since I have been attending the meetings that this will have been done. I personally am looking forward to seeing lots of them. It should make an interesting display for the meeting room.

I am looking forward to renewing old friendships as well as making new acquaintances. See you all soon!

IOWA

The Horological Association of Iowa and the Iowa Retail Jewelers Association held their Annual Spring Technical Seminar at the Hilton Inn in Des Moines on April 23. A technical seminar was presented to the watchmakers on the Citizen Quartz Analog and the Citizen Digital Alarm by Citizen Watch Co. and S.H. Clausin Co. Deyo and Co. presented a program for the jewelers on ring repair, stone setting and retipping.

Don Smith, who has operated Don's Jewelry in Sac City, Iowa for the past 23 years retired on May 31, 1978. Don has been a faithful member of the Horological Association of Iowa, the AWI, and the Fort Dodge Watchmakers Guild. He also served over 12 years in the U.S. Navy before and during WW II.

ILLINOIS

Marvin Whitney spoke at the April 20 meeting of the Central Illinois Watchmakers Institute. Discussed were the AWI certification programs and chronometer repairs.

CALIFORNIA

On May 7, Mr. Leslie Smith conducted a bench course on the Seiko 4300 SMQ.

The Bay Area Watchmakers Guild presented a trade show featuring Technology in Horology. All the latest advances in every facet of the trade were displayed by the watch manufacturers and by the suppliers of materials and services. The trade show was held at the San Francisco International Airport.

NEW YORK

On May 1, a panel of experts from major watch companies answered the question, "What can the watch repairer expect

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from the service department of the watch factories?" and other questions pertaining to service at the counter and the bench. Irving Albert was the moderator of the panel, which included representatives from Omega, Bulova, Seiko, Helbros, and Bucherer.

PUERTO RICO

There has been a recent reorganization of watchmakers in Puerto Rico on an island-wide level with the purpose of creating a more efficient organization.

The new organization is led by Salvador Rivera Vera, who has been a watchmaker for 23 years and is now privileged to say that he enjoys a wide background in this field. Eleven years ago, he led the watchmakers of Puerto Rico on a similar campaign for improvements in watchmaking. Other than Mr. Rivera Vera, there presently stands a good number of men in this field pushing hopefully toward a forthcoming assembly.

Mr. Rivera Vera conceived the idea of this new organization while working in Cleveland, Ohio, for a nation-wide trade shop called Pollak Watch Service.

Although the working conditions on the mainland are as adequate as anywhere on earth, many Puerto Ricans have aversions about their jobs here; they have plans to incorporate with the American Watchmaker's Institute in order to get all of the benefits offered by that organization; in addition, the PuertoRican group would like to introduce a proposal for a code of ethics.

The watchmakers in Puerto Rico have had two dis-

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Board of Directors, L to R, front—Damaso Perez, Roberto Villanueva, Luis E. Molinary, Salvador Rivera Vera (President). Standing—Doel Gonzalez, Fredy Soto Colon, Angel L. Torres, Hector Zapta, Elmo Rodriquez, Julio Correa Heradia.

trict meetings, which drew as many as 40 members.

The officers of the Puerto Rican organization include: Salvador Rivera Vera, President; Angel Luis Torres, Vice President; Fredy Soto Colon, Secretary; and Roberto Villanueva, Treasurer.

Other important members include Julio Correa, Damaso Perez, Elmo Rodriquez, Hector Zapata, Noel Gonzalez, Luis Molinary, and Bolivar Pagan.

PENNSYLVANIA

The Watchmakers Association of Pennsylvania, Inc. announces the formation of a new Guild in Pennsylvania in the Philadelphia area. It is known as the Delaware Valley Watchmakers Guild and will be an Affiliate Chapter of the State Association. Jack Tillman is President and Tom Murray is Secretary-Treasurer of the Guild. On April 16, 1978, 15 members of both organizations met at Breezewood to discuss by-laws and organization procedures. Those attending from the Watchmakers Association of Pennsylvania were Bob Bishop, President; Paul Fehrenbach, Secretary-Treasurer; Mario Bocchicchio, and Shirley McDonald, Directors; and Dan Sorbo and Adam Farnish, members. Those attending from the Delaware Valley Watchmakers Guild were Jack Tillman, President; Tom Murray, Secretary-Treasurer; Cliff Boyer; Dick Meyer; Ken Book, Grant Swensgard; Raul Calle; Jack Glusman; and Elias Layos, Jr.

The Watchmakers Association of Pennsylvania has been in existence since 1934 and was incorporated in 1951, but most of the members were from the western Pennsylvania area, and they functioned both as State organization and a Guild. However, with the new Guild in the East, the Pittsburgh area members will form their own Guild in the immediate future. There is also the possibility that a third guild may be formed in the Allentown-Bethlehem area.

At a recent meeting, Gene Eckstein presented a very interesting program concerning good nutrition and eating healthy foods.

Approximately 45 watchmakers attended a recent Solid State Seminar presented by Bob Nelson at the Holiday Inn in Pittsburgh.

COLORADO

On March 18 and 19 the UWC&C held a two-day seminar at the Continental Denver Motor Hotel. Mr. Howard Opp of Chillicothe, Ohio was the instructor from AWI who presented

Members taking part in the bench course presented by Howard Opp.

Ray Rennemeyer presenting a clock course.

the bench course on the Electronic Watch ESA 9157-58 and ESA 9200. Mr. Opp gave the course on both days. Mr. Larry E. Burnworth of Colorado Springs gave a bench course on the Universal Replacement Module. Mr. Ray Rennemeyer gave the Clock Course on bushing a clock and reassy.

The members held a business meeting and voted on the changing of the name of the Association from United

Vice President Emery Brittenham conducting the business meeting.

Watchmakers and Clockmakers of Colorado to the name of Colorado Horological Society, Inc. Ten new members were signed up at the seminar.

VIRGINIA

On Tuesday, May 2 the Potomac Guild held a meeting in Annandale. The meeting placed emphasis on final preparations for the HAV Convention, which the Potomac Guild is hosting in Old Town Alexandria.

OHIO

A regular board meeting of the Watchmakers Association of Ohio was held on April 29-30 in Columbus. Plans are being finalized for the WAO 32nd Annual Convention to be held July 28-30 at the Columbus Marriott Inn. A seminar on the Citizen LCD alarm watch is scheduled, with other activities and entertainment in the planning stage. Jim Broughton, Travel Committee chairman, reports that reservations are now being taken for the boat trip, scheduled for August 7-11. The Association presented a seminar on the Bulova Model 242 Stepper Motor Quartz Watch on Sunday, May 21 in Findlay. Mr. Calvin Sustachek of Racine, Wisconsin, conducted the seminar.

ARIZONA

At the April 18 meeting of the Arizona Watchmakers Guild, Sgt. Regan of the Phoenix Police Department Community Services Division spoke to the guild members concerning security for the small store operator. An idea exchange program was held at the meeting.

The Southern Arizona Watchmakers Guild held a meeting on April 11 at the Newton Travel Lodge. A buffet was held before the meeting. At a recent meeting, guests were Mrs. Nielsen, Mrs. Hertel, Mrs. Layne, Mrs. Spanhook, Mr. Tim McGuire, and Mr. Vince Padula. Door prize was a pair of fine tweezers, donated by the McGuires, and won by Jim Michaels. A second door prize was won by Bill Andrews.

FLORIDA

The Florida State Watchmakers Association continues to have a very interesting education program to keep abreast of the times. A recent seminar in Tampa included Accutron Tips; an interesting slide program on Rolex and a two-hour session on clocks. Gerald Jaeger, AWI Instructor, presented two bench courses, one in Dayton Beach, and one in Ft. Lauderdale. Mr. Jaeger did a great job and received many compliments and thanks, especially since he spent his spring vacation working.

The FSWA is planning two seminars, one on June 11 and one July 30. Also scheduled is the Convention in Orlando, to be held on October 27-29. □

A man is just as happy as he makes up his mind to be.

—Abraham Lincoln

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SCHOLASTICALLY SPEAKING

by Gerald G. Jaeger CMW

Chairman, Research and Education Council

One always completes a term in any office with a feeling of lack of accomplishment. In the case of completion of my term as chairman of REC the negative feeling is greatly reduced because of the quality and dedication of the men who will follow me in this endeavor.

My one main goal was to achieve a continuity within the REC which would insure the continued success of our summer training programs as they are now set up. To facilitate this desired continuity of leadership, I have devised a procedure for forthcoming elections which will be presented to the entire group at the annual REC meeting in Cincinnati this June. The AWI Constitution dictates that we must submit a slate of candidates for the Executive Committee to the general membership prior to the Annual Meeting. This slate must include not only candidates for the executive committee but a candidate or candidates for Chairman of REC. We are in compliance with this mandate. The constitution might be considered vague as to all other leadership considerations. When the chairman of REC appoints a nominating committee they prepare a slate and submit it to the membership. This is all well and good, but it leaves open little or no involvement of our general membership in these vital processes. Admittedly, we all have the opportunity to vote by mail, but this often gets to be too much of a cut and dried method. At the time the constitution was written, I rather expect the REC was expected to be an organization whose business would be, by and large, conducted through the mails. It would have been hard to envision active participation such as we now enjoy.

It is important to AWI and to our industry that REC continue its efforts in a direction that eventually leads to better classroom instruction. Educational sessions such as we now employ provide the vehicle to this end. President Jim Broughton and Executive Secretary Milton Stevens both recognize this and have been most cooperative in working with REC. We have enjoyed a partnership which insures the future of both AWI and REC.

I had hoped for a developing of closer ties between the Affiliate Chapters group and REC, especially in the areas where there is both a school and an affiliate chapter. This had been fairly well explored through a couple of articles in our column in *Horological Times*. I'm sorry to say there was very little response to them. It is my intent to request a few minutes on the Affiliate Chapter program this year. There should be a close working relationship between the bench watchmaker in the field and our schools of horology. It is time we meaningfully explore methods to bring this about. It is vital that our schools prepare our students for job entry as it is today. Sometimes we in education lose touch with the needs of industry. A closer working relationship will lessen the possibility of this happening.

I see many interesting but extremely challenging years ahead for REC. The many new innovations in timekeeping have certainly not diminished the role of the teacher in our industry. These new disciplines are such that we, acting individually, will not be able to master and bring to the classroom. I feel confident that REC, working with AWI, and with the cooperation of industry, can develop classroom-oriented courses. Industry has worked with REC and I see no reason why these efforts will not continue; in fact I look to years of greater industry involvement.

A look at the outstanding leadership potential within REC convinces me that our most productive years still lie ahead.

It has been my privilege and honor to represent REC as its Chairman for the past two years. Much remains to be done and the resources to do the job are at hand. It will be the challenge of our new leadership to implement them.

Tempus fugit! □

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Members of the Watch Material and Jewelers Distributors Association will visit the E. & J. Swigart Co. and the Cas-Ker Co. July 7, 8, & 9, 1978. During their stay in Cincinnati, they will also visit AWI Central for a tour of the Headquarters office, Editorial office, and Museum. The yearly event is a cooperative effort to examine business procedures by members of the organization.

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ESSENCE OF CLOCK REPAIR

(Continued from page 11)

the power sources. In our clock the barrels are cord operated. Later, steel or brass cables were used, or supplemented. The going time train consists of the usual number of wheels: main (barrel), second, third, fourth, and escape wheel. The strike train, however, is set somewhat differently to other striking clocks, and it can be observed in Figures 2 and 3 (front and rear plate views respectively) that there exist two detents marked as a and b, set in the upper part of the mechanism. These two detents must be properly set (and adjusted if necessary) for correct strike release and strike locking.

The secret to the repeating hour strike lies in the two-pronged toe of the large detent (a in Figures 2 and 3). This two-pronged toe unfortunately cannot be seen in the photos, but actually sits in behind the cannon pinon, the latter behind the large hour wheel c in Figure 2. The two-pronged toe of the large detent actually works in conjunction with two brass cams set at the back of the cannon pinon.

At the hour, the inner prong of the large detent falls from the surface of the long cam (under the influence of the counterpoise weights to which we shall refer) and releases the hour strike. After approximately two minutes, the large cam then releases the outer prong of the large detent. This produces a repeat of the hour strike. Other factors, such as the hour snail, vertical rack and small detent, are also involved in this operation and shall be discussed.

At the half hour, the inner prong of the large detent drops into a small slot (under the influence of the counterpoise weights) between the two brass cams. This releases the half hour strike. Because of the size of the small slot the outer prong of the large detent remains inoperative, outside the rim of the cams.

The small detent, b in Figure 3, actually released the strike mechanism and is located towards the rear of the clock (center left, back plate). This small detent is controlled by the strike release lever (d in Figure 3) which is itself rocked by the strike release arm pivoted at right angles to it, which is rocked by the large detent at the appropriate times for hour strike, repeat hour and half hour sequences. Unfortunately Figure 3 does not clearly show the large detent strike release arm. However, it does clearly show the pivotal point between this strike release arm and release lever immediately to the left of the arrow for d in Figure 3.

The small detent, which finally releases the strike mechanism, is normally held in check and locked by a pin on the fly wheel in the strike train. A cutaway slot in the toe of the strike release lever is set to allow for clean functioning of the strike mechanism.

A common hour snail attached to the front of the hour wheel works in conjunction with a steel lifting piece to operate a steel locking piece against the teeth of a steel hour rack, or *cremaillere.* The edge of the hour rack can be barely seen as e behind the right hand pillar plate in Figure 2. The hour rack is unusual in that it is vertical in nature. The number of hours struck is, of course, dependent upon the height the lifting piece is moved up or down by the hour wheel snail.

The two counterpoise weights, shown as f in Figure 3, keep pressure applied to the large detent and to the strike release lever operating against the small detent.

A star wheel, g in Figure 3, is employed to operate the hammer strike against a steel bicycle bell (old-fashioned, of course) gong. The latter is situated at the top center of the upper frame plate, but is cut off in the photo. □

IN THE SPOTLIGHT

(Continued from page 19)

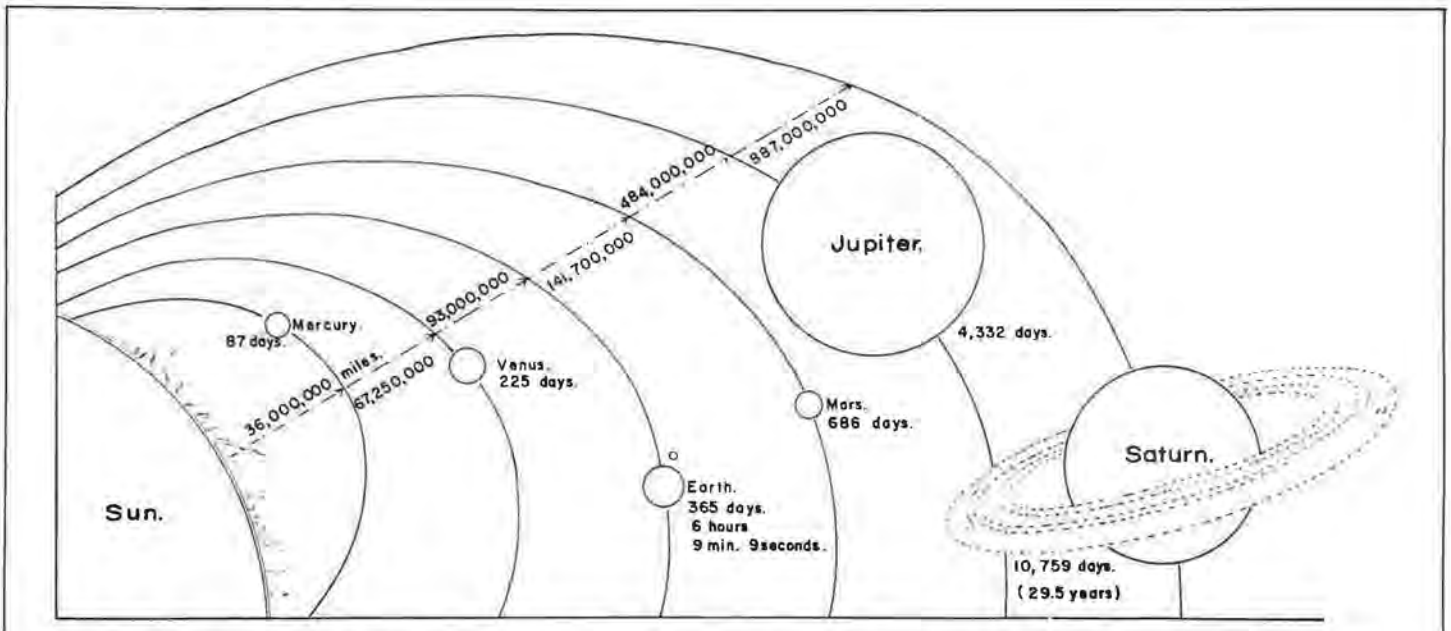

Figure 7. The portion of the solar system shown in accurate time by the Gebhard Astronomical and World Clock.

feature of the clock is interesting enough, if all others were omitted—imagine if you will, in this atomic age of extreme high speeds and orbiting satellites, a wheel making just one revolution in 29½ years—that is exactly what the Saturn wheel does.

Last, we mention the strike device, Figure 8, but it is by no means the least interesting. When announcing the first quarter hour, a child appears and strikes a bell, one time. On the half hour a youth comes out and strikes twice (two quarters); at the three-quarters a figure representing full manhood appears and strikes three times, and on the completed hour, old age appears to strike the four completed quarters. At all these stages of the hours the guardian angel figure above them protects them by her outstretched hand, except at the

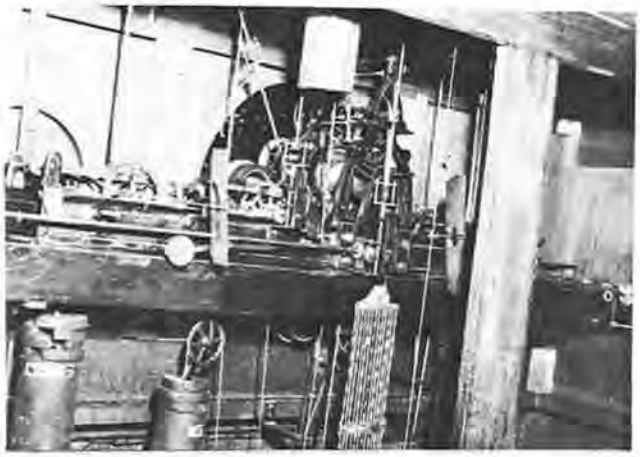

Figure 8. Left section main frame. Quarter strike train extreme left. Quarter figure drive next to clock. Lepaute's "Pin Wheel" escapement.

appearance of old age when the hour is completed, the angel's hand remains at her side, signifying that time has run its course. At the completion of the final quarter struck, to the left of the quarter striking figures is another angel holding an

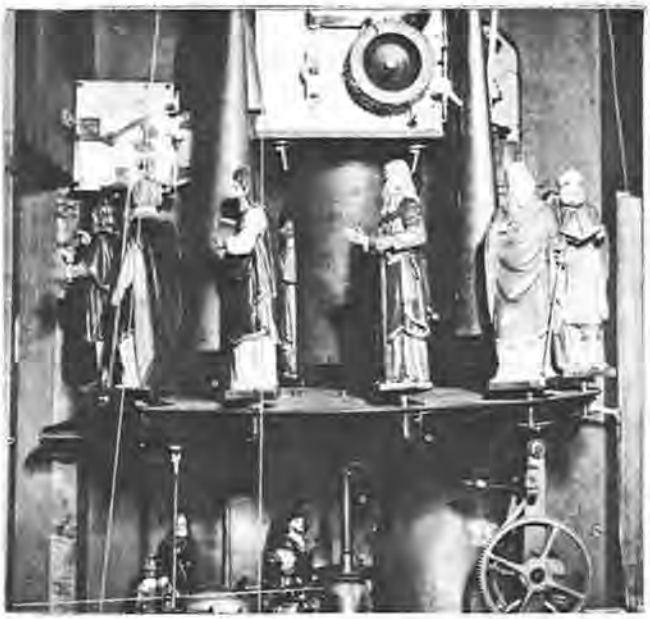

Figure 9. Apostle carriage from back.

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hour glass; this glass is reversed to indicate the start of a new hour. Just under this latter angel is a figure representing death; he announces the hour by striking the correct strokes upon another bell.

At twelve o'clock midnight, Figure 9, the twelve figures representing the twelve Apostles each appear and bow in reverence to their master, except Judas Iscariot, who fails to show his respect by turning his back; then a cock crows thrice (upper right of clock).

In the photo of the mechanical carriage that takes the apostles upon their midnight tour, the contrivance which actuates the figure, making him turn and face the master when he arrives at the front of the clock, is seen underneath the carriage; one for each figure except Judas Iscariot. At the extreme left stands Peter, chalice in hand, ready to come out the instant the carriage is tripped by the clock. Next behind him is Andrew, then James, John, Philip, and Thomas with a book. As the figures are located upon a circular carriage, only one half shows in the photo. Thomas is followed by Matthew, Bartholomew, James (the Less), Simon, and Thaddeus, Judas coming last.

Upon midnight of December the 31st each year, a bugler appears at the extreme top left (Figure 1) of the clock to announce the new year by tooting a horn.

Finally, it goes without saying the full force or impact of this wonderful piece of man's ingenuity and labor from an era antidating such things as TV, transistor, and even the lowly automobile, can only come by viewing it first hand. □

THE SHIP'S CHRONOMETER

(Continued from page 33)

hole on the maintaining wheel while the tail end pin is fitted in a slot on the fusee wheel. The fusee key or end piece fits over the lower end of the fusee arbor and is held by a tapered pin pressed through a hole in the arbor. See Figure 5.

The power from the fusee is transmitted through the maintaining wheel, and in the process puts tension on the maintaining spring. Just as soon as the winding begins, the power from the fusee is taken away and the maintaining spring reasserts itself and in so doing tries to force the maintaining wheel backwards. It is unable to do this because of the click arrangement on the maintaining wheel which immediately engages the ratchet wheel teeth and holds the maintaining wheel fixed, so the force is expended by pushing the fusee wheel forward, driving the center wheel.

A stop bar or stop hook or snail in or on top of the fusee prevents overwinding. See Figure 6. By the action of the fusee chain at full wind, the bar moves out to engage the winding stop on the underside of the barrel bridge or the fusee stop or snail, protruding from the top or smaller end of the fusee, contacts the notch on the fusee stop iron. The stop iron is a spring lever with a hook fixed to the underside of the barrel plate with a small amount of play on its pivots, so that when the chain comes to the uppermost end of the fusee, it raises the lever just far enough for its hook to catch the snail and stop the winding.

The mainspring barrel is supported by its arbor between the pillar plate and barrel bridge. The barrel contains the mainspring and in some makes a mainspring brace. See Figure 7. The brace is a separate piece of mainspring shorter than the inside circumference of the barrel and lies against the inside wall of the barrel. One end of the brace slips under the barrel hook, leaving the other end free to which the mainspring is hooked. The reason for the brace is that it relieves some of the stress placed on the outer end of the mainspring when fully wound and also ensures a more central development of the coils. In some chronometers, the mainspring hook is rigidly attached to the mainspring and engages with a hole

Figure 7. Mainspring brace positioned in barrel.

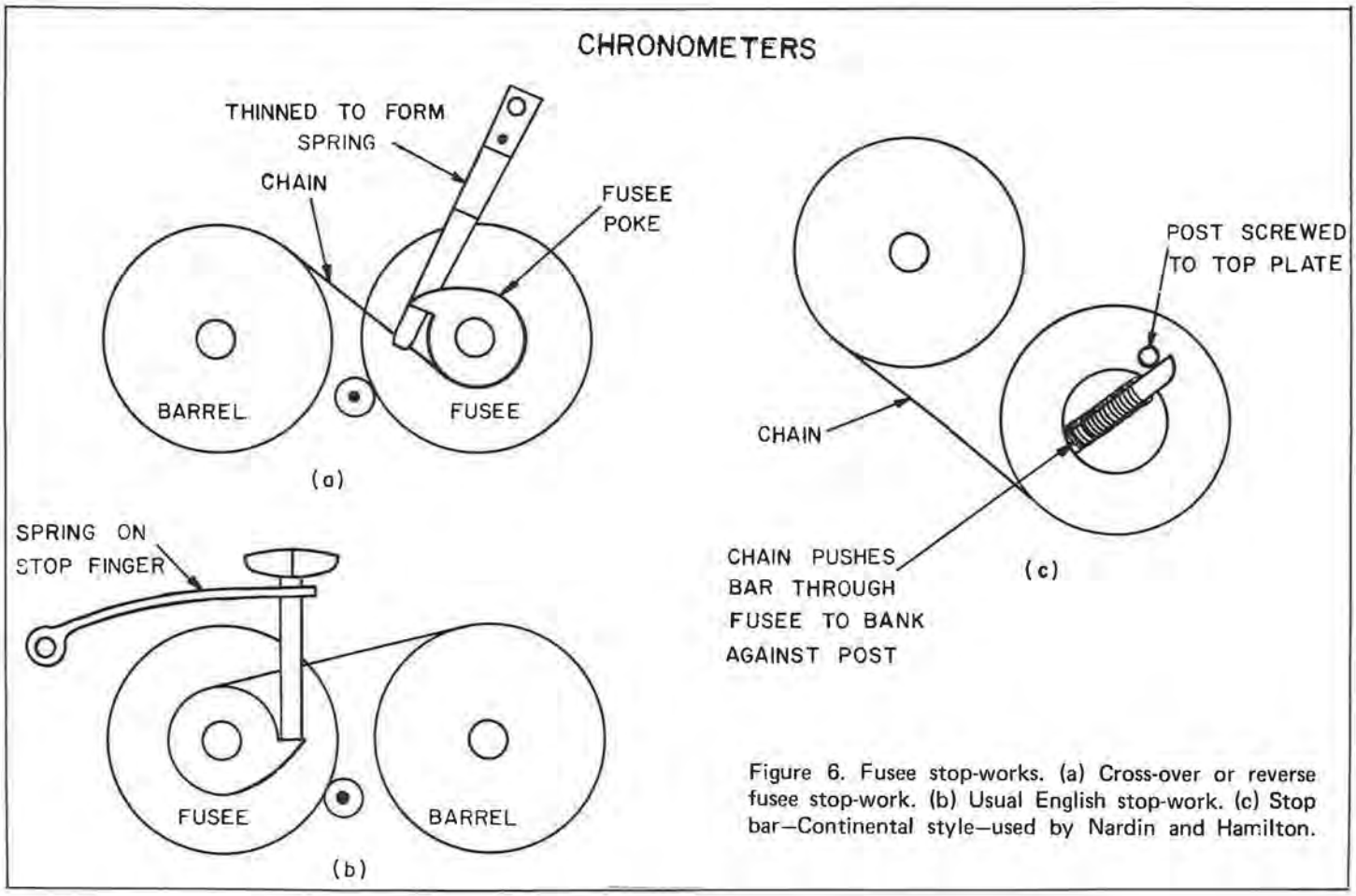

Figure 6. Fusee stop-works. (a) Cross-over or reverse fusee stop-work. (b) Usual English stop-work. (c) Stop bar–Continental style–used by Nardin and Hamilton.

in the barrel; in others, the hole is in the end of the spring and the hook is riveted to the barrel.

Most chronometer barrels have straight sides (Figure 8), but in the later Hamiltons a shoulder was added to the outside diameter at the open end of the barrel. See Figure 9. This shoulder was added to aid assembling in that it prevented

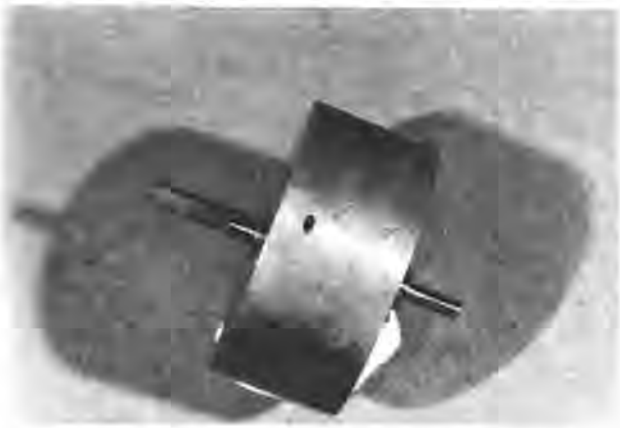

Figure 8. Straight side barrel—note hole for fusee chain hook.

the chain, under certain conditions, from sliding completely off the barrel and also, as a safety feature in order to provide some measure of protection to the center wheel pinion teeth.

A set-up ratchet wheel is mounted over the barrel arbor where it protrudes through the barrel bridge. The backward motion of the set-up ratchet wheel is retarded by a click. The Hamilton and several other makes employ a click spring but by and large they are not necessary because the only time the set-up ratchet wheel is turned is during set-up. The function of these parts is to prevent the barrel arbor from turning during winding and running. Even after running down there is still some power remaining on the barrel from set-up. The only time the barrel arbor is turned is during disassembling (when removing the power), and assembling, when the mainspring is being set up.

Fusee vs Going Barrel

Even though the fusee has been replaced by the going barrel in watches, and several very prominent chronometer makers fitted some of their chronometers with a going barrel, the fusee still remains as an integral part of the chronometer's driving mechanism. These makers were of the opinion that in the long run an instrument fitted with a fusee would perform better than one with a going barrel. Although they conceded that the going barrel was much simpler to construct, the necessity of a stop works, the redesigning of the up-and-down indicator, and the difficulty of obtaining a longer and stronger spring would create more problems than it would solve.

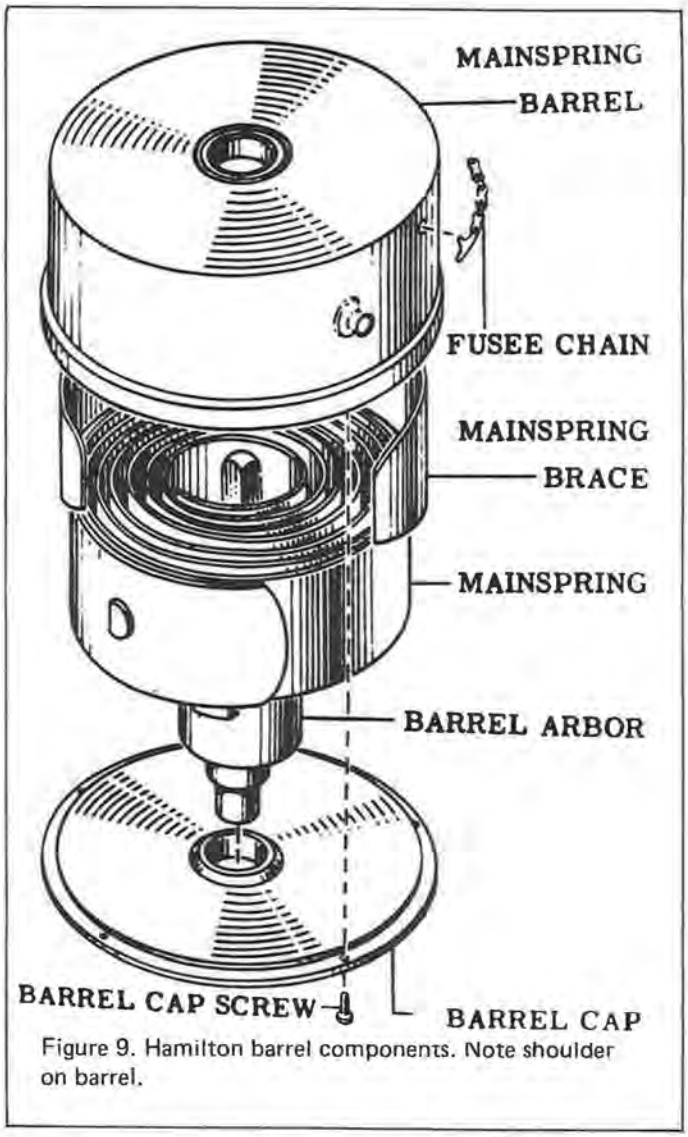

Figure 9. Hamilton barrel components. Note shoulder on barrel.

About 1770, LeRoy refused to use either a fusee or a remontorie in his chronometers, fitting his marine timepieces with a going barrel. He contended that the hairspring and the hairspring alone affected the timepiece's isochronism. Sully, Arnold, F. Berthoud, Breguet, and Jurgensen fitted several of their chronometers with a going barrel. Breguet used two, sometimes four barrels all geared to the center wheel pinion, which floated between them. However, the most outspoken advocate of the going barrel was a French maker, Henri Robert, who in 1839 wrote several articles strongly supporting the feasibility of the going barrel. See Figure 10.

In 1807, John R. Arnold, son of the senior Arnold, used the going barrel in several of his chronometers. Instruments numbering 324, 342, 344, 356, and 367 were fitted with a going barrel while numbers 326, 338, 366, and 383

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employed the fusee. Arnold continued to make standard chronometers with some minor improvements, but by and large, most of his instruments utilized the fusee.

Although several earlier makers attempted to supplant the fusee with the going barrel, they evidently had some strong reservations regarding its soundness for they, too, reverted to the use of the fusee. So it was apparent years ago, whether the fusee had the strategic importance that has customarily been attributed to it.

As we all know, the going barrel, because of its simplicity and lower production cost, finally replaced the fusee in all portable timepieces except the ship's chronometer. However, it was the consensus of most chronometer makers

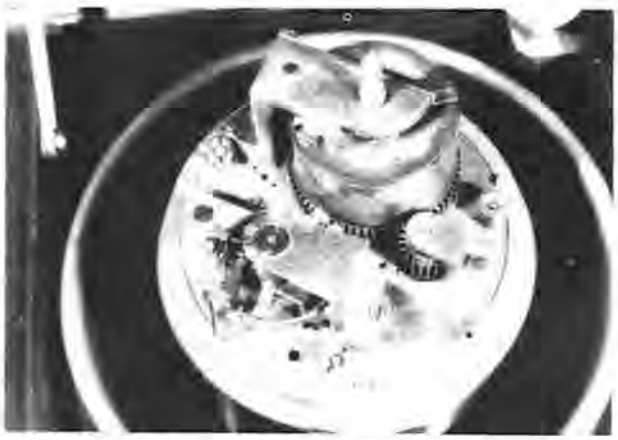


Figure 10. H. Robert No. 102. Going barrel with stopworks. Pivoted detent. Pinion on right drive time train position between plate and dial.

and to some degree with the Hamilton and Elgin engineers that the consistency of rates achieved over the years and of no height or space restrictions as there were in watches, that the use of the fusee outweighed any advantages gained by using the going barrel.

But when the Hamilton was produced, time was of the essence and the need of chronometers which would be accurate, reliable, and seaworthy for our expanding Navy was overwhelming. There was no time for any prolonged experimenting incorporating any new design changes. E.W. Drescher, Hamilton's Watch Design Supervisor who was in charge of the chronometer design section, told me that if they had time, he saw no reason whatsoever why they (Hamilton) could not design a chronometer with a going barrel in conjunction with the detached lever escapement, monometallic balance with overcoiled hairspring, free sprung and fully jeweled, that would perform as well, if not better, than any Earnshaw designed ship's chronometer.

So the Hamilton chronometer follows the conventional design (Nardin) which persisted for over a hundred years. The only new changes made by Hamilton that could be considered revolutionary in chronometer design was the balance and hairspring assembly and interchangeability of parts, which is an achievement in itself when one realizes that there are 121 different components.

Hamilton did produce a 21-jewel, 35 size gimballed and nongimballed chronometer watch (Model 22) which incorporated all of Mr. Drescher's aforementioned components, except being free sprung. One of the design characteristics of this watch which contributed to its superb performance was an unusual long mainspring which allowed an almost constant flow of power over a 24-hour period. This design feature was a large contributing factor in the accuracy of this instrument, since the performance of this watch during trials equalled or exceeded the performance of many types of ship chronometers.

Arguments as to the respective merits of the fusee, the going barrel and the proper design or configuration of the fusee will probably continue. Saunier, in his *Treatise on Modern Horology* when making his concluding observations on stopworks and the uncoiling of springs, states that, "The power of selecting the best series of turns to include within the limits of stopwork is so important that it must be regarded as the reason for the retention of the fusee in chronometers, because with the fusee we can secure with certainty a rather longer period of going and a mainspring the uncoiling of which takes place under the best conditions."

The last observation is of the highest importance, so much so that it alone should settle the discussion between the advocate of the fusee and of the going barrel."

The arrangement or placement of the barrel and the fusee has also been criticized, for the usual arrangement or placement of the barrel and fusee in most chronometers is such that the chain comes straight off of the barrel onto the fusee (See Figures 6b and 6c) on the side away from the center wheel pinion. Mudge maintained that in this arrangement the pressure and friction on the fusee pivots (which are quite large) is the *sum* of the force of the spring on the fusee and of the fusee wheel on the center wheel pinion, whereas if the spring acted on the same side as the pinion, it would only be the *difference.*

Sir Edmunds Beckett writing in *Rudimentary Treatise* around 1880 said, "I confess I know no reason why the common arrangement should be adhered to except that it is the common one, which is generally considered reason enough for anything bad."

To equalize this pressure and friction, the crossover or reverse (See Figure 6a) was designed whereby crossing over the fusee chain, the fusee and barrel rotated in opposite directions. Thus, this arrangement has the mechanical advantage of equalizing the side pressure on the fusee arbor. Although it was generally conceded that the reverse fusee was superior over the usual arrangement, only one chronometer maker made continued use of it. Victor Kullberg (1824-90), one of the most brilliant and successful chronometer makers of the last half of the 19th century, used the reversed fusee in all of his chronometers.

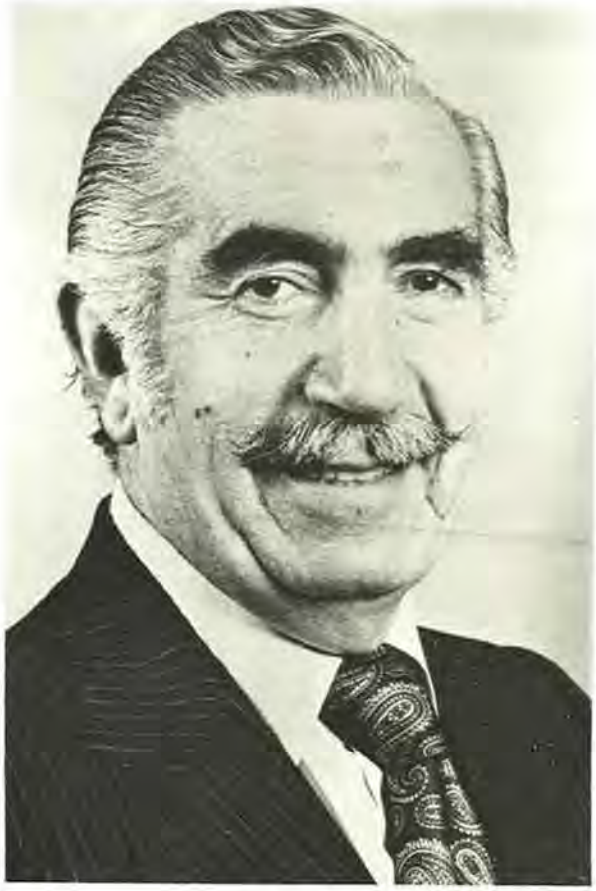
Next month, the functional description continues. □

No man who does a good deed should expect gratitude. The reward of a good deed is having done it.

JASANOFF NAMED TO BULOVA POST FOR BRACELETS

Milton Jasanoff, a widely known jewelry industry sales executive, has been named Bulova Watch Company's director of bracelet marketing, a new post, R. Mark Bourquin, the president of Bulova, has announced.

Mr. Jasanoff, who headquarters at Bulova Park, Flushing, N.Y., reports directly to Mr. Bourquin. He is responsible for initiating and expanding the marketing of Bulova



Milton Jasanoff

watch bracelets to consumers through the 22,000 Bulova jewelers in the United States.

"Milton Jasanoff is proably the most experienced bracelet marketing executive in the fine jewelry industry of the United States," Mr. Bourqin commented. "We are delighted to have him join the Bulova management team, and jewelers can now look forward to working with Bulova to expand their watch bracelet replacement business."

For many years Mr. Jasanoff served as director of sales and as a sales executive with Kreisler Manufacturing Company. He also has served as vice president of sales of the Hadley-Kalbe Corporation. He is a resident of Englewood Cliffs, New Jersey.

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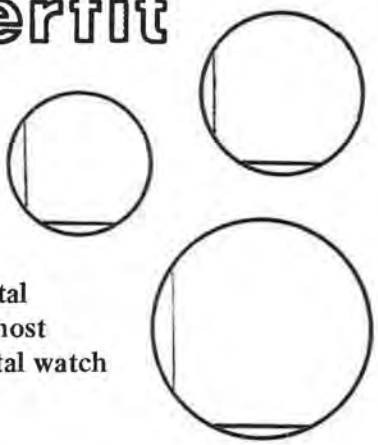
announces



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ANNUAL BOARD MEETING AND AFFILIATE CHAPTER MEETINGS SET

The annual Board of Directors meeting of the American Watchmakers Institute will be held June 24 and 25 at the Americana Hotel, Greater Cincinnati Airport. The annual Affiliate Chapter meeting will precede it on June 23. Delegates from all sections of the United States will attend, each representing AWI Affiliate Chapters.

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Lesson 4	Using a Meter to Measure Voltage
Lesson 5	The Theory of Electron Flow and Ohm's Law
Lesson 6	Using Meters to Measure Current and Resistance
Lesson 7	How Magnetism Can Generate Electricity
Lesson 8	Generating Electric Pulses at Your Bench
Lesson 9	Introduction to Diodes and Transistors
Lesson 10	Experimenting with Diodes, Transistors, and Capacitors
Lesson 11	The ESA Electronic Watch, Calibre 9158
Lesson 12	Electronic Principles of the Accutron
Lesson 13	Quartz Crystals and Electronic Reduction
Lesson 14	Bench Practice on the ESA 9180
Lesson 15	LED and LCD Solid State Watches
Lesson 16	Summary

In addition to the written lessons, students will be involved in servicing two electronic watches as well as working with concept teaching kits. AWI will provide the watches and kits. This course will prepare individuals for the new AWI Certification Examination of CERTIFIED ELECTRONIC WATCH SPECIALIST.

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HOME STUDY DEPARTMENT
P.O. BOX 11011
CINCINNATI, OHIO 45211

BENCH TIPS

From the Loupes & Tweezers, published by the Horological Association of Virginia, comes a crown tip, submitted by George W. Pittman of the Peninsula Guild. When you have good quality crowns with stems broken off in them, do not throw them away. Salvage them! Keep a bottle of alum water on your bench or desk and drop these crowns in the bottle for a few days. The alum will destroy the old stem stub and you can reuse these crowns. Only a little buffing may be needed. (At today's prices for good quality crowns, a little economy helps a lot.)

George E. McNeil of the Potomac Guild in Virginia presents this tip for the care of lathe collet chucks. A new collet chuck should run true. It will continue to run true after much usage provided it has not been sprung by clamping a piece too large or too small. This is abuse. Always measure your work with a micrometer before selecting a chuck. If a workman has but a small assortment of chucks, he may be tempted to use one that is too small or too large and thus spring the jaws to such an extent that it will never run true again. It will have to be replaced.

This tip is from Bob Bishop, President of the Watchmakers Association of Pennsylvania, and member of AWI's Bench Tip Committee. The dial feet of the Accutron 214 are very soft, and frequently the threads become stripped and the dial nuts will not hold. Most of the time flattening the post with a pair of flat-nosed pliers will provide enough new surface for the dial nut threads to grip.

Bob Jordan, from Coopers in Jenkins Arcade, also with the Pennsylvania Association, sends this tip. A simple way to make a curved spring bar from a straight one is to place the bar between two nesting spoons of approximately the right curvature, and press them together until the proper curve is reached. Aluminum measuring spoons are good for this.

Anthony Casciato, also with the Watchmakers Association of Pennsylvania has this tip. Tangled hairsprings are a common problem and this is a way of untangling them. Cut a small triangle of watch paper slightly larger than the hairspring. Place the hairspring on a tapered pin. Place the piece of watch paper over the hairspring and put one point of the triangle one coil behind the point of entanglement. Rotate the triangle with a piece of pegwood at the other points in the direction of the coil until the point of entanglement reaches the outside.

All the way from Honolulu, Hawaii comes this handy tip from Wayne Webb of Waikiki. For opening those tight fitting snap-back cases that have no apparent notch for a case opener, force a heavy single edge razor blade into the seam until the back parts slightly. Obviously, the razor blade is not strong enough to pry the case completely open, but it will open enough of a gap to insert a regular knife edge opener to finish the job.

Our thanks to the watchmakers who sent in the above tips. To have your bench tip printed in the *Horological Times,* send it with your name and address to Jingle Joe Crooks, 265 N. Main Street, Mooresville, North Carolina. □

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THE TRADESMAN

Pearl and Bead Restringing. All types. Fast service. Jean A. Gruenig, P.O. Box 12007, Columbus, Ohio 43212.

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Electronic Digital Watch Repair. We repair LED/LCD, Chronographs, and Alarms. In and out of production models accepted. Rapid, efficient, personal service. Stock quantity discounts available. Draw customers–expand your repair income. Free estimates available. Write for our price list. Parsec Enterprises, 634 Shelby St., Shelbyville, IN 46176. 317-392-4080.

Quality Watch Repair for the trade. All types Chronographs, electric, Accutron. Send for price list or call 412-837-2551. You'll be pleased. Robert J. Murtland CAT, P.O. Box 89, Delmont, Pa. 15626.

Wheels, pinions, barrels or whatever, repaired or made new. Repivot arbors. On all watch parts, inquire first. Ken-Way Inc., 311 Chestnut St., Addison, Ill. 60101.

Johnnies Watch Repair. Specialized in Accutrons since 1962, including all high grade watches. All work fully guaranteed. P.O. Box 3842 GS. Springfield, MO 65804. Phone (417) 744-2082.

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Calendar

JUNE

4-7—Portland Gift Show; Mulnomak County Exposition Center; Portland, Oregon

4-11—International Exhibit of Gold, Jewelry and Silverware; Vicenza, Italy

9-10—JC-K Financial Management Workshop; Chippewa Hotel; Mackinac Island, Michigan

10-11—Kansas Jewers Convention; Hutchinson Holiday Inn and Holidome, Hutchinson, Kansas

11-12—JC-K Inventory Management Workshop; Chippewa Hotel; Mackinac Island, Michigan

11-14—Mid-year China, Glass, and Gift Show; Atlantic City Convention Center; Atlantic City, New Jersey

11-16—International Decorative Accessories Market; Merchandise Mart; Chicago, Illinois

13—Watchmakers' Association of New Jersey; regular meeting

18-20—Birmingham Gift and Jewelry Show; Civic Center; Birmingham, Alabama

19-22—AWI Annual REC meeting; Cincinnati, Ohio

20-21—Northeast Craft Fair; Dutchess County Fairgrounds; Rhinebeck, New York

23-24—JC-K Sales Management and Motivation Workshop; Atlantic Oakes By-the-Sea Hotel; Bar Harbour, Maine

23-25—AWI Annual Meeting; Americana Inn; Greater Cinti. Airport; Cincinnati, Ohio

24-25—June Market Days; Denver Merchandise Mart; Denver, Colorado

24-25—Pennyslvania RJA Pittsburgh Jewelry Show; Greater Pittsburgh Merchandise Mart; Monroeville, Pennsylvania

25-26—JC-K Financial Management Workshop; Atlantic Oakes By-the-Sea Hotel; Bar Harbor, Maine

25-28—Charlotte Gift, Jewelry and Housewares Show; Merchandise Mart; Charlotte, North Carolina

28-30—American Society of Appraisers International Conference; Hershey Motor Lodge; Hershey, Pennsylvania

JULY

1-7—Christmas Gift, Jewelry and Housewares Show; Dallas Market Center; Dallas, Texas

2-5—Miami Merchandise Mart Gift Show; Miami International Merchandise Mart; Miami, Florida

7-8—JC-K Financial Management Workshop; Sheraton/Atlanta Hotel; Atlanta, Georgia

9-12—SJTA Southern Jewelry and Gift Fall Show; Hyatt Regency Hotel; Atlanta, Georgia

15-17—Great Lakes Jewelry Exposition; Hyatt Regency O'Hare; Chicago, Illinois

15-16—Oklahoma Retail Jewelers Association; Annual Show; Camelot Inn; Tulsa, Oklahoma

15-17—Mississippi Retail Jewelers Association Convention; Biloxi Hilton Hotel; Biloxi, Mississippi

18-21—JC-K Inventory Management Workshop; New York Sheraton; New York, New York

19-22—Early Bird Gift and Decorative Accessories Preview; Merchandise Mart; Atlanta, Georgia

22-26—Retail Jewelers of America Fall International Jewelry Trade Fair and Convention; Americana and New York Hilton Hotels; New York, New York

23-26—Charlotte Gift and Jewelry Show; Merchandise Mart; Charlotte, North Carolina

23-27—Atlanta National Gift Show; Georgia World Congress Center and Merchandise Mart; Atlanta, Georgia

24-29—Early Bird Gift Market; Merchandise Mart; Chicago, Illinois

28-30—Watchmakers Association of Ohio Convention and Annual Meetings; Mariott Inn; Columbus, Ohio

30-Aug 4—Chicago Gift Market; Merchandise Mart; Chicago, Illinois

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Calendar

AUGUST

9-11—Pacific States Craft Fair; Ft. Mason Facilities; Pier 2, San Francisco, California

13-15—Third Orlando Gift and Decorative Accessories Show; Convention Center/Sheraton Towers Hotel; Orlando, Florida

15-16—JC-K Inventory Management Workshop; Airport Sheraton; Los Angeles, California

17-18—JC-K Financial Management Workshop; Airport Sheraton; Los Angeles, California

19-21—20th Annual Pacific Jewelry Show; Century Plaza Hotel; Los Angeles, California

21-22—JC-K Financial Management Workshop; Fisherman's Wharf Sheraton; San Francisco, California

23-24—JC-K Sales Management and Motivation Workshop; Fisherman's Wharf Sheraton; San Francisco, California

SEPTEMBER

3-8—Dallas Fall Gift, Jewelry and Housewares Show; Dallas Market Center; Dallas, Texas

24—Quartz Watch Seminar and Bench Course; Watchmakers Association of New Jersey

ADVERTISERS INDEX

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