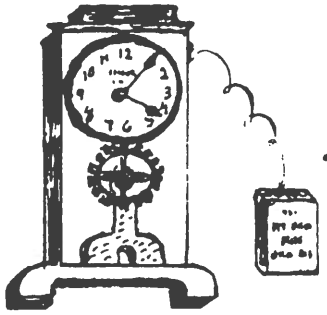


The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78

NATIONAL ASSOCIATION of WATCH and CLOCK COLLECTORS, Inc.

VOLUME XIV, #1 JAN 1988

Fellow Horologists:

In this, the first issue of 1988, we continue the IBM Workbook serial in which the various methods of slave clock regulation are discussed. This section is perhaps the most interesting in the light of the ingenuity employed to accomplish the result.

In addition, Dr. George Feinstein continues his series , " A Century of U.S. Electric Clock Patents, 1852-1951" with details of a patent by D. Drawbaugh, describing an unusual magnetically impulsed clock. This series is a comprehensive compilation of Electric Clock patents, entirely original, and unavailable anywhere else.

The next regular meeting of Chapter 78 will take place on Sunday March 27 in conjunction with the Westchester Chapter 90 at the Hommock's School in New Rochelle, NY. The agenda will consist of a brief business meeting and "State of the Chapter" report. We were quite remiss when we recently commented on the joint electrical chapter meetings that were held in conjunction with various regionals around the country. We neglected to make mention of one of our staunchest supporters, the Southern Ohio Regional group that holds its regional meeting in April in Fort Mitchell, Kentuckey. They provide a comfortable facility complete with refreshments, and the program, provided by the Electrical Horology Society, The Midwest Electrical Society, and Western Electrics, probably gets the largest attendance of electrical enthusiasts ever assembled in one place. Consider this meeting if you're planning to be in the area around April 14-16th this year.

We have received an original article on Sempire Clocks from our own William Ellison, and a very rare reprint of the service manual on DOUBLE CONTACT Tiffany Never-Wind clocks from Leon O'Briant, one of our regular contributors. This material will appear in the next issue of the journal.... Don't miss out, so PAY YOUR DUES if you haven't yet done so... This is the last issue for those who have not paid their 1988 $10 membership dues!

Co-Editors: Harvey Schmidt
Dr. George Feinstein

President: Martin Swetsky

Self-Regulating System

The basic principle of the electric clock systems is to have one clock, called the Master Clock, regulate or escape all other clocks in the system. This does away with having to regulate a pendulum in each clock, and it assures uniformity of time throughout the system. Power is supplied from the commercial current or a battery and this eliminates the necessity of having to wind a multiplicity of individual time units. In other words, when clocks are operated as individual key wound pendulum escaped units it is necessary to regulate the pendulum and keep up the spring tension in each individual clock, whereas, in an electric system there is but one pendulum to regulate and one source of power. This very much simplifies maintenance, and because one pendulum escapes or regulates all the clocks, uniformity of time is assured throughout the system.

The International Business Machines Corporation furnishes three different arrangements for the control of a system of clocks from a central master clock and power supply. These three arrangements are known as the Plain Minute Impulse Sustem, D.C. Self-Regulating System, and A.C. Self-Regulating System. A brief explanation of these three methods of control follows:

Plain Minute Impulse System.

The plain minute impulse system of operating an electric clock system was developed and put into use over 50 years ago. It consists of a master clock, Battery control relays, and the secondary units. The master clock once each minute releases an electric power impulse from the battery through the control relays, to step the secondary units forward one minute. The secondary units contain no clock movement; only a magnet and

ratchet, known as an Electric Drive. Such an electric drive movement is very compact and rugged. They need no cleaning, oiling, or periodic attention. The plain minute impulse electric drive system is used by practically all manufacturers of clock systems and every type of clock, program machine, recorder, time stamp, etc. manufactured by the International Business Machines Corp. can be furnished for operation in such a system.

D.C. Self-Regulating System.

The D.C. Self-Regulating system is the same as the plain minute impulse except that a feature is added that corrects all secondary units and brings them into exact time with the master clock once each hour. This is accomplished by operating the secondary clocks through a double control circuit, one side of which carries impulses all of the time, and the other side for only 50 minutes of the hour.

The secondary clocks balance themselves between these two sets of impulses. If any secondary clock is thrown out of step with the master clock, either accidentally or intentionally, it will within an hour automatically come back to its normal balance between the two sets of impulses and again agree with the master clock. The range of correction covers 17 minutes slow or 10 minutes fast in one hour. The system will correct clocks that are as much as 45 minutes slow, but it requires three hours to accomplish this.

This system offers all the ruggedness and simplicity of a plain minute impulse control, together with the added advantage that it sets and runs all secondary units in exact unison with the master clock. It saves time amd trouble involved with a plain impulse system, of having

to send a man around periodically to check the time of the secondary units to see that they agree with the master clock, and if any are found in error, to open them up and re-set them.

Every type of recorder, clock, program machine, and time stamp manufactured by the International Business Machines Corp., with the exception of the 3300 Recordolock, can be operated in a Self-Regulating electric system.

A.C. Self-Regulating System.

The International A.C. Self-Regulating System is the same as the previously described D.C. Self-Regulating System with the single exception that the control relay equipment is arranged to take its power directly from the 110 or 220 volt alternating current supply and transform same to a lower voltage, unidirectional impulse current suitable for operating our 24 volt or 12 volt electric drive units.

Each master relay and each distribution relay incorporates a power transformer consisting of a regular two-coil step down transformer and a copper plate rectifier to change the alternating current to unidirectional impulse current. The rectifiers are connected up so as to give full wave rectification. 60 cycle alternating current will therefore be changed to current of 120 unidirectional impulses per second.

This unidirectional impulse current will energize our standard driving magnets perfectly, but due to its not being a smooth flowing current and also due to some inductance being developed in the clock magnets, its voltage must be somewhat higher than the nominal voltage of the clock magnets.

To prevent breakdown of the copper plate rectifiers by the inductive kick-back from the clock magnets, the rectifiers are incorporated

as a permanent part of the clock circuits and all openings and closings of the circuits by the relays is done on the A.C. side of the rectifiers.

To prevent heating of the copper plate rectifiers, all current iskept off them except during the duration of the minute impulse. This necessitates the use of A.C. relays wherever relays are required to operate at other times than during the regular impulse. Therefore in this system the minute impulse master relay, seconds beat master relay, and all bell circuit relays operating from a duration contact or a timing relay, must be of the A.C. type.

The International Self regulating A.C. System is furnished in two voltages - 24 volt and 12 volt.

In the 24 volt system the master relay and the distribution relays are equipped with complete power transformers with 24 volt A.C. taps for the control of the bell circuit relays. No bells can be operated from these transformers.

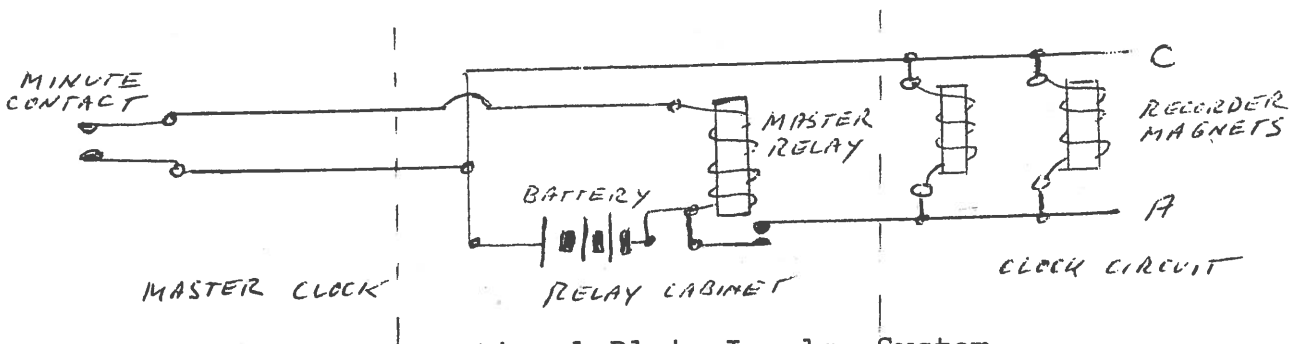
In the 12 volt system the master relay and the distribution relays contain only the copper plate rectifiers and a separate clock circuit transformer must be added to furnish 24 volts A.C. to the rectifiers. This transformer can then also be used for the ringing of bells.

Only half as many units can be carried on a 12 volt A.C. circuit as on a 24 volt A.C. circuit, and the circuit can be carried only one-halfas far with the same size wire.

Electric impulse Systems.

In the following pages various typical layouts of electrical impulse systems are illustrated and described. The purpose of the diagrams

and descriptions is to show how International control units relate to each other when actually installed in a clock system. The following diagram illustrates the wiring and connections in a Plain Impulse System. Some form of battery is essential on a plain impulse system as no provision is made for automatically setting the clock system after commercial power failures.



International Plain Impulse System

Operation -

The Master Clock minute contact closes once each minute, allowing master relay to be energized, which closes the curcuit to wire "A" and allows current to momentarily flow through magnets of recorders, secondary clocks, etc. Note that the system operates on two wires throughout. If the master clock is of the magnet wound type, an extra pair of wires must be carried from wires "A" and "C" in the relay cabinet to the master clock for winding purposes.

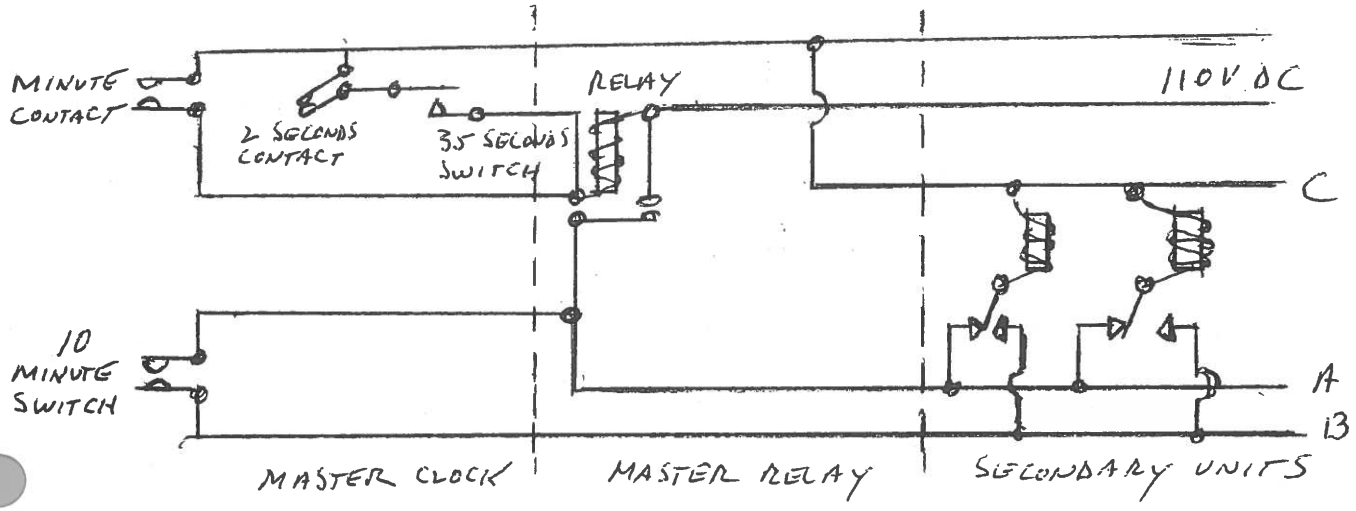
International D.C. Self-Regulating System

Operation

Master clock minute contact closes once each minute, allowing master relay to be energized, which closes circuit to wires "A" and "B" and allows current to momentarily flow through magnets of recorders, secondary clocks, etc. The above is all that takes place so long as all

secondary units are in unison with the master clock. If, however, for any reason a secondary unit gets thrown out of step with the master clock, either ahead or behind, it will within the hour be brought back into perfect unison with the master clock by one or the other of the two following actions:

International D.C. Self-Regulating System



The above diagram illustrates the wiring and connections for an International D.C. Self-Regulating System.

1st. - if ahead -

The 10 minute switch in the master clock disconnects the "B" wire for ten minutes once each hour from the 50th minute to the 59th minute inclusive. Therefore, if any secondary unit is ahead of the master clock it will cease to operate as soon as it reaches its own 59th minute where it transfers from wire "A" to wire "B". By this means all fast secondary units are lined up together at their 59th minute point where they wait for the master clock. Just before the master clock reaches its 60th minute point, the 10 minute switch reconnects the "B" wire to the impulse circuit and when the 60th impulse comes through,

all secondary units receive it and step forward in unison with the master clock.

2nd if Behind

The 35 seconds switch in the master clock closes once each hour for about 35 seconds, between the 59th and 60th minute impulses, and while the 10 minute switch is still open. This allows the 2 seconds contact to operate the master relay and send out about 17 rapid impulses over the "A" wire only. If any secondary units are behind the master clock and therefore still on the "A" wire, they will receive these rapid impulses until they reach their 59th minute points where they cut over onto the dead "B" wire in agreement with the master clock.

Note that so long as the secondary units are in unison with the master clock they receive only the regular minute impulses and are not affected by the Self-Regulating feature. The master clock opens wire "B" for ten minutes before the even hour whereas the secondary units receive their impulses over wire "B" only after the even hour. The secondary units are connected to the "B" wire only from the 59th to the 3rd minute points inclusive. At all other times they operate from the "A" wire.

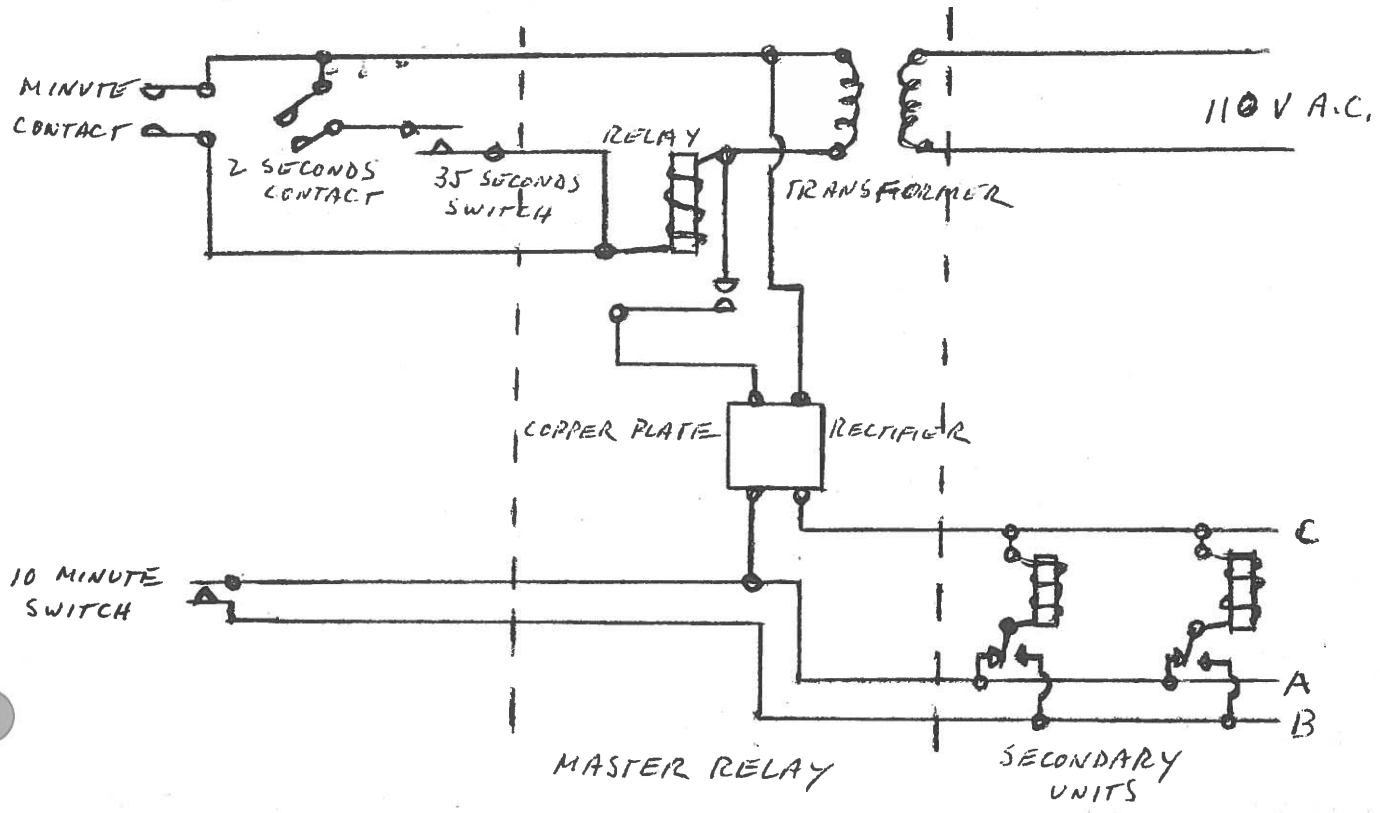
International A.C. Self-Regulating System

Operation:

Master clock minute contact closes once each minute, allowing master relay to be energized which closes the A.C. circuit to the rectifier. This A.C. in going through the rectifier is changed to unidirectional impulse current and as such flows out over the wires "A" and "B", through the magnets of secondary units and back over wire "C". Note that the rectifier is integral with the clock circuit and is

energized only during the duration of the minute impulse.

INTERNATIONAL A.C. SELF-REGULATING SYSTEM



The above diagram illustrates the wiring and connections for an International A.C. Self-Regulating System.

The above is all that takes place so long as all secondary units are in unison with the master clock. If, however, for any reason a secondary unit gets thrown out of step with the master clock, either ahead or behind, it will within the hour be brought back into perfect unison with the master clock by one or the other of the two following actions:

1st - If Ahead

The 10 minute switch in the master clock disconnects the "B" wire for 10 minutes once each hour from the 50th minute to the 59th minute inclusive. Therefore, if any secondary unit is ahead of the

of the master clock it will cease to operate as soon as it reaches its own 59th minute where it transfers from wire "A" to wire "B". By this means all fast secondary units are lined up together at their 59th minute point where they wait for the master clock. Just before the master clock reaches its 60th minute point, the 10 minute switch reconnects the "B" wire to the impulse circuit and when the 60th impulse comes through, all secondary units receive it and step forward in unison with the master clock.

2nd. If Behind

The 35 seconds switch in the master clock closes once each hour for about 30 seconds, between the 59th and 60th minute impulses, and while the 10 minute switch is still open. This allows the 2 seconds contact tooperate the master relay and send out about 17 rapid impulses over the "A" wire only. If any secondary units are behind the master clock and therefore still on the "A" wire, they will receive these rapid impulses until they reach their 59th minute points where they cut over onto the dead "B" wire in agreement with the master clock.

Note that so long as the secondary units are in unison with the master clock they receive only the regular minute impulses and are not affected by the Self-Regulating feature. The master clock opens the wire "B" for ten minutes before the even hour whereas the secondary units receive their impulses over wire "B" only after the even hour. The secondary units are connected to the "B" wire only from the 59th to the 3rd minutepoints inclusive. At all other times they operate from the "A" wire.

1852-1951 A CENTURY OF U.S. ELECTRIC CLOCK PATENTS.

By Dr. George Feinstein

TABLE I: Chronology (Continued)

Patent No. - Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description, and Comments
356,069 01/11/1887 (01/14/86)	46, 52, 166	Primary Electric Clock	V. Himmer	Assignor to Standard Electric Clock Co.
357,885 02/15/1887 (09/30/86)	55	Electric Clock System	T. J. Zoeller	Electro-magnetic relays.
359,799 03/22/1887 (06/24/85)	65, 207	Hydropneumatic Clock System	C.A.Mayhofer	Assignor to Carl Diener Pat. Germany 06/12/85 France 06/12/85 Belgium 06/12/85 England 06/12/85
359,830 03/22/1887 (03/23/85)	65	Pneumatic Clock	R.C.Wittmann	Assignor to himself & A. F. Bernsee
360,078 03/29/1887 (11/27/86)	52	Primary Electric Clock	J.J.Abel & C.B.Gifford	
360,092 03/29/1887 (12/07/85)	55, 59, 187	Secondary Electric Clock	W.B.Harvey	
360,481 04/05/1887 (09/21/86)	65	Auto-pneumatic Clock Mechanism	P.G.Puttemans	
360,903 04/12/1887 (06/15/86)	165	Electric Pendulum Clock	A.L.Parcelle	A pendulum resilient in its entire length and actuated by an electro-magnet communicates motion to the train.
362,462 05/03/1887 (02/24/86)	54, 65, 139	Pneumatic Clock System	P.G.Puttemans	
362,902 05/10/1887 (02/04/87)	149	Circuit-controller for Self-winding Clocks	C.H.Pond	
363,440 05/24/1887 (01/28/87)	59	Secondary Electric Clock Movement	C.D.Warner	

Patent No. Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description, and Comments
363,498 05/24/1887 (02/15/86)	52, 165	Primary Electric Pendulum Clock	J.Zeiner	
364,429 06/07/1887 (09/09/86)	134, 165	Electric Clock	G.E.Mejer	
365,023 06/14/1887 (03/01/87)	59, 187	Electric Synchronizing Apparatus for Clocks	A.Ramel & W.W.Dean	Assignors 1/2 interest to P.Bakewell.
366,513 07/12/1887 (09/02/86)	181	Electric Controlling and Regulating Device for Pendulums	W.S.Scales	Assignor to Synchronous Time Co.
367,663 08/02/1887 (03/07/87)	52	Electric Programme Clock	A.J.Reams	
367,898 08/09/1887 (05/29/78)	166	Magnetic Clock	D.Drawbaugh	Assignor to E.W.Chellis
367,960 08/09/1887 (02/09/87)	52	Electric Clock System	C.L.Clarke	Assignor to Telemeter Co.
368,689 08/23/1887 (11/15/86)	181	Controlling Device for Clocks vibratory length of the pendulum the rate.	W.S.Scales	By the operation of setting the hands to correct time the is adjusted to correct
369,386 09/06/1887 (09/09/86)	61, 185	Electric Synchronizing Attachment for Clocks	E.F.Bard	
373,138 11/15/1887 (12/15/86)	60, 185, 187	Clock-synchronizing Apparatus	C.J.Hexamer	
377,895 02/14/1888 (08/25/85)	58, 185	Secondary Electric Clock	W.B.Harvey	
383,655 05/29/1888 (12/21/87)	(200/ 38R)	Circuit-closing Device for Electric Clocks	C.H.Pond	Contacts operated by a cam on the shaft of the scape-wheel.

Patent No. Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description, and Comments
383,786 05/29/1888 (10/18/87)	207	Electric Apparatus for Winding Clocks Austria-Hungary 01/26/88	M.Viau	Pat. England 09/27/87 Belgium 09/28/87 France 09/30/87 Italy 10/05/87 Spain 11/20/87
384,271 06/12/1888 (03/23/87)	166, 181	Electric Pendulum Clock	A.L.Parcelle	Assignor to Manhattan Clock Co. of Colorado Pendulum rod does the flexing.
384,472 06/12/1888 (10/29/87)	207	Electric Winding Attachment for Clocks	A.J.Reams	
386,103 07/17/1888 (02/20/88)	58	Secondary Electric Clock Movement	C.Bohmeyer	Pat. Germany 07/12/87
387,276 08/07/1888 (04/17/88)	60, 187	Electric Clock-synchronizer	A.G.Wiseman	
387,614 08/07/1888 (04/04/88)	65	Clepsydra	J.Cardona	
387,703 08/14/1888 (05/07/88)	187	Circuit Closer for Electric Clocks	C.D.Warner	Assignor to the Standard Electric Time Co.
387,704 08/14/1888 (05/07/88)	52	Electric Clock System	C.D.Warner & A.D.Bennett	Secondary clocks.
387,974 08/14/1888 (01/10/87)	51	Electric Clock-synchronizing System	C.J.Hexamer	Assignor to Philadelphia Time Telegraph Co.
388,622 08/28/1888 (05/25/88)	149	Electric Motor for Self-winding Clocks	F.W.Brainerd	Similar to early Self Winding Clock motors.
390,230 10/02/1888 (04/25/87)	60, 185	Clock-synchronizing Apparatus	C.E.Hoefling	Pat. England 10/08/86
391,446 10/23/1888 (05/24/88)	186	Clock-synchronizer	A.G.Wiseman	

Patent No. Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description and Comments
391,969 10/30/1888 (10/01/87)	207	Electric Self-winding Clock	V.Himmer	
392,230 11/06/1888 (11/18/87)	55	Electric Regulating & Hand Setting Mechanism for Clocks	W.S.Scales	Assignor to Synchronous Time Co.
393,159 11/20/1888 (09/22/87)	51	Clock-synchronizing Mechanism	E.Kronenberg	
393,637 11/27/1888 (06/01/88)	75	Electric Striking Attachment for Clocks	J.H.Gerry	Assignor to the Self Winding Clock Co.
393,638 11/27/1888 (06/01/88)	181	Pendulum-regulator for Clocks	J.H.Gerry	Assignor to the Self Winding Clock Co. Mechanism for adjusting length of suspension spring from clock dial.
395,357 01/01/1889 (03/17/88)	60	Controlling Device for the Regulating Members of Clocks	W.S.Scales	Assignor to R.E.Robbins
399,128 03/05/1889 (05/25/88)	149, 209	Self-winding Electric Clock	F.W.Brainerd	
401,006 04/30/1889 (10/11/88)	(70/ 271, 185/ 40A)	Electric Self-winding Time Piece	M.Garranza & J.M.Tinoco	
401,065 04/09/1889 (08/31/87)	207	Electric Winding for Torsion-pendulum Clocks	H.Rabe	Assignor to Hanauer Electrische Uhren Fabric, Steinheuer and Rabe.
402,329 04/30/1889 (10/09/88)	75	Electric Striking & Repeating Clock	A.M.J.Jansen & V.J.A.M.Jansen	
402,823 05/07/1889 (09/11/88)	59	Electric Clock	E.G.Hammer	Operated by an ordinary motor and the escapement controlled by an electro magnet.
405,089 06/11/1889 (03/21/89)	149	Electric Self-winding Clock	J.H.Gerry	Assignor to Self Winding Clock Co.

Patent No. Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description, and Comments
407,945 07/30/1889 (09/22/88)	81, 220, 238	Electric Clock for Use in Exposed Places	A.Speer	Driving large hands by meshing with giant-fixed ring gears at the hands outer ends.
408,846 08/13/1889 (05/03/89)	55	Automatic Signaling Device for Time-service	C.H.Pond	Assignor to the Self Winding Clock Co.
410,013 08/27/1889 (04/27/88)	165	Electric Pendulum Clock	A.L.Parcelle	
411,138 09/17/1889 (12/27/88)	52	Electric Clock System	C.H.Carter	
411,168 09/17/1889 (05/03/89)	46	Gong-striking Mechanism for Synchronized Clocks	C.H.Pond	Assignor to the Self Winding Clock Co. Gong operated by synchronizer.
413,281 10/22/1889 (08/27/88)	166, 170	Electric Pendulum-driven Clock	M.L.M.Hussey	
413,340 10/22/1889 (08/09/89)	181	Electric Regulator for Pendulum Clocks	J.H.Gerry	
415,817 11/26/1889 (03/05/89)	207	Electrical Appliance for Winding Clocks	F.A.Lane	Assignor 1/2 interest to F.E.Morgan.
416,148 11/26/1889 (10/26/88)	59	Secondary Electric Clock	E.L.Slocum	
417,753 12/24/1889 (11/27/88)	55	Time-distributer for Electric Clocks	L.H.Spellier	Assignor to Spellier Electric Time Co.
417,927 12/24/1889 (05/24/89)	207	Automatic Electric Clock-winding Device	F.A.Lane	Assignor 1/2 interest to F.E.Morgan.
417,928 12/24/1889 (09/09/89)	207	Electric-winding Clock	F.A.Lane	Assignor 1/2 interest to F.E.Morgan.
418,125 12/24/1889 (03/07/89)	52, 166	Electric Synchronizing Device for Clock Pendulums	J.Hamblett	

Patent No. Date (of Appl.)	Class 368 Sub-Class	Invention	Inventor	Assignees, Foreign Patents, Description, and Comments
419,776 01/21/1890 (01/17/87)	134, 165	Electrical Clock	A.B.Jones	
424,268 03/25/1890 (12/13/89)	(346/ 34, 50)	Electro-magnetic Watch Clock	R.B.Carr	Assignor to A.Howard
424,273 03/25/1890 (08/07/89)	46	Electric Time-Dial	C.A.Colby &	Secondary clock.
424,929 04/01/1890 (11/02/89)	59	Double-faced Electric Clock	E.W.Lindenau	Assignor to Joliet Clock Mfg. Co.
427,781 05/13/1890 (12/05/89)	49, 54	Electro-pneumatic Clock System	C.A.Mayrhofer	Assignor to the Electro-Pneumatic Time Co.
428,676 05/27/1890 (02/14/89)	187	Electric-circuit Closer for Clocks	H.C.Karr	
428,854 05/27/1890 (07/26/89)	(200/ 37R)	Electric Programme-clock	J.L.McCaskey	
429,396 06/03/1890 (08/26/89)	207	Electrical Clock Winding Mechanism	C.A.Ward	
435,185 08/26/1890 (12/07/89)	(346/ 25, 34, 50, 81, 102)	Electrical Watchman's Clock	H.S.Park	
437,905 10/07/1890 (06/26/90)	(40/ 469, 475)	Electric Advertising Clock	M.Levi	Assignor 1/2 interest to R.Forsholm.
438,767 10/21/1890 (04/07/88)	54, 139	Electro-pneumatic Clock	V.Popp	Assignor to Popp Compressed Air and Electric Power Co., Ltd.
439,838 11/04/1890 (06/02/90)	165	Electric Actuating Device for Pendulum Clocks	J.H.Dyson	Assignor 1/2 interest to H.O.Wetherell
440,241 11/11/1890 (09/06/89)	59, 126	Electric Actuating Mechanism for Clocks	H.T.Schlegel	Assignor 3/4 interest to A.A.Schlegel & M.J.Gilbo

To Be Continued.

3 Sheets—Sheet 1.

D. DRAWBAUGH.

MAGNETIC CLOCK.

No. 367,898. Patented Aug. 9, 1887

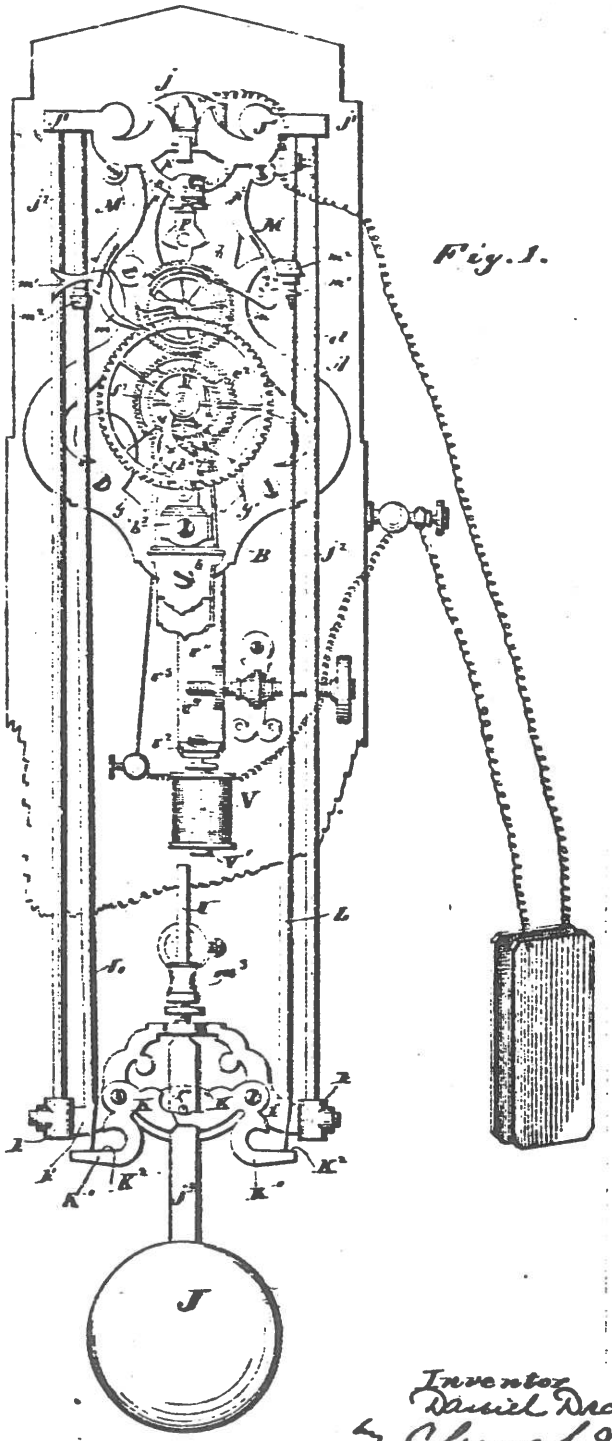


Fig. 1.

Witnesses.
Chas. R. Burr.
Fred'k. Church.

Inventor
Daniel Drawbaugh
by Church & Church
his Attorneys.

-1074-

3 Sheets—Sheet 2.

D. DRAWBAUGH.

MAGNETIC CLOCK.

No. 367,898. Patented Aug. 9, 1887.

Fig. 2.

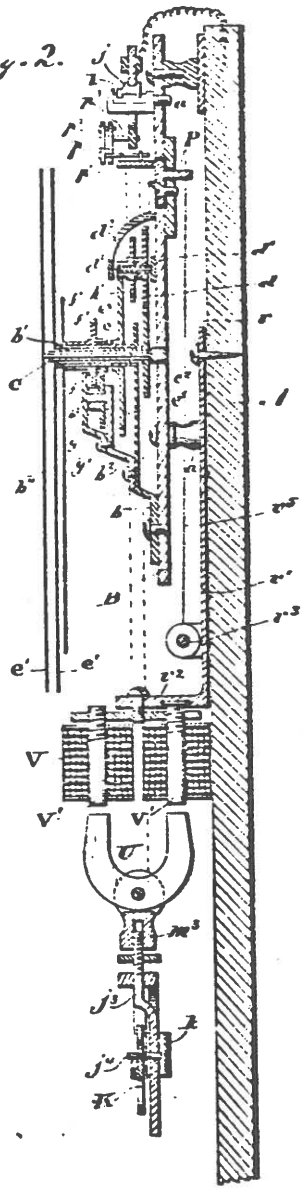


Fig. 5.

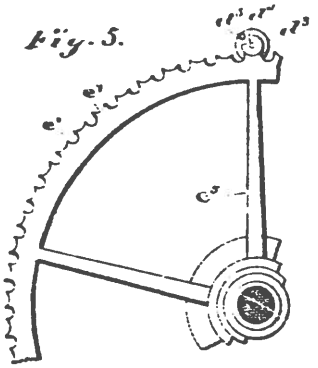


Fig. 6.

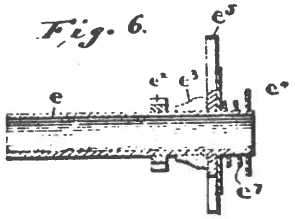
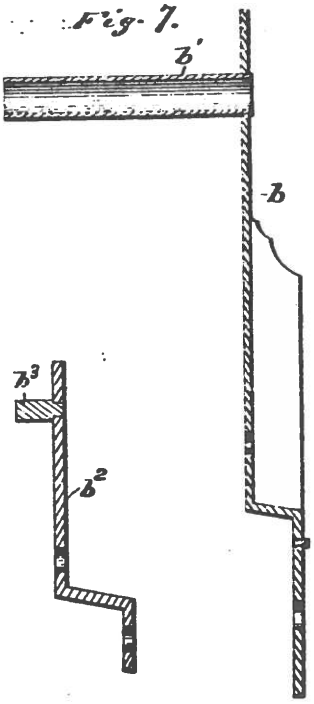


Fig. 7.



Witnesses.
Chas. R. Burr
Fred F. Church.

Inventor.
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by Church & Church
his Attorneys.

3 Sheets—Sheet 3.

D. DRAWBAUGH.

MAGNETIC CLOCK.

No. 367,898. Patented Aug. 9, 1887.

Fig. 3.

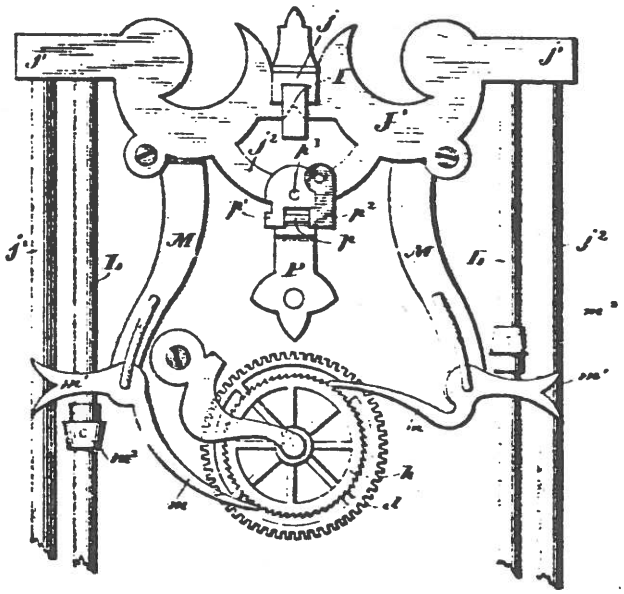
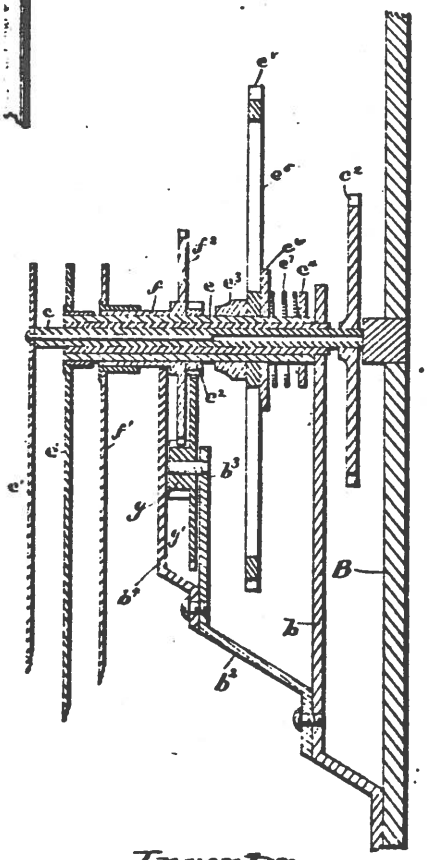


Fig. 4.



Witnesses.
Chas. R. Burt.
Fred'k. C. Church.

Inventor.
Daniel Drawbaugh
by Church & Church
his Attorneys.

UNITED STATES PATENT OFFICE.

DANIEL DRAWBAUGH, OF EBERLY'S MILL, ASSIGNOR TO EDGAR W. CHELLIS, OF HARRISBURG, PENNSYLVANIA.

MAGNETIC CLOCK.

SPECIFICATION forming part of Letters Patent No. 367,898, dated August 9, 1887.

Application filed May 29, 1878.

To all whom it may concern:

Be it known that I, DANIEL DRAWBAUGH, of Eberly's Mill, in the county of Cumberland and State of Pennsylvania, have invented certain new and useful Improvements in Magnetic Clocks; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to that class of mechanism designed more especially for measuring and registering divisions of time, wherein the motive power employed is electricity and the governor a pendulum; and it consists in the several novel and improved constructions and arrangements of parts, as hereinafter more fully described, and pointed out in the claims, whereby the structure of such a device is simplified and accuracy of movement secured with the expenditure of but little power.

In the accompanying drawings, Figure 1 is a front plan view, and Fig. 2 a central vertical section, of the operating parts of a clock mechanism, exhibiting the application of my improvements. Fig. 3 is a front elevation of a portion of the pendulum and the driving mechanism. Fig. 4 is a longitudinal vertical section of the mechanism controlling the movement of the hands. Fig. 5 is a detail showing the manner of connecting the driving mechanism and the mechanism controlling the hands. Fig. 6 is a detail showing the manner of connecting the arbor of the minute-hand and the master-wheel. Fig. 7 illustrates a portion of the supporting-plate or main frame.

Similar letters of reference in the several figures indicate the same parts.

The mechanism controlling the movements of the hands is all mounted upon a metallic plate or frame, B, supported upon posts *a*, rising from the base-plate A.

The clock mechanism proper, or that for effecting the regular and proportional movements of the hands, is constructed and applied as follows: To the plate B is detachably secured a bracket, *b*, whose upper or free portion stands a short distance from the plate B, and is provided with a sleeve or tubular post, b', and to the bracket *b* is in like manner secured a second bracket, b^2, carrying a post, b^3, and keeper b^4. Mounted to turn freely within the sleeve b' is a spindle, *c*, carrying the seconds-hand c', and provided at its rear end with a pinion, c^2, in gear with a pinion, *d*, supported upon a spindle, d'. Upon the exterior of the sleeve b' is fitted a sleeve, *e*, carrying the minute-hand e', and upon the last-named sleeve is mounted a sleeve, *f*, to which the hour-hand f' is attached. The sleeve *f* carries a wheel, f^2, in gear with a pinion, *g*, supported upon the post b^3, and attached to a wheel, g', in gear with a pinion, e^2, secured to the sleeve *e* of the minute-hand, the several wheels and pinions f^2, *g*, g', and e^2 being so proportioned relative to each other that twelve revolutions of the sleeve *e* will effect one revolution of the sleeve *f*.

The keeper b^4 stands across the end of the post b^3, with its end in front of the wheel f^2 on the sleeve *f*, serving not only to retain the pinion *g* and wheel g' in position upon said post, but also to hold the sleeve *f* in operative position upon the sleeve *e*. Loosely mounted upon the sleeve *e*, between a hub, e^3, secured to the said sleeve and a removable collar, e^4, is the large wheel e^5, through which the necessary movements are transmitted to the minute and hour hands.

Surrounding the sleeve *e* and interposed between the collar e^4 and a washer, e^6, in contact with wheel e^5, is a spring, e^7, which serves to maintain a sufficient frictional connection or contact between the said wheel and its sleeve to drive the latter, at the same time permitting the sleeve to be turned within the wheel for the purpose of setting the minute-hand, when necessary.

On the periphery of the wheel e^5 are formed a series of relatively-wide teeth, e^8, with concave ends or surfaces e^9, and upon the arbor d^2, to which the pinion *d* for driving the seconds-hand is mounted, is secured a hub, d^3, fitting within the concave ends of the teeth e^8 and provided with a cut-away portion, d^4, and a pin, d^5, for entering the spaces between the teeth e^8. By means of the hub d^3, entering the concave ends of the teeth e^8, the wheel e^5 is

prevented from moving until the pin d^2 enters the space between contiguous teeth, when said wheel will be moved through a distance equal to the width of one tooth, and again held until, during the revolution of the arbor d^2, the pin shall engage the next tooth.

In the example given the parts are so proportioned that one complete revolution of the arbor d^2, representing sixty seconds, as indicated by the movement of the hand e', shall advance the wheel e^3, and with it the hand e', one-sixtieth of a revolution, representing one minute, at the same time advancing the hour-hand proportionally, as will readily be understood.

To the arbor supporting the pinions for actuating the hands, as described, is attached the driving or escapement wheel h.

At or near the upper end of the plate B is secured a knife-edge, I, or other suitable support for the pendulum J, which is constructed and arranged as follows: To a plate or cross-head, J', is secured a hardened bearing, j, resting upon the knife-edge I, constituting the suspension-point or center of vibration of the pendulum. To each end j' of this cross-head J', and on opposite sides of the pivot, is secured a rod, j^2, whose lower end passes into or through a socket, k, in a cross-piece, k', said rods being adjustably fastened in the sockets and serving as suspension-rods for sustaining the pendulum J. The stem j^3 of the pendulum is provided with a pin, j^4, which is secured, and the weight sustained upon the inner curved ends of the two levers, K K, pivoted upon the cross-piece k'. The outer ends or arms, K^2, of the levers K are formed in arcs of circles, of which the rods L constitute the radii. The upper extremity of each rod L rests in contact with one of the ends j' of the cross-head J', and the lower end bears upon the curved surface of the arms K^2, in which latter are formed a series of bearings to receive the rounded ends of the said rods L. The rods j^2 and L are made of metals having different rates of expansion—as, for example, the rods j^2 may be of steel and the rods L of brass—and they are so proportioned and placed with respect to each other and the points of bearing upon the levers K as that any elongation or shortening of the rods j^2 from the effects of heat or cold shall be compensated for by the raising or lowering the pendulum with respect to the cross-piece k', upon which it is sustained, this effect being produced by the superior rate of expansion or contraction of the rods L acting upon the lever K, thereby raising the pendulum in proportion as the fulcrums of the levers K are lowered, and vice versa.

The cross-head J' carries two arms, M, adjustable about their points of attachment and provided with pawls m, whose inner ends or points make contact with the teeth of the ratchet-wheel h, and are held in engagement therewith by gravity. Both of said pawls extend outward beyond the pivot, their outer ends, m', projecting the one above and the other beneath an adjustable collar or stop, m^2, secured to the rods L. These stops m^2 operate to sustain the pawls when the points of the latter are retracted or swung back upon the ratchet-wheel, serving as a means for regulating the motion to be communicated to the gears at each oscillation of the pendulum by limiting the stroke of the points upon the teeth of the ratchet-wheel.

As will be readily understood, at each movement of the pendulum from one extreme to the other one of the pawls will operate upon the ratchet-wheel and advance the mechanism connected thereto a distance proportional to the stroke of the pawl and the point of engagement with the ratchet-wheel, and the same motions occur upon the return of the pendulum, the opposite pawl being then brought to bear upon the ratchet-wheel and the other retracted. The amount of movement thus produced at each oscillation of the pendulum can be regulated at this point by the adjustment of the collars for sustaining the pawls and of the arms bearing the pawls with respect to the cross-head. Upon the upper end of the stem of the pendulum is screwed or otherwise adjustably secured a block, w^3, carrying a permanent magnet, U.

To the base A is pivotally attached, as at r, a plate or hanger, v', provided with a lateral extension or foot, r^2, to which latter is secured an electro-magnet, V. The pole-pieces V' of this electro-magnet V are arranged above and facing the extremities of the horseshoe-magnet carried upon the pendulum, and the point at which the cores of the electro-magnet and extremities of the permanent magnet coincide, as the latter are carried to and fro by the pendulum, is regulated by an adjusting-screw, v^3, or equivalent device, operating upon the support for the electro-magnet. It will thus be seen that the magnet is adapted to operate as an adjustable polarized armature for the electro-magnet.

One terminal of the electro-magnet V is connected to one plate or pole of a source of electricity, and the opposite terminal is connected by a wire, v^5, with a bracket, P, insulated from but supported upon the plate B. This bracket has pivoted upon it a rod or strip, p, of conducting material. The outer end of this conductor p projects between two plates, p' p^2, the former, of conducting material, fastened by a pin, p^3, to the cross-head j^3, and the latter, p^2, of non-conducting material, pivotally supported upon and adjustable with respect to the plate p'. The opposite terminal of the battery or other source of electricity is connected to the cross-head j^3, as shown, so that the circuit through the electro-magnet will be closed so long as the plate p' maintains contact with the strip p. The two plates p' p^2, which serve to close and open the circuit, are adjusted and held apart so as to leave a space between their free ends somewhat greater that the width of the conducting-strip p. As

the pendulum oscillates from one extreme to the other, the plate p' is held against and carries the strip p with it to the opposite extreme; but as soon as the pendulum reaches its highest point and commences to move in the opposite direction the plate p' is drawn out of contact with strip p and the circuit is broken, the plate p' during the return movement operating merely to carry the strip p back to the starting-point and leave it in position to be again engaged by the plate p'.

The electromotor described is applied and caused to operate upon the pendulum to actuate the latter at regular intervals, and thus keep it oscillating in the following manner: By means of the adjusting devices applied to the support for the electro-magnet the latter is fixed to one side of the center of oscillation of the pendulum, with its cores facing a point at or near the extreme end of the arc through which the permanent magnet on the pendulum swings, so that at each alternate excursion the poles of the permanent magnet will be caused to approach and face those of the electro-magnet. The circuit through the coils and the connections with the battery or other source of electricity are so arranged that when the circuit is closed and the cores temporarily magnetized the poles of the permanent magnet will face the opposite poles of the electro-magnet, so that they will be mutually attracted. The connection being made and the various parts adjusted, as described, the pendulum is set in motion. As it swings toward the electro magnet the plate p' bears against the conducting-strip p, thereby closing the circuit through the electro-magnet and energizing its cores, and causing the latter to attract the permanent magnet. As the pendulum, being propelled by gravity, passes the center its power diminishes; but the attractive power of its magnets for each other increases, so that the loss is compensated or more than compensated for, and the pendulum is raised to or above the elevation from whence it started. During this excursion of the pendulum the plate p' remains in contact with the strip p, carrying it over to one side; but as soon as the extreme of movement is reached and the pendulum starts in the opposite direction, or toward the side from whence it started, the plate p' is moved away from the strip p, thereby breaking the circuit through the electro-magnet and holding it open during the return movement, the insulating-plate p' serving merely to carry the conducting-strip p back to the starting-point, to be again acted upon by the plate p' upon the next forward movement of the pendulum.

The advantage secured by the employment of a permanent magnet with poles opposed to those of the electro-magnet and located to one side of the center, and in arranging the mechanism so as to break the circuit as the poles pass, is two-fold: first, to enable the clock to be driven with a relatively weak current, such as may be supplied by what is known as an "earth battery," and, secondly, to secure a practically-continuous action and regular movement of the pendulum. This last-named result is due in a large measure to the manner of applying and operating the electro-magnet relatively to the permanent magnet, whereby the strength of the latter is maintained, instead of being reduced, at each successive beat of the pendulum, as the charging-circuit is broken the instant the pendulum begins to move away from the electro-magnet, thereby producing in the coils a secondary or induced current in the opposite direction, which not only deprives the cores of their attractive force, but by momentarily reversing their polarity accelerates the departure of the permanent magnet.

Experience has demonstrated that with a mechanism such as described, when a permanent magnet is affixed to the pendulum of insufficient strength or power to run the clock mechanism, if the pendulum is oscillated by hand or otherwise, the permanent magnet will gradually gain strength until sufficient power is developed to actuate the clock without other assistance.

It will be observed that the compensating devices on the pendulum, while serving to preserve the length of the latter, also operate to maintain the poles of the permanent magnet at the same distance from the cores of the electro-magnet, and thus prevent variations, which would otherwise occur in the propelling power.

Having thus described my invention, I claim as new—

1. In a clock such as described, and as a means for actuating the devices controlling the movements of the hands or pointers, the pivotally-supported cross-head to which the pendulum is attached, the gravitating pawls, and the ratchet-wheel, in combination with the stops engaging said pawls to limit their movement relative to the ratchet-teeth, substantially as described.

2. In combination with the driving-spindle of the clock mechanism, and the ratchet-wheel mounted thereon, a pivoted cross-head provided with adjustable arms carrying pawls, compensating suspension-rods attached to the cross-head and bearing the pendulum, and stops such as described, applied to the suspension-rods and engaging the pawls, as and for the purpose set forth.

3. The combination, with the main frame or plate B, provided with the bracket b, carrying sleeve b', and the bracket b^2, of the spindle c, sleeves e and f, and gears for driving spindle c and sleeve e from the main driving-shaft, and the gear mounted on the bracket b^2, for transmitting motion from sleeve e to sleeve f, substantially as described.

4. In a clock mechanism such as described, the combination, with the driving-shaft and its gear, of the spindle carrying the second-hand, supported within a tubular bearing or sleeve, and the sleeve carrying the minute-

hand, supported upon the exterior of said tubular bearing, the driving-wheel for the minute-hand sleeve, the washer or collar upon the sleeve, and the spiral spring operating to move the wheel longitudinally on its support to form an elastic frictional connection between the wheel and sleeve, substantially as described.

5. In a clock mechanism such as described, and in combination with the devices for controlling the movements of the hands, the ratchet-wheel, the pawls supported upon the cross-head for alternately engaging the teeth of the ratchet, the suspension-rods secured at their upper ends to the cross-head and at their lower ends to a cross-piece, the levers mounted upon the said cross-piece and engaging the stem of the pendulum, and the rods bearing upon the cross-head and levers, substantially as and for the purpose set forth.

6. In a clock such as described, and in combination with the pendulum for actuating the mechanism thereof, the permanent magnet secured to the pendulum, the stationary electro-magnet with cores of opposite polarity facing the poles of the permanent magnet and located to one side of the center of oscillation of the pendulum, an electric circuit, including the electro-magnet and a source of electricity, and a circuit-breaker connected to the pendulum and included in the electric circuit, operating to interrupt the current as the poles of the electro and permanent magnets are brought in line and the pendulum begins its reverse movement, substantially as described.

7. In a clock such as described, the combination, with the compensating rods supporting the pendulum, and the magnet connected to the stem of the pendulum, of the stationary electro-magnet located within the arc traversed by the pendulum and co-operating with the magnet borne by the latter to drive the pendulum, substantially as described.

8. In a clock such as described, and in combination with the pivoted cross-head, the suspension-rods, the cross-piece, the levers supporting the stem of the pendulum, and the expansion-rods interposed between said levers and cross-head, the magnet secured to the stem of the pendulum, the electro magnet co-operating with said first-named magnet, and a circuit-breaking device for interrupting the flow of current through said electro-magnet, substantially as described.

9. The combination, in a clock such as described, of a pendulum operating upon the clock mechanism to drive the latter, a fixed electro-magnet, a polarized armature attached to the pendulum, and a circuit-breaker for closing the circuit during the oscillation of the pendulum toward the electro-magnet and opening it when the pendulum is moving in the opposite direction, substantially as described.

10. The combination, in a clock such as described, and with devices for actuating the hands driven from the pendulum, of a permanent magnet attached to the pendulum and standing radially of its center of oscillation, and an electro-magnet located at a point within the arc traversed by the pendulum, but to one side of the center thereof, and with its cores facing the said permanent magnet, substantially as described.

11. In a clock such as described, the combination, with the actuating devices and the pendulum of the opposing magnets, the conducting and non-conducting plates borne by the cross-head, of the pendulum, the movable conducting-strip mounted upon the frame and having its free end projecting between the said plates, and the electric generator and circuit-connection, such as described.

12. In a clock such as described, the combination, with the pendulum and its attached magnet, of the electro-magnet mounted upon a pivoted support, and the adjusting devices for changing the position of the electro-magnet relatively to the arc traversed by the pendulum, substantially as described.

13. In a clock such as described, the combination, with the movable stem of the pendulum and compensating devices therefor, of an armature attached to said movable stem, and an electro-magnet located at or near the end of the arc traversed by the pendulum, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have hereunto set my hand and seal this 23d day of May, 1878.

DANIEL DRAWBAUGH. [L. S.]

Witnesses:

WASHINGTON J. HINES,

PETER STUCKER.

---- MART ----

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Harvey Schmidt, 75-80 179th Street, Flushing, NY 11366

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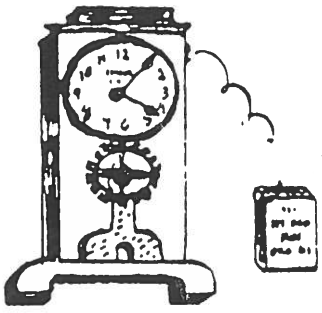


The JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

Chapter No 78

NATIONAL ASSOCIATION of WATCH and CLOCK COLLECTORS, Inc.

VOLUME XIV, #2, 3, 4. Dec 1988

Fellow Horologists:

This combination issue completes the Journal publication for 1988, long, long overdue, and without long-winded explanations, please accept the apologies of the officers and editorial committee for the delay. Personal commitments and responsibilities conspired to prevent their meeting to prepare and edit the material for publication. Now that we're back on track, we hope to maintain our regular schedule for 1989.

This issue contains a complete reprint of the original Repair and Instruction manual for the single contact Tiffany Never-Wind clocks. The material was provided by Leon O'Briant, a long time member and frequent supplier of information from his personal library. It was unfortunate that Leon's material was in poorly reproduced form and we thank Dr. George Feinstien for his re-typing and touch-up efforts. George also provided us with the ATO material and the Dickinson patent information in this issue. H.W. (Bill) Ellison has provided a original article on the Sempire Clock, with a comprehensive description of the operation of its unique switch contact. Bill also suggested that we begin a "Helpful Hints" column and started it off with a few of his own. How about making this a regular feature... We're sure that there must be lots of good ideas out there, waiting to be published! Thanks to Western Electrics, chapter #133 for the expoded view of the early Bulle clock. More on Bulle in future issues, with lots of repair info.

In addition, we have included a portion of "A COURSE IN RAILWAY SIGNAL ENGINEERING" originally printed shortly after the turn of the century, which covers the theory, design, and developmentof the battery (or more properly, "CELL") from the early wet cells to the sealed dry cell. Additional illustrations of some of the very earliest cells from other sources is included to round out the material.

Now, the bad news... 1989 dues NOW DUE... (Send to Harvey Schmidt)

Good reading ahead...

Co-Editors: Harvey Schmidt
Dr. George Feinstein
President: Martin Swetsky

REPAIR
INSTRUCTION
AND
INFORMATION
CHART
OF
STYLE 1100

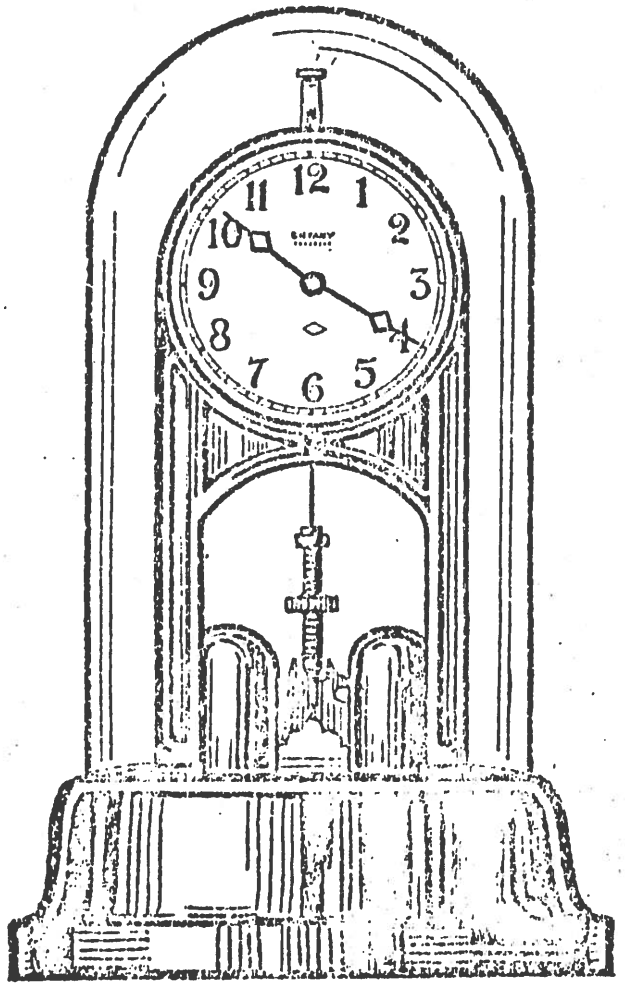
The TIFFANY Never-Wind CLOCK

TIFFANY Never-Wind CLOCK CORPORATION

BUFFALO, N. Y.

U. S. A.

The TIFFANY Never-Wind CLOCK



STYLE 1100

FOREWORD--(Clocks in General)

Mr. Watchmaker:--

The result of your best clock repair work is often spoiled, after you have carefully made the repairs and set the clock up on your customer's mantelpiece, by the careless handling or moving of the clock by your customer or some one in the household.

So true is this that many of the leading jewelers in our cities have found the clock business such a nuisance and so unprofitable that they have already stopped handling clocks or else contemplate doing so.

This certainly is not to your interest or ours and there should be no more reason for selling clocks or making repairs without a good profit than for selling Automobiles, Victrolas, Typewriters and Sewing Machines. The public has got to have clocks.

If we abuse our Autos, Victrolas or Typewriters we soon learn that we not only have to pay for repairs, but learn to use these articles properly and--why not a clock?

Is it not therefore up to you, for you come in direct contact, and to us, to do all we can from now on to educate the clock buying public to properly and decently treat their clocks and to not blame you or the manufacturer for what is plainly the public's own fault.

We promise to do our part by printed matter sent with each clock and by reading matter which will have National Circulation. Won't you co-operate with us and other Clock Manufacturers to this end, for much depends upon the retailer and his watchmakers?

To further assist you in an exact knowledge of the latest--up-to-date--model of the Tiffany Never-Wind Clock now having such a large sale, we are sending you this General Information and Repair Booklet.

A careful examination of the Tiffany Never-Wind Clock will convince you that it is the simplest clock mechanism in the world and will show you how little there is to get out of order and how quickly and profitably repairs can be made in case of accident.

With proper treatment, the Tiffany Never-Wind Clock is guaranteed to give satisfaction and is guaranteed against defects in manufacturing.

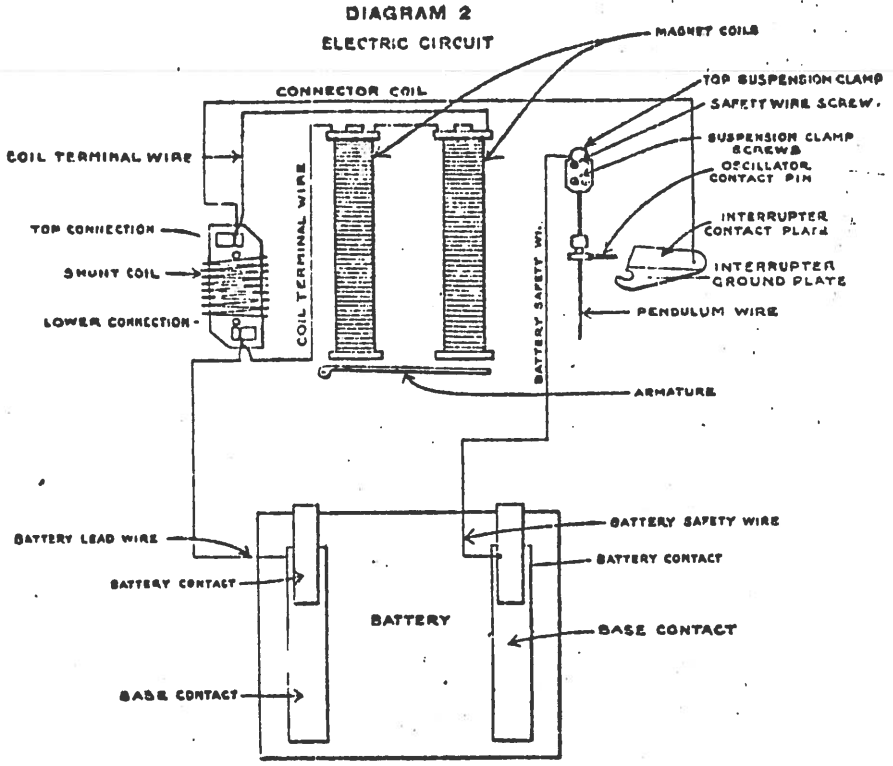
Get a first hand knowledge of the Tiffany Never-Wind Clock and thus assist your store to make big sales and profits. The demand shows that the market for a clock you NEVER-WIND is immense.

The Diagram on pages 12 and 13 clearly indicates every part of the clock with its correct technical name; reference to this diagram will help you locate the part, its correct technical name and location and be useful to you particularly when reading the instruction chart following.

TIFFANY NEVER-WIND CLOCK CORPORATION

BUFFALO, N.Y.

DIAGRAM 2
ELECTRIC CIRCUIT



TESTING THE ELECTRIC CIRCUIT IN A NO. 1100 STYLE CLOCK

The things mentioned below rarely, if ever, happen to this clock and it is best, generally speaking, not to take down the movement until after you have looked the clock over carefully just as it is, but we give you the following information to be used if necessary:

See that the larger insulated Battery Lead Wire is in position in base of clock, that is, that it remains soldered to the center of that one of the two brass Base Contacts which has the fibre insulation. Also see that smaller, naked Battery Safety wire, remains soldered to the other brass Base Contact.

If Magnet Coils or Shunt Coil are short-circuited, they will drain or run down a battery and if this is true you will find the following:

If the Shunt Coil is open or short-circuited, then quite a spark will show where Oscillator Contact Pin meets the Contact Plate.

If either of the Magnet Coils are grounded then the Armature will stay up or freeze against the bottom of the Magnet Coils.

If Interrupter is short-circuited then the Armature would stay up or freeze against the bottom of Magnet Coils.

TESTING INSTRUCTIONS (Concluded)

If there is an open circuit anywhere, either in Magnet Coils or Interrupter, then the current will not pull up the Armature.

NOTE--These tests should be made with a good battery in place in clock.

CAUTION--Leave the battery in place only briefly and only while actually making tests, also see that the Oscillator Contact pin is not touching the Contact Plate while making tests; otherwise you will run the battery down.

Put good battery in the clock and see if Armature pulls up and releases (drops) when contact is made. If Armature pulls up and drops instantly then the Magnet Coils are all right, but if Armature pulls up and stays up then there is a "ground" and the trouble is either in the Magnet Coils or in the Interrupter. Where this is the case (stays up) disconnect the Connector Coil and then make the "ring test" (see below) putting one point on the Contact Plate and the other point on the frame of clock. If it does not ring, then the Interrupter is all right. If it does ring, take out the watch case screw in the Interrupter and see if there is some little metal chip between the Contact Plate and the Ground Plate causing a short-circuit. Then put watch case screw back tight in place again, being sure that fibre washer is in place and see that watch case screw does not touch the Contact Plate where it passes through the hole in Contact Plate.

Then test coils by putting one point on the inside wires which are twisted together in the center, back of and between the two Magnet Coils and the other point on the frame. If it rings then the coils are grounded. Then to find out which coil is grounded, disconnect the wires where they are twisted together between the Magnet Coils, then ring from each wire to the frame. If either one rings then that is the coil that is grounded and the only way to fix that is to put in a new Magnet Coil (be sure and send us the old coil when ordering the new coil).

TO TEST THE SHUNT COIL--Find the terminal ends of the Shunt Coil and see if they are connected to the soldering lugs. There is one terminal wire to each soldering lug. If they are connected then the Shunt Coil must be all right unless there is a break inside the Shunt Coil, in which case a new Shunt Coil is needed.

RING TEST--To test the Shunt Coil fix up a pair of cords to the light circuit and have a 110 volt, 60 watt lamp in series, and touch one tip to each of the soldering lugs. In making this test the "Shunt Coil" should be disconnected from the magnets. If the Shunt Coil is O. K. the lamp will burn dim; if the coil is open there will be no light, and if the coil is short-circuited the light will burn brightly. If you cannot make all these tests yourself your neighboring electrician will be glad to help you out and explain them to you.

REPAIR DIRECTIONS.

No. 1100 Style Movement

IMPORTANT--The less you take this clock apart, the less likely to get out of adjustment and the less you have to put together and adjust. Most of the parts are fixed, properly adjusted and rarely have to be touched or readjusted. We tell you how to do it when necessary, but strongly urge your reading these directions through at least once before beginning any repair work on a Tiffany Never-Wind Clock. This is the simplest clock movement in the world, one that the watchmaker or clock repairer can readily understand and whenever repairs are necessary, due to accident or abuse, they are easily and quickly made and highly profitable. We invite you to write us on any points we can be of service to you, for watchmakers who have made a study of our simple movement, are today the Tiffany Clock's most enthusiastic friends.

Sec. 1. OIL--No oil of any kind should be used anywhere on the No. 1100 Tiffany Never-Wind Clock movement and if you find any oil has been used by anyone, such oil should be cleaned off. This clock is constructed to function perfectly without oil and oil is a non-conductor of electric current and spoils contacts. Not having any oil on it, the Tiffany Never-Wind Clock, through the accumulation of dust with the oil, will not get gummed up and will run for years with little or no cleaning. The use of oil in assembling is positively forbidden in our factory.

Sec. 2. The latest model Tiffany Never-Wind Clock is so constructed that the greater part of its very simple mechanism is protected by the Back-Plate, on which the movement is mounted, and the Back-Cover placed over the movement.

Sec. 3. Even in case of accident, about all that can happen is--to bend or break the Pendulum Wire, or bend the Suspension Bracket which supports the Pendulum.

Sec. 4. TO REMOVE THE BACK COVER--Unscrew the screws (one on each side of the Back Cover) which fasten the Back Cover to the Back Plate, and then pulling the Back Cover out slightly at the bottom, lift it over the Suspension Bracket. This exposes the working mechanism of the clock.

THE PENDULUM (In General)

Sec. 5. If the Pendulum Wire has a bend or kink, by putting on the Pendulum Weight and rubbing the side of an ordinary, round lead pencil against the flat side of wire that bulges, it will generally straighten out the wire and make it as good as new.

Sec. 6. If the Pendulum Wire has a sharp kink in it or is broken, then it needs a new wire and we can either send you a Pendulum Wire (only 25 cents), or if you will return to us the top and bottom attachments to the wire, the Regulating Screw and Nut complete with the Oscillator Nut and Contact Pin, we can then send you the complete Pendulum Wire assembly, properly spaced and adjusted so that it is the work of but a few minutes for you to insert the new wire (our charge for this service, including the new wire being but 50 cents). In any event let us know whether the pendulum is of the "hook on" (new) or "slot" (old) style (see diagrams 3, 4 and 5 on pages 9 and 11).

Sec. 7. Once in a while a customer may knock the Suspension Bracket to one side--see that Suspension Bracket is at right angle to the Back Plate on which the movement is mounted, so that the Pendulum Wire hangs straight down through the center of hole in the Oscillator Guide. The Oscillator Contact Pin should swing (revolve) so as first to make contact just above the center of the small platinum wire which is on the face of the Contact Plate and then, as the Armature pulls up and trips the Interrupter, this Oscillator Contact Pin on the Pendulum Wire will rest in the top of little notch just below, until the reverse motion of the Pendulum Weight swings the Oscillator Contact Pin free and allows the Contact Plate to drop into proper position to receive the next contact of the Oscillator Contact Pin.

Sec. 8. If the Oscillator Contact Pin does not point directly at a line drawn vertically through the center of the clock movement, take a small pair of pliers and grip the Pendulum Wire just below the top and twist the Pendulum Wire so as to bring the Oscillator Contact Pin back into position. This you can often do without removing the Back Cover. The Oscillator Contact Pin should not bend down or up but point at a right angle from the Pendulum Wire and you should see that the Suspension Bracket has not been bent down or up so as to raise or lower the Oscillator Contact Pin and prevent its making contact at the proper point on the Contact Plate. If the Suspension Bracket has been so bent, you can bend it back in place with a pair of pliers, being sure that the two screws hold the Suspension Bracket tight in place.

Sec. 9. It is possible that once in a while you may find that some one has pulled the Pendulum Wire partly down in the Top Suspension Clamp so that it brings the Oscillator Contact Pin too low. To correct this, in the case of the New Pendulum Wire Assembly (diagram 3, page 9) loosen slightly the three little watch screws (Suspension Clamp Screws and Safety Screw) and push Pendulum Wire up to Top Suspension Pin and hold Pendulum Wire in place and tighten three screws; and in case of Old Pendulum Wire Assembly (Diagram 5, page 11) loosen the Suspension Clamp Nut and push Pendulum Wire up as far as it will go, holding Pendulum Wire in that position and tighten the Suspension Clamp Nut.

Sec. 10. If the Pendulum Wire makes clock run too fast and you can't slow it down within the regulation limits on the Regulating Screw, then rub the flat sides of the Pendulum Wire very lightly with fine Emery paper--taking off or thinning the Pendulum Wire but a very little at a time. If the Pendulum Wire makes a clock run too slow, then clip off the wire a trifle at the bottom, never more than 1/8".

Sec. 11. DOUBLE CONTACT--When a clock makes a double click or contact instead of a single, it is probably due to the fact that the Suspension Bracket has been bent down or up. You can test and correct this (See Sec. 7, page 7). Sometimes the Armature Arm needs adjusting to proper position (See diagram 6, page 12). It may be simply that the clock tips forward or backward and that setting the clock level will stop the double clicking.

THE PENDULUM (Now Used).

Sec. 12. TO REMOVE NEW PENDULUM WIRE WITH ATTACHMENTS FROM CLOCK (Diagram 3, page 9)--First remove the Back Cover, then loosen Safety Screw, which is the upper one of three small watch screws in Top Suspension Clamp, and disconnect the Safety Wire under head of this screw, then remove Top Suspension Pin which runs through Suspension Bracket and Top Suspension Clamp and then carefully take the Pendulum Wire through slot in back of Oscillator Guide.

DIAGRAM 3
NEW PENDULUM WIRE ASSEMBLY

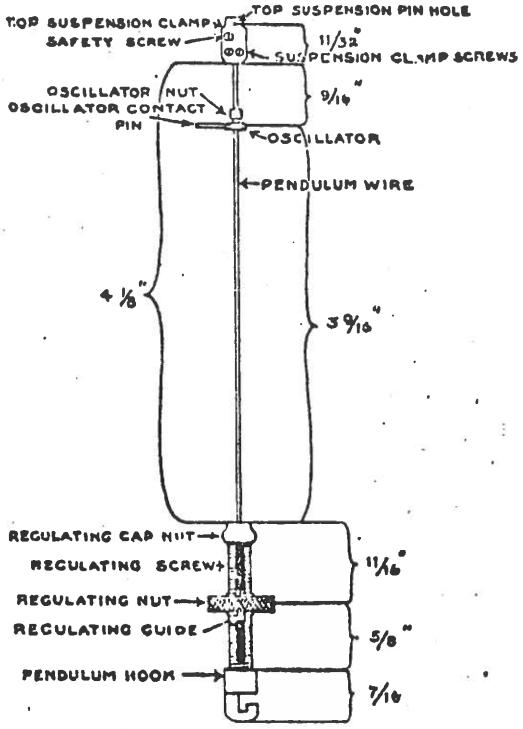
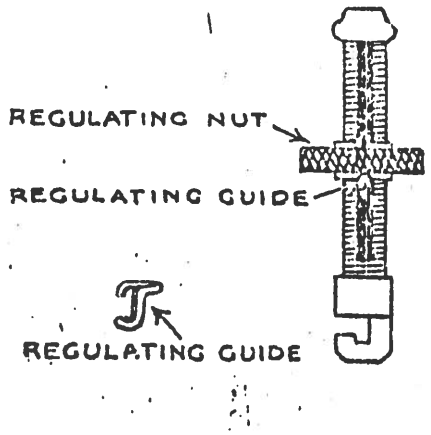


DIAGRAM 4



Sec. 13. TO ASSEMBLE NEW PENDULUM WIRE YOURSELF (See diagram 3, page 9):

First--Put Regulating Nut on Regulating Screw from the top, with the "S-F" marked on Regulating Nut facing upward.

Second--Put Regulating Guide in place in Regulating Nut (See enlarged drawing--diagram 4, page 9).

Third--Put Regulating Cap Nut on top of Regulating Screw.

Fourth--Put Pendulum Wire in from the top, through the Regulating Cap Nut, the Regulating Guide and through the small hole in the bottom of the Regulating Screw.

Fifth--Insert Pendulum Wire in slotted end of Bottom Suspension Clamp (this Suspension Clamp being contained in the bottom of Regulating Screw) as far as the slot goes and then put the Bottom Suspension Clamp back into the hole in bottom of Regulating Screw and then screw the Pendulum Hook on tight.

(over)

-1090-

Sixth--Have Oscillator Nut loose and push upper end of Pendulum Wire through to proper distance (as per diagram 3, page 9) and tighten Oscillator Nut.

Seventh--Loosen slightly the three little watch screws (Suspension Clamp Screws and Safety Screw) and push Pendulum Wire up to Top Suspension Pin and hold Pendulum Wire in place and tighten three screws.

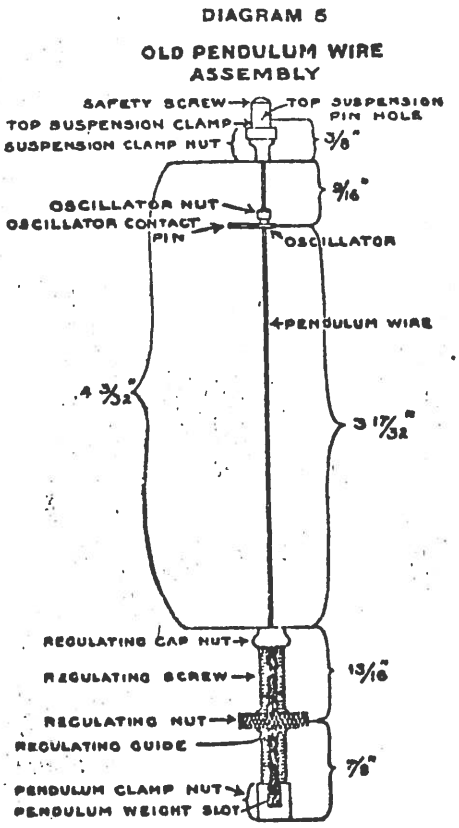
NOTE--REGULATING GUIDE--In the latest model No. 1100 Style movement, the Regulating Guide is a small piece of Bronze wire bent to shape, which is located in the Regulating Nut, which travels up and down on the Pendulum Wire in the groove in Regulating Screw, as the Regulating Nut is turned up and down (See diagram 4, page 9).

Sec. 14. TO INSERT NEW PENDULUM WIRE AND ATTACHMENTS ALREADY ASSEMBLED--Pass the Pendulum Wire, at a point on the wire just below Oscillator Contact Pin, through the slot in back of Oscillator Guide, turn the Pendulum Wire around so that the Oscillator Contact Pin points toward the center of Back Plate and just to the left of the Interrupter Contact. Then put in slot of Suspension Bracket and put in Top Suspension Pin. In case of New Pendulum Wire Assembly, the Battery Safety Wire is fastened under the upper (Safety) Screw (Diagram 3, page 9) and in case of Old Pendulum Wire Assembly the Battery Safety Wire is fastened under the Safety Screw (Diagram 5, page 11).

THE PENDULUM (Formerly Used)

Sec. 15. TO REMOVE OLD PENDULUM WIRE WITH ATTACHMENTS FROM CLOCK--(Diagram 5, page 11)--First remove the Back Cover, then loosen Safety Screw on top of Suspension Bracket and disconnect the Safety Wire just under it, then remove Top Suspension Pin which runs through the Suspension Bracket and Top Suspension Clamp and then carefully take the Pendulum Wire through slot in back of Oscillator Guide.

Sec. 16. TO ASSEMBLE OLD PENDULUM WIRE YOURSELF--
(See diagram 5, page 11)



First--Put Regulating Nut on Regulating Screw from the top, with the "S-F" marked on Regulating Nut, facing upward.

Second--Put Regulating Guide in place in Regulating Nut (See enlarged drawing--diagram 4, page 9).

Third--Put Regulating Cap Nut on top of Regulating Screw.

Fourth--Put Pendulum Wire in from the top, through the Regulating Cap Nut, the Regulating Guide and through the small hole in the bottom of the Regulating Screw.

Fifth--Insert Pendulum Wire in slotted end of Bottom Suspension Clamp (This Suspension Clamp being contained in the bottom of Regulating Screw), as far as the slot goes and then push the Bottom Suspension Clamp back into the hole in bottom of Regulating Screw and then screw the Pendulum Clamp Nut tight.

Sixth--Have Oscillator Nut loose and push upper end of wire through to proper distance (As per diagram 5, page 11) and tighten Oscillator Nut.

Seventh--Loosen slightly the Suspension Clamp Nut and push Pendulum Wire up as far as it will go, holding Pendulum Wire in that position and tighten the Suspension Clamp Nut.

DIAGRAM 6

TIFFANY
NEVER-WIND CLOCK

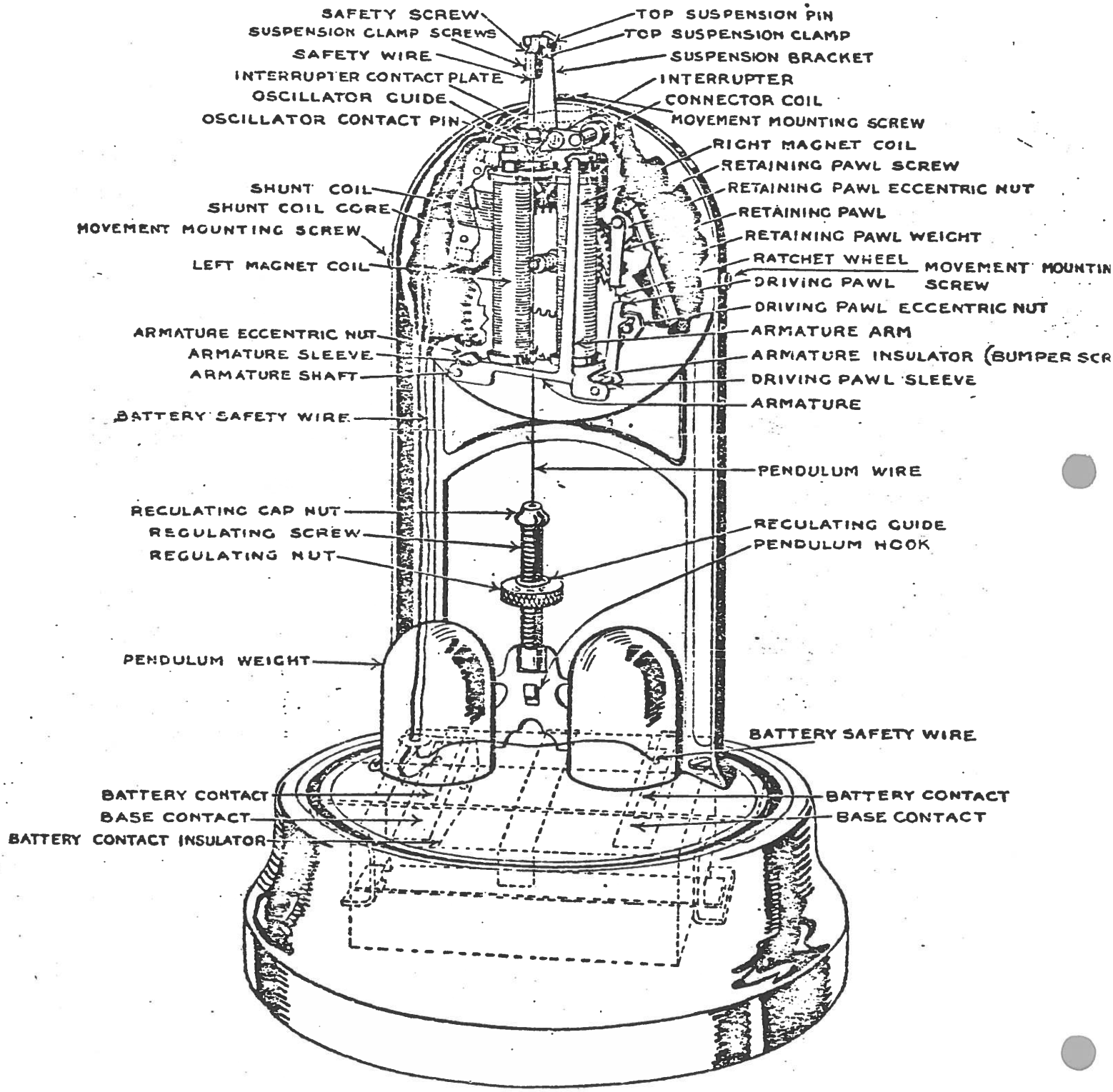
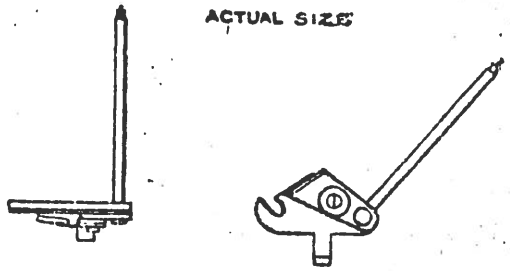


DIAGRAM 7

INTERRUPTER

CROSS SECTION

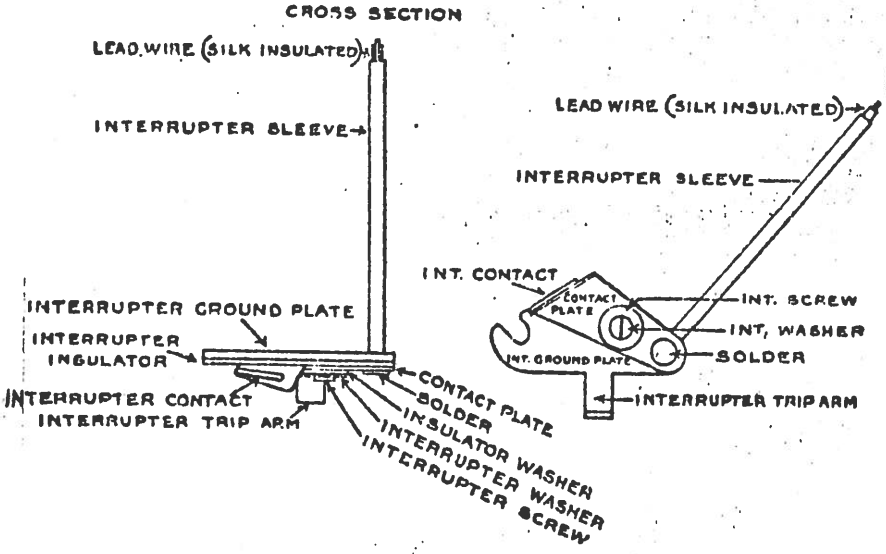
ACTUAL SIZE



FOR DETAIL - SEE INTERRUPTER ENLARGED BELOW

INTERRUPTER - (ENLARGED)

CROSS SECTION



SUSPENSION BRACKET

Sec. 17. The Suspension Bracket is used to suspend the Pendulum Wire and its proper position is covered under chapter on Pendulum Wire (Pages 7-11 inclusive).

INTERRUPTER

Sec. 18. The Interrupter, which is made up of several parts, one of which is the Contact Plate, is one of the vital parts of the clock mechanism and a knowledge of its purpose and function is important in connection with the complete Pendulum and Suspension Bracket. As the Pendulum Weight revolves to the right (Looking from the back of the clock), it brings the Oscillator Contact Pin on Pendulum Wire in contact with the Platinum wire (Interrupter Contact) which is on the face of the Contact Plate. When all adjustments are as they should be, this Oscillator Contact Pin first makes contact at a point just above the middle of the Platinum wire (Interrupter Contact). The electric circuit is thus closed and the electric current flows instantly into the two Magnet Coils. The two Magnet Coils then become magnetic and pull up the Armature.

TWO ACTIONS THEN TAKE PLACE:

First--The Armature trips the Interrupter, causing the Oscillator Contact Pin to slide down the Interrupter Contact until the Oscillator Contact Pin rests in the top of the little notch in the Interrupter Ground Plate. This being done instantaneously, the circuit is made and broken instantly, for the Interrupter Ground Plate is out of circuit and no current is being used while the Interrupter Contact Pin is resting in the notch on the Interrupter Ground Plate.

Second--The Driving Pawl, which is fastened to the right end of Armature, is moved upward by the action of the Armature and engages the next tooth above in the Ratchet (Driving) Wheel and immediately, as the current is cut off as described just above, the Armature drops, the weight and dropping of the Armature propelling the gears and pinions of the clock movement.

Sec. 19. If the Interrupter sticks, that is, does not drop down so as to rest on Oscillator Guide Bracket when the Oscillator Contact Pin is swung away from it by the reverse motion of the Pendulum Weight, it may be that it has been jammed. Insert a knife blade and wedge slightly between Interrupter and the bearing and work the Interrupter up and down a few times. If that does not fix it, then the Connector Coil, which is located

between the dial and the back plate and which connects the shaft of the Interrupter with the upper end of Spark Coil, should be unsoldered and the Interrupter pulled out of the bearing and cleaned, as also the inside of the bearing itself. No oil should be used, just wiping with a soft cloth.

Sec. 20. TO REMOVE INTERRUPTER WITH ATTACHED SLEEVE FROM BEARING FOR PURPOSE OF CLEANING--After removing Back Plate, unsolder that end of Connector Coil between Back Plate and Dial which is soldered to Interrupter Lead Wire, then remove fibre washer, then friction washer and then loosen large hexagon nut enough so that Interrupter Bearing will drop out of place sufficiently to allow you to pull Interrupter and Interrupter Sleeve out of Interrupter Bearing, which will then enable you to clean inside of bearing and outside of sleeve with soft cloth, as Oil must not be used.

Sec. 21. SPARKING AT CONTACTS--If a clock shows a "spark" at contact point on Interrupter Contact as contact is made, it may be due to the need of re-soldering the soldering lugs on both ends of Shunt Coil. To do this re-soldering, it must be done with a heated soldering iron, but no acid should be used, but rosin dissolved in alcohol or in turpentine. If this does not stop the "sparking" then a new Shunt Coil is needed.

Sec. 22. TO REMOVE SHUNT COIL--Unsolder the two wires, one at either end and remove the two screws which are nearest the coil of wire.

THE ARMATURE

Sec. 23. The Armature consists of several parts and is located at the bottom of the two spool Magnet Coils. It is supported at left end on Armature Shaft, the shaft itself being embedded in the Armature Eccentric Nut and the turning of the Armature Eccentric Nut adjusts the proper spacing of the Armature below the two Magnet Coils. The right end of Armature is supported by the Driving Pawl which rests on a celluloid bushing covering the Driving Pawl Stop Pin which is embedded in the Driving Pawl Eccentric Nut. The Driving Pawl Eccentric Nut is for the purpose of adjusting the Driving Pawl.

Sec. 24. On our older No. 1100 style movements, a piece of thin silk should be in place (shellaced on) on the top of Armature so as to come between the upper side of Armature and the soft iron bottom of the magnet cores,

the purpose of this insulating silk being to prevent the Armature freezing (sticking) to the Magnet Coils as the freezing prevents the Armature from dropping freely as it should; in our later model No. 1100 style movement there is or should be this piece of silk on the top of the Armature under the Left Magnet Coil and under the Right Magnet Coil there is a rubber disc called the Armature Insulator, which serves the same purpose as the insulating silk and also deadens the sound.

Sec. 25. THE ARMATURE SHAFT is a steel pin driven into the Armature Eccentric Nut to support the Armature.

THE ARMATURE ECCENTRIC NUT is used for adjusting the space between the Armature and the two Magnet Coils.

THE ARMATURE SLEEVE is a small brass tube at left end of Armature used as a "stop collar" and is forced on the Armature Shaft; this must fit tight to the Armature Shaft.

TO REMOVE THE ARMATURE pull it straight off the Armature Shaft to which it is fastened only by friction of the Armature Sleeve.

DRIVING AND RETAINING PAWLS

Sec. 26. THE DRIVING PAWL is attached to the right end of the Armature and at every upward movement of the Armature, engages one tooth of the Ratchet Wheel and as the Armature drops, pulls the Ratchet Wheel down one tooth. It is the dropping of the Armature which propels the clock train.

THE DRIVING PAWL ECCENTRIC NUT is for the purpose of adjusting the Driving Pawl to the Ratchet (driving) wheel.

THE RETAINING PAWL is placed on Back Plate just above the Driving Pawl and the pressure of the Retaining Pawl Counter Weight keeps the Retaining Pawl in position between the teeth of the Ratchet Wheel and its purpose is to prevent the Ratchet Wheel from turning backward (upward) as the Driving Pawl reaches up and pulls the Ratchet Wheel down one tooth at each contact. Generally there are two full teeth in the Ratchet Wheel between the teeth in which the Driving Pawl and Retaining Pawl rest--but occasionally there may be three.

Sec. 27. RETAINING PAWL COUNTER WEIGHT lies between the Back Plate and Dial and is adjusted to Retaining Pawl Shaft by a small set screw, in such position that the right hand lug on Back Plate acts as a "stop" for it and this stop prevents the weight from falling on the wrong side of center when clock is tipped upside down as it often is in transit.

IN GENERAL

Sec. 28. See that Magnet Coils are not loose, if necessary tightening nut or screw which holds each Magnet Coil at the top. If Magnet Coils are loose or bent over against center shaft of clock this will cause a short-circuit and run down the battery very quickly.

Sec. 29. TO REMOVE BACK PLATE AND DIAL--First, unscrew small knurled nut in center of dial and wedge off clock hands. Second, remove three screws, one at top of Pedestal and one at either side of Pedestal and lift out Back Plate. The dial is held in Pedestal merely by friction.

Sec. 30. Examine the little pin on Center Shaft of the clock between the two Magnet Coils and see if the pin touches either of the two Magnet Coils as the shaft revolves. If it does, the pin should be filed off slightly--for its touching the Magnet Coils would cause a short-circuit and run down the battery.

Sec. 31. Examine the clock hands and see that they do not interfere in revolving.

Sec. 32. IN RETURNING A CLOCK TO US FOR REPAIRS do not send the glass globe, which might get broken in transit. Wrap the Pendulum Weight separptely and put inside of base of clock where the battery ordinarily is and put battery underneath base in packing box where it will not damage the clock. Use sufficiently large wooden box so that no pressure will come against head or top of clock and mark outside of box for identification.

Sec. 33. When clocks are unpacked, see that head or top of clock is not struck against some object and that each pendulum weight is used only on clock it is packed with and that you follow the other directions in order.

THE BATTERY

Sec. 34. TO PUT IN BATTERY--See directions sent with each clock. We decline any responsibility unless our simple "setting up" directions are followed exactly as given.

Sec. 35. BATTERY RENEWALS--As our earlier clocks used a larger (No. 5) battery, please specify "small three cell battery" when ordering for our No. 1100 style clocks.

Sec. 36. BATTERY GUARANTEE--We guarantee our standard size battery to run the style No. 1100 clock a year, the average battery life being 15 months. While we use a standard size battery, obtainable for renewals almost anywhere, as both you and we are interested in your customers having good battery service, we recommend and guarantee batteries furnished by us.

Sec. 37. A CLOCK IS SOMETIMES STOPPED accidentally or by some one without the owner's knowledge and the battery blamed, where very often it will run the clock for months if the clock is simply started again.

Sec. 38. A FRESH BATTERY SHOULD TEST about eight amperes, sometimes showing slightly less when first received in cold weather, till warmed up. A high amperage battery has not necessarily a long life and The Tiffany Never-Wind Clock requires long life rather than high amperage, in fact often will run two or three months on a battery showing no amperage on the ordinary ammeter tester. If you have not an ammeter tester, by changing the battery from a clock that does go to one that does not--you can determine whether the fault lies with the battery and if the battery shows any signs of dampness or leakage or if the battery is dead, it should be removed from the clock at once and a new battery substituted. The three battery cells should not be removed from the inner cardboard box container when inserted in the clock. When laying a battery down (except in clock) do not allow its brass contacts to come in contact with any metal, as that would short-circuit and run down the battery immediately.

Sec. 39. BATTERY TESTER (Ammeter)--A good Ammeter is made by the American Ever Ready Company of New York City, which can be bought for about $1.50 at almost any hardware or electrical store, where they will show you how to use it. When making test of battery, hold the cord contact and right leg of Ammeter on battery contacts only for a second or two, as otherwise you will be running down the battery, and if the battery does not register with the contacts applied one way, reverse the points, as different makes of Ammeters register differently.

REGULATING

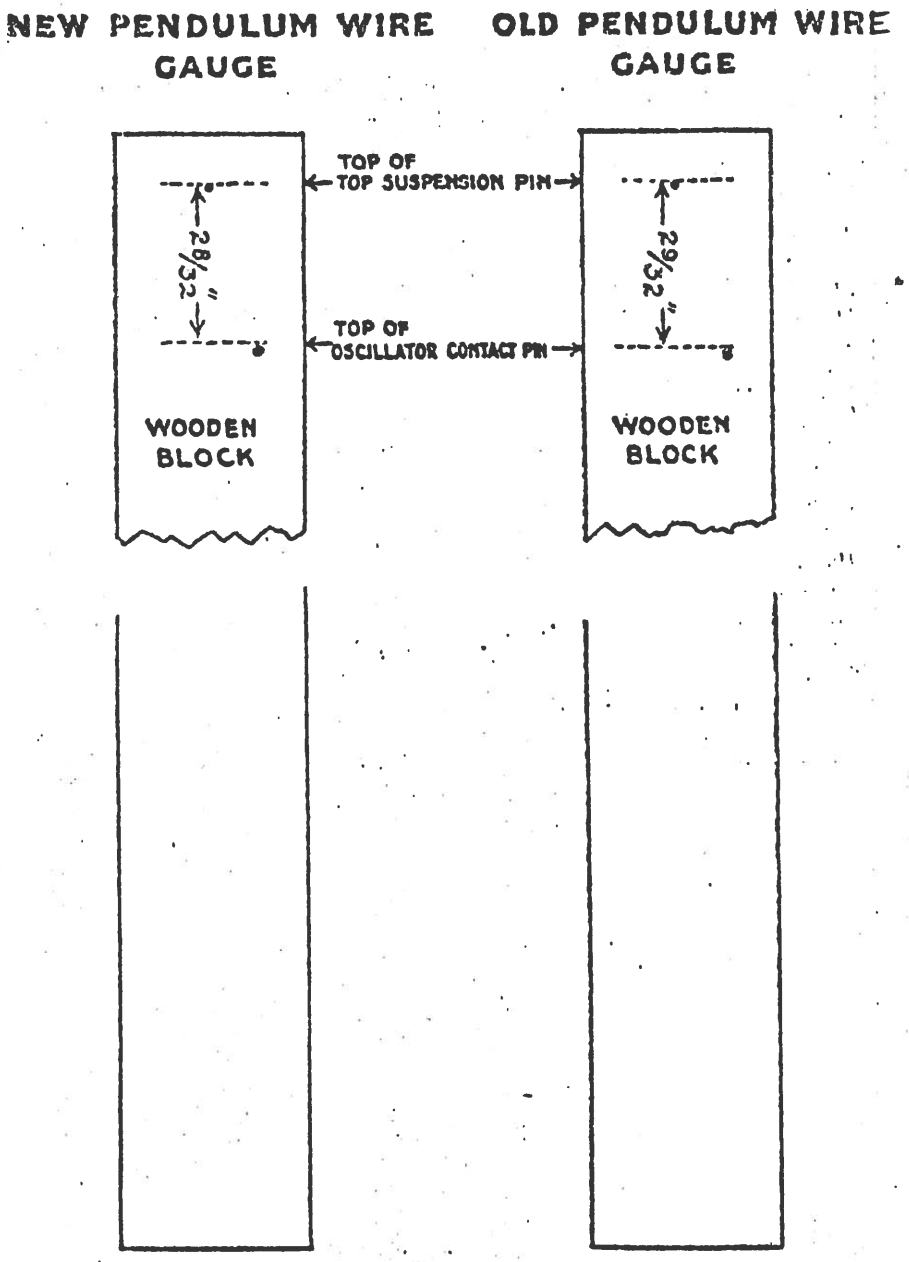
Sec. 40. THE TIFFANY NEVER-WIND CLOCK is the only clock in the world that does not require the pendulum to operate the clock-train. In the old-time clock the pendulum and clock-train are so linked together that friction on the one or other makes its impression on the time-keeping quality. Whereas in The Tiffany Never-Wind Clock, these two functions are distinctly independent of each other, thereby insuring more accurate time keeping.

Sec. 41. You know there is no such thing as a perfect timepiece--ours approaches nearer than any other mantel clock; yet because it never needs winding, does not imply that its hands may not require moving forward or backward once in a while and occasionally the Regulating Nut be touched. It will run within a minute a week or better--its good time-keeping being simply up to the owner.

Sec. 42. The Tiffany Never-Wind Clocks are regulated at our factory at level. Should further regulation be necessary, turn slightly knurled Regulating Nut, between and just above the Pendulum Weight (see indicating letters "S-F" on top of knurled nut). Turn to the right to make clock go faster and to the left to go slower. All clocks require slight re-regulating after being placed in position, and a quarter turn of the Regulating Nut makes a difference of about two minutes a day. These clocks, properly regulated, make contact every twelve seconds or five times a minute. A clock tipping forward will run fast and back slow, tipping to the left fast and to the right slow, hence the importance that it should stand level. Your customers should be shown how to set the hands and how to regulate. This will save you the trouble and loss of time calling at their homes and make the clocks "stay sold."

Sec. 43. IT IS WELL TO REMEMBER THAT THE NEARER LEVEL THE CLOCK STANDS THE BETTER THE TIME AND THE LESS RE-REGULATING NECESSARY. It stands to reason, on account of the often severe and sudden changes in temperature, that a clock in the jeweler's window will not run as accurately as in the store, nor will a clock that is being moved about in demonstrating, so that you may need to set the hands forward or back occasionally in the case of the clock you are showing in the window or demonstrating with on the show-case. The clock should not be moved about with the heavy Pendulum Weight on and each Pendulum Weight should be used only on clock it is packed with. Mixing the pendulum weights causes much unnecessary re-regulation.

DIAGRAM 8



Actual Size of Gauge to Assemble Pendulum Wires.

To assemble these two gauges take a simple, smooth block of wood and use two headless pins the same size diameter as the Top Suspension Pin, these pins to occupy the periods as shown in each gauge.

SALES HELPS

Important--Read Very Carefully

There is a right and a wrong way to sell the Tiffany Never-Wind Clock. Permit us to point out the right way--so that your sales may be large and ever-increasing, your customers pleased and satisfied and, your profits clean because you have no "come-backs."

The one who has trouble with this clock or does not make good sales, is the one who does not follow the directions sent with each clock, nor take the few minutes necessary to read carefully what we send him.

First--When clocks are unpacked, see that head or top of clock is not struck against some object and that each pendulum weight is used only on clock it is packed with and that you follow the other directions in order.

Second--You can make good sales only by having on hand at least three of these clocks--for you should have one in window displayed with window card, one for a demonstrator in your store and at least a third ready for immediate delivery to your customer.

Third--From the experience of your jewelry customers, we know that this clock, properly leveled, running, on time and with display card in the window, not only sells many clocks, but is a splendid window attraction and draws many a new customer into the store. It is not the custom generally to have clocks displayed in the window or show cases on time--but you see this being a new clock to the public, they will invariably look to see if the time is right and if within a minute or two with their watches, be favorably impressed and themselves begin to advertise the clock by talking about it. This may seem a little matter to you, but we beg to assure you that with your kindly interest in and attention to this "on time" request of ours, your sales will grow rapidly and the whole store be benefitted thereby. You see, the public is first attracted by the clock's novelty, the window card stating that it requires no winding excites curiosity and, if the clock is on time, is impressed with its time-keeping and they then come into the store to ask questions, which is what you want. Once in the store, you have a chance to sell him or her not only the clock but other things, and this clock works wonders as a window attraction and should be kept there.

Fourth--It stands to reason on account of the often severe and sudden changes in temperature, that a clock in the window will not run as accurately as in the store, nor will a clock that is being moved about in demonstrating so that you may need to set the hands forward or back occasionally in the case of the clocks you are showing in the window or demonstrating with on the show case.

Fifth--Always sell, advertise and refer to this clock as the Tiffany Never-Wind Clock--never as an electric clock. You see, the word electric often frightens your customers before they understand how simple the clock is, might imply the necessity of wiring or of getting a shock and thus prevent a sale.

Sixth--A question commonly asked of you--is it a perfect time-piece--should be answered truthfully, that there is no such thing in the world, and that your customers may need to set the hands and touch the regulator once in awhile, especially when the clock is first set up, but show them how easy it is to do this by simply lifting the globe and without moving the clock. Tell them no to regulate this clock by an alarm clock, which itself is often not correct, for this clock is capable of fine regulation and timekeeping, and can be so regulated by the owner instead of bothering you to go to his or her home.

Seventh--The Western Union Clocks are set every hour and often vary several minutes in an hour; the Government clock in Washington, D. C.,is kept in a special room where the temperature, dryness, air pressure, etc., are always the same and still that clock is corrected every day; the Big Ben Clock in the tower at Westminster, London, England, is corrected every half hour electrically from Greenwich. Tell your customers these facts, it will pay you, and they will then see why not even the Tiffany Never-Wind Clock can be left entirely to itself and always be on time.

Eighth--The Novelty and Attractiveness of the Tiffany Never-Wind Clock is such that this clock becomes, quite naturally, an object of interest and inspection by friends and family of the purchaser. While this is most excellent from a re-sale standpoint, you can readily understand that if this clock is frequently moved, the pendulum weight taken off and perhaps even the battery taken out to show a friend how the clock operates, that this would be likely to disarrange the clock, as it would any other clock in the world, and prevent its giving satisfactory time service. Consequently your customer should be informed of the above when sale is made. Properly treated, it is a fine time-keeper.

Ninth--The battery which furnishes the motive power for this clock, is a standard dry cell, obtainable at any hardware or electrical store--but as we guarantee our batteries to run the clock a year, it is advisable to secure the batteries from us, but only for the reason of the above said guarantee, which batteries purchased in the open market do not carry.

Tenth--A lot of the trouble and expense that all jewelers have with all makes of clocks is their own fault by allowing their customer to buy any clock expecting too much and not realizing that a clock is not a hammer but a piece of mechanism that requires decent treatment and some attention from its owner. The Tiffany Never-Wind Clocks are now new, not an experiment, but are running successfully in thousands of homes to the delight and satisfaction of their owners.

TIFFANY NEVER-WIND CLOCK CORPORATION, BUFFALO, NEW YORK.

INSTRUCTIONS ON BACK LABEL OF WALL CLOCK

CAUTION

We decline any responsibility unless our simple setting-up directions are followed out exactly as given.

DIRECTIONS

Remove papers from outside of clock, being careful of glass globe which is wrapped with clock. The pendulum weight and battery are wrapped separately.

TO PUT IN BATTERY

First--Carefully lay clock on its face on soft cloth being sure not to strike the top suspension bracket against anything; this suspension bracket is the top of the clock.
Second--Remove bottom plate by inserting fingers and pulling straight out.
Third--Lift latch in base.
Fourth--Place battery in base so that its two brass strip contacts are in contact with the two flat brass strips in the base, then put the latch in slot by springing either side clamp slightly.
Fifth--Put back bottom plate flush with rim of base so that the clock stands level.
Sixth--Slowly tip clock right side up.
Seventh--Now carefully remove elastic holder around pendulum wire.
Eighth--Carefully hook on pendulum-weight. Give the pendulum-weight a three-quarter turn (not swing) to the right or left and let go. Be sure the clock stands level so that the pendulum does not touch anywhere in turning. Move the minute-hand forward or backward at any time to correct time same as in any clock.

REGULATING

This clock has been regulated at our factory. Should further regulation be necessary, turn slightly knurled-nut between and just above pendulum weight. See indicating letters (S-F) on top knurled-nut. Turn to the right to make the clock go faster, and to the left to go slower. All clocks require slight re-regulating after being placed in position, and a quarter turn of the regulating nut makes a difference of about two minutes per day.

IT IS WELL TO REMEMBER

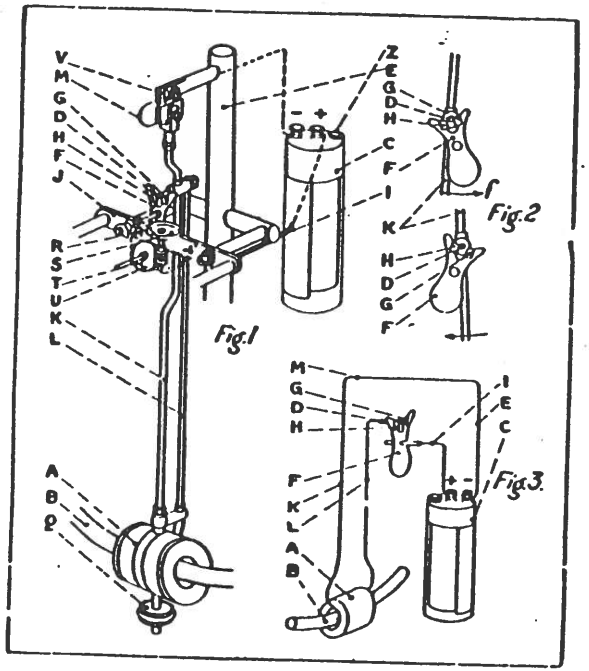
The nearer level the clock stands the better the time. It is best not to move clock about with the pendulum weight on. Use only a soft cloth or chamois to remove dust from the case but no cleaning compound. Oil should never be used on the movement of this clock.

BATTERY RENEWALS

When ordering renewal battery for this clock order battery for Model 2000.
Renewal Batteries at Your Jewelers, or

Tiffany Never-Wind Clock Corporation
Buffalo, N.Y.

THE BULLE CLOCK



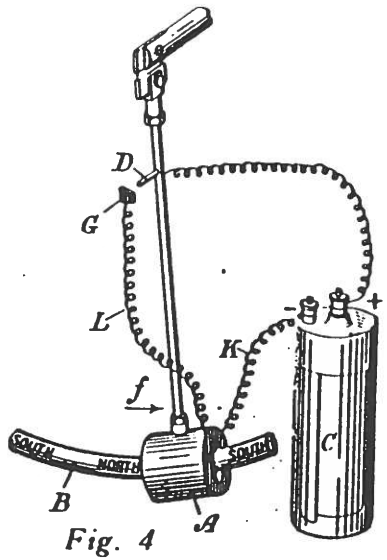


Fig. 4

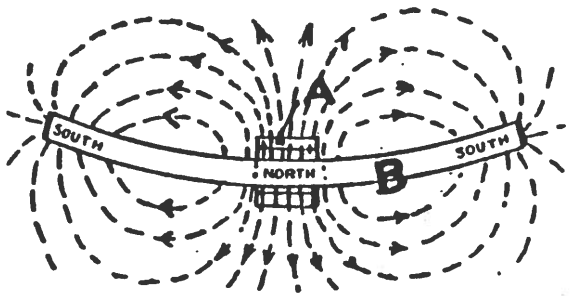
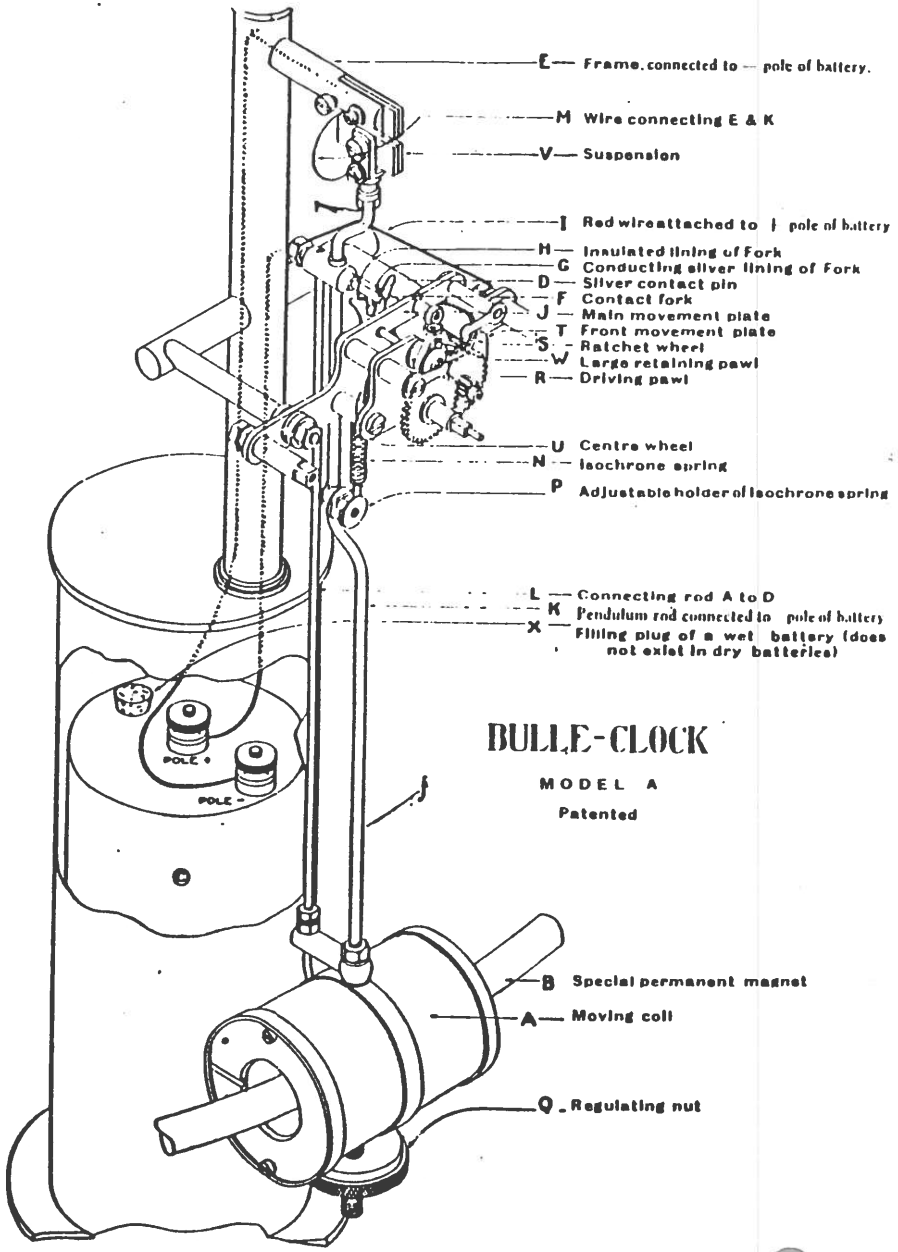


Fig. 5

Lines of force of the special consequent pole magnet of a Bulle Clock.

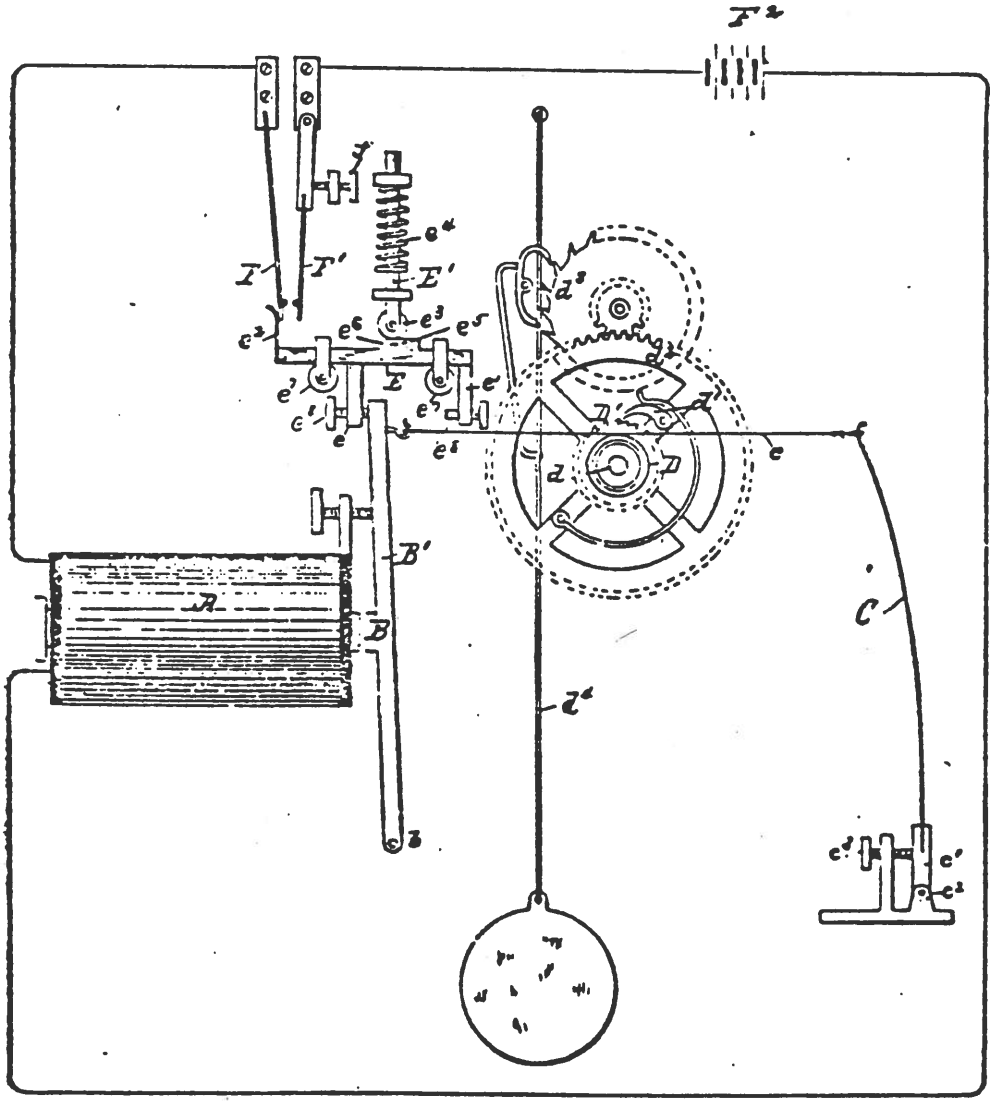


(No Model.)

S. C. DICKINSON.

ELECTRIC CLOCK MOVEMENT.

No. 346,094. Patented July 27, 1886.



WITNESSES:

Henry Ridgely

A. J. Fitch

INVENTOR

Selem C. Dickinson

BY

A. J. Fitch

ATTORNEY

UNITED STATES PATENT OFFICE.

SILAS C. DICKINSON, OF WILTON, IOWA.

ELECTRIC-CLOCK MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 346,094, dated July 27, 1886.

Application filed February 27, 1886. Serial No. 193,242. (No model.)

To all whom it may concern:

Be it known that I, SILAS C. DICKINSON, of Wilton, county of Muscatine, State of Iowa, have invented certain Improvements in Electric-Clock Movements, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification.

My invention relates to an electric-clock movement; and it consists in certain improvements, hereinafter particularly described, upon the mechanism for this purpose for which Letters Patent No. 334,517 were granted to me January 19, 1886.

In the drawing there is shown in elevation an electric-clock movement containing my invention.

A is an electro-magnet. B is an armature carried by an armature-lever, B', which is pivoted at *b*. C is a spring, the free end of which is connected by a cord, *c*, to the free end of the lever B', the cord being looped or given a turn or turns around a drum, D, placed intermediate to the spring and lever, as shown, and which is mounted to revolve on a shaft, *d*. The drum is provided with a ratchet, D', with which engages a pawl, *d'*, carried by the spur-wheel *d''* on said shaft. The cord *c* is of such a length that when the armature is in contact with the magnet the spring will be flexed, as shown. The operation of these devices, as fully set forth in my issued Letters Patent above referred to, is obvious. The drawing of the armature-lever from and out of contact with the magnet by the recoil of the spring C through cord *c* operates to rotate the shaft *d* through the drum D and its ratchet and pawl, and the drawing of the lever B' toward the magnet reversely rotates the drum D when the magnet is excited. The wheel *d''* being thus intermittently rotated in one direction, it may be combined with an escapement, *d'''*, and pendulum *d''''*, and thus the devices serve to actuate a clock-movement.

E is a bar, which slides in suitable guides, and is placed above the end of the lever B', and has the downwardly-reaching arms *e e'*, adapted to engage the end of the said lever.

F F' are two spring bars or tongues, mounted in clamps and placed in the circuit of the battery F''. These tongues are parallel to each other, and located relatively to the bar E so that the arm *e'* thereof is adapted to engage one of the tongues. The movement of the bar in its ways in one direction causes the arm *e'* to engage the tongue F and carry it to contact with the tongue F', and thus close the circuit and excite the magnet, and the movement of the bar in the reverse direction causes the tongue F to be released, and thus to break the circuit. The swinging of the lever B' to the right by the recoil of the spring C throws the lever into engagement with the arm *e'* of the bar E, and thus slides the bar to the right, and the tongue F is brought into contact with the tongue F' and the circuit is closed. The magnet being thus excited, the armature-lever B' is drawn or swung to the left, or toward the magnet, and the lever engages the arm *e* of the bar E, and the bar is thus slid to the left and the tongue F released, when the circuit is broken and the magnet ceases to act, and the spring again draws the lever B' to the right. This operation, as set forth in my aforesaid Letters Patent, is continuous, the circuit being thus alternately opened and closed. My present improvement consists in the combination, with the said bar E, of a rod, E', arranged to slide in ways and at right angles to said bar, and carrying a friction-roller, *e'*, which engages the surface of the bar, and provided with a spring, *e''*, which operates to hold said roller into engagement with said bar. Upon the face of the bar which the said roller engages is formed the projection *e'''*, with an incline, *e''''*, leading from the face of the bar to the top of the projection. I furthermore find it desirable to provide the friction-rollers *e'* for the bar to travel upon in the ways or guides thereof, as shown. These devices are arranged relatively to each other, so that when the circuit is broken and the spring draws the armature-lever B' to the right to engagement with the arm *e'* of the bar E, and the bar is thus shifted to the right, the roller *e'*, at or near the limit of the movement of the lever in this direction, will engage the incline *e''''*, passing thereto from the top of the projection *e'''*, and thus operate to carry the bar somewhat farther to the right, and thus insure the perfect contact of the tongues F F' through the arm *e'* and the closing of the circuit. When the armature-lever B' is then drawn toward the

magnet and its end engages the arm e of the bar and throws the bar to the left, the roller e^3 will ascend the incline e^4 to the top of the projection and assume position to be ready to again descend to assist in causing the closing of the circuit at the succeeding reverse swing of the lever.

I find it desirable to seat the spring C in a block, c', which is hinged or pivoted at c^2, and which has a set-screw, c^3, bearing against it, as shown, so that the tension of the spring C may be adjusted. I also prefer to similarly seat the spring-tongue F', and to provide a set screw, f, so that the distance apart of the tongues may be regulated at pleasure. It is furthermore desirable to provide the adjustable set screws e^2 in the arms e e' of the bar E, for an obvious purpose.

I find that by means of my described improvements the described devices operate with greater ease and precision, and that there is less liability to wear upon the various parts.

What I claim as my invention, and desire to secure by Letters Patent, is—

In an electric-clock movement having an electro-magnet and its armature-lever, a spring, C, and shaft d, and devices, substantially as described, whereby the tension of said spring operates to rotate the shaft, the combination therewith of the bar E, carrying arms e, e', and e^3, and having projection e^4 and its incline e^5, and movable, as described, together with the rod E', provided with spring e^6, and carrying roller e^3 in engagement with said bar, and the tongues F F' in the battery-circuit, as and for the purpose set forth.

SILAS C. DICKINSON.

Witnesses:
J. D. WALKER,
W. F. HAYFORD.

HELPFUL HINTS

(Contributions are encouraged from ALL EHS members, and appropriate credit will be given. These suggestions need NOT be original, but credit the source where possible. Perhaps a prize may be offered for the most useful or original idea, but participation is a MUST)

The following from H.W. Ellison

Small Quantities of Paint

If you need touch-up paint or small quantities of paint, you might wish to try a Tamiya Paint Marker. These are similar to felt tip pens except that they are filled with high quality enamel. The markers seem to stay liquid for a long time and the pen tip is very useful for fine lines. There is no need to clean-up the tip after use so the paint markers are very convenient. The Tamiya Paint Markers are available in hobby stores and cost approximately $3.00. Currently, colors are limited.

Electrical Contact Lubricant

Tamiya also makes an effective contact lubricant which seems to help in minimizing arcing and preventing oxidation of electrical contacts. The lubricant is a grease intended to lubricate the speed control switch on high powered, radio controlled model cars. Not all hobby stores which sell the model cars offer the switch lubricant. The price of the lubricant is $2.98.

Contact Cleaner and Bulle Clocks

A small squirt of electronic contact cleaner or TV tuner cleaner on the contact pin and switch contacts of a Bulle clock help keep the clock running when it is necessary to move the clock. The Bulle clock seems to use a very small portion of the contact surfaces and it is almost impossible to return the clock to exactly the same position (with respect to the contacts) after moving the clock.

The Sempire Clock Company

One of the pleasures of collecting electric clocks is understanding how the designers of these clocks met the many challenges which faced them. Then, as now, designers must make compromises and the results of these decisions have a direct influence on the performance of our clock collections. One of the most difficult areas of electric clock design is switch which causes the clock to rewind. If the switch is to be successful, it must close rapidly to prevent arcing and open rapidly, again to minimize arcing. There must be sufficient pressure to make a good contact, yet not too much pressure which might make it difficult to break the contact or even impede the timekeeping function of the clock. All-in-all, the design of the switch is not a trivial task. This article examines the switch design used by one manufacturer, the Sempire Clock Company.

The December 1, 1981 issue of the EHJ contains a copy of a catalog for the Sempire Clock Company of St. Louis, Missouri. Sempire, a company which was in operation from 1900 to 1910, manufactured an electro-mechanical clock which they called an "Elechrometer." Included in the advertising copy was an unsolicited testimonial by a Mr. A. Ramel, Assistant in charge of the Observatory at Washington University. Mr. Ramel reviews the Sempire clocks from both a mechanical and an electrical point of view. The electrical review is particularly interesting since Mr. Ramel sums-up the goals of an electro-mechanical clock in a very few words. (A copy of the testimonial follows exactly as it was originally printed in the advertisement - mistakes and all.)

> "Electrically: - The essential features - a positive contact for making circuit and one for short duration are admirably, from a practical standpoint, provided for. The clocks under my observation, although subjected to severe tests, and running continuously for several months, have never failed to wind. The contact made is a rubbing one, self-cleaning, and cannot be but of an instant's duration."

With the aid of sketches, Figures 1 through 4, let's see if we agree with Mr. Ramel. The Sempire winding mechanism consists of a specially shaped armature which pivots about Point 1 in the figures. Integral with the armature is Pin A which extends into the switch area. Also integral with the armature is a weighted arm which provides the energy to drive the clock. Since the area we are examining is the switch, the armature and the weighted arm are not shown in the figures. Parts B and C are brass stampings which pivot about the points marked 2 and 3, respectively. Part B is designed so that it would always rest against pin A if it were not for Part C which serves as a pawl and locks Part B in place. An electrical contact is integral with Part B and is identified in the figures as the "contact point."

Parts B and C of the switch mechanism are mounted to the clock frame which forms one side of the battery connections. The second battery connection is made to the part marked "spring contact." The spring contact is insulated from the clock frame.

Figure 1 shows the clock at the start of the running cycle. In this position, the weighted arm would be slightly above horizontal. As the clock runs, Pin A follows the circular path marked in the figures and allows the Part C to engage and hold Part B in position. This is shown in Figure 2. As the clock continues to run, Pin A begins to lift Part C. Figure 3 shows this action just before the Part C releases Part B. An instant later, Part C is disengaged and Part B is permitted to fall. This action allows the electrical contact point on Part B to touch the spring contact and complete the electrical circuit. When the circuit is complete, the magnet is energized and pulls the armature back into the original position. Pin A moves along with the armature and forces Part B to open the switch and break circuit. This returns us back to the positions in Figure 1 and the cycle begins again.

The entire cycle, Figures 1 through 4, takes approximately 6 minutes. The release of the Part B (Figure 3) and the closing and opening of the switch (Figure 4) is practically instantaneous. Part B and Part C are designed to prevent overtravel when the rather violent resetting occurs. Additionally, the vertical tail on Part B is curved so that the impact of Pin A with Part B is minimized and the whole mechanism comes to a stop relatively gently. (Of course, the satisfying clunk so loved by electrical clock collectors is still present.)

If we examine the last part of the cycle in detail, when the switch is closed and the mechanism is then reset, the Sempire switch emerges as an excellent design. Firstly, if arcing is to be minimized, the switch must close rapidly. This is the case in the Sempire since Part C releases Part B and the weighted tail on Part B causes B to rotate rapidly about Point 2. As Part B rotates, the actual electrical contact point on Part B swings down until it slides across the spring contact. This sliding action cleans any oxide or contamination from both contacts and contributes to minimizing arcing. As Part B continues to rotate, the path of the electrical contact into the spring contact is designed so that the force between the two contacts increases as travel continues. As the force builds, the wiping action becomes more effective and finally, at some point in the travel of Part B, a good electrical circuit will be made.

When the electro-magnet is energized, the magnetic force causes the armature to rotate rapidly about Point 1 until everything is back to the positions shown in Figure 1. This action occurs very quickly and the electrical contact is broken rapidly and positively. Both of these actions tend to minimize arcing. The travel of Pin A mechanically forces Part B and the electrical contact of B into a position which opens the electrical circuit. This prevents the switch from trying to reset again and again, should something go wrong. The electrical circuit is complete for only an instant and this protects battery life.

Probably the biggest fault in the Sempire design occurs when the battery is too low to cause the armature to rotate back into the original positions shown in Figure 1. When this occurs, the switch will remain closed until the battery is completely run down. If left

in this condition, the battery will certainly leak. Of course, dealing with battery acid in a clock is as much a part of electric clock collecting as is the sound of these clocks when they rewind.

All-in-all, the Sempire switch design is very well done. The rapid closing, the self-cleaning action during closing, and the very rapid and positive opening of the electrical circuit during resetting all contribute to very good operating characteristics. Mr. Ramel's testimonial is well deserved.

H. W. Ellison
February, 1988

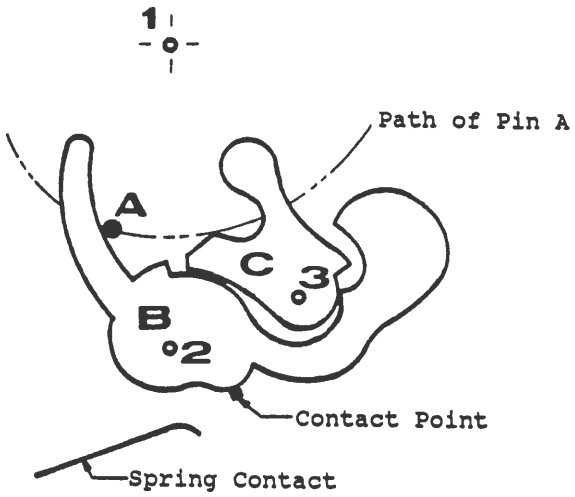


FIGURE 1. START OF CYCLE.

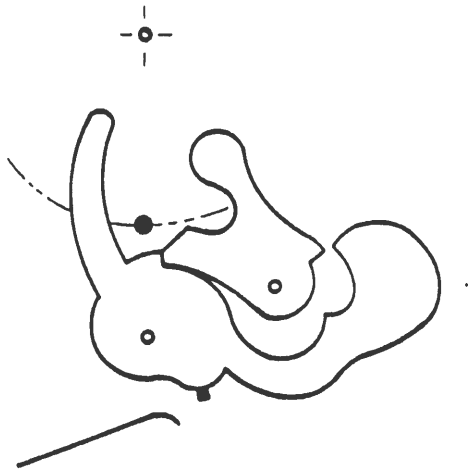


FIGURE 2. PART C LOCKING PART B.

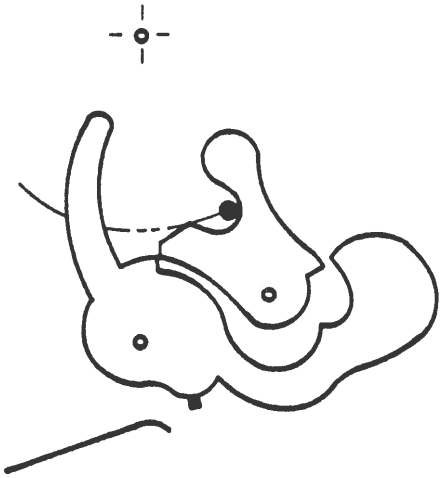


FIGURE 3. AN INSTANT BEFORE PART C RELEASES PART B.

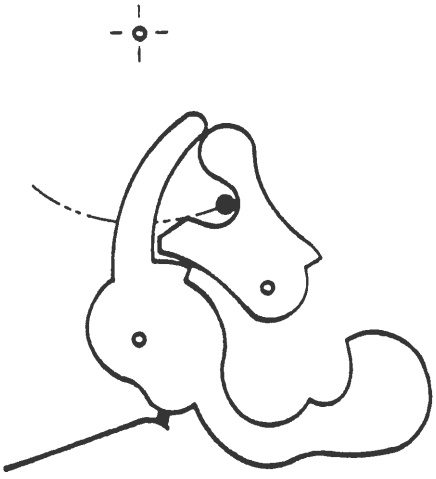


FIGURE 4. AN INSTANT AFTER PART C RELEASES PART B.

HATOT REGENERATIVE PENDULUM SYSTEM (ATO)

One of the greatest difficulties facing inventors of pendulum electric clocks is to ensure a constant and uniform arc, although the battery E.M.F. or driving force varies 2.5 per cent ± over a period of use. With early designs, especially those with short pendulums, variation in amplitude due to this cause was a very serious drawback. Notable among the many ingenious devices that have been invented to compensate for this is that of Leon Hatot of Paris, patented in 1924. This system overcomes the difficulty by applying regenerative principles following the same law as the propelling forces.

Fig. 47 shows the arrangement. A curved permanent magnet bob B is carried on the pendulum rod A. Surrounding the two magnet limbs without touching are an electro-magnet D and a copper ring, called a regenerative ring (E, E1). The coil is connected in series with a special contact switch F and battery.

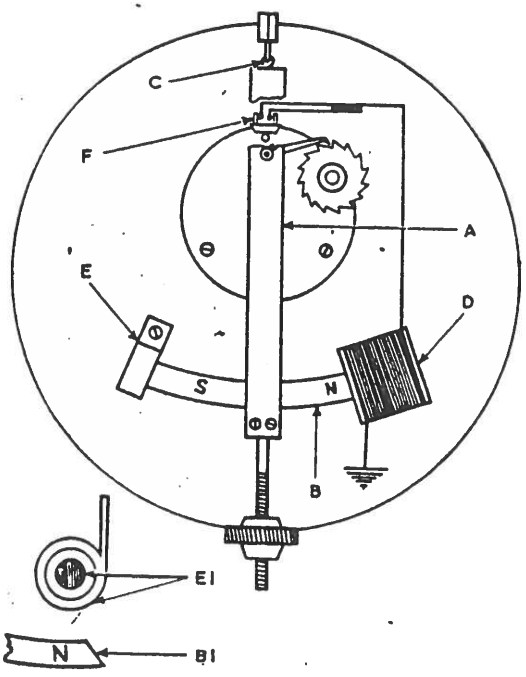


FIG. 47.—REGENERATIVE PENDULUM OF LÉON HATOT SYSTEM

On impulse being given to the pendulum by the working coil reacting with one limb of the magnet, the opposite limb threads the copper ring (which can be assumed to be a closed circuited winding of one turn), thereby setting up a current in the ring and therefore a reactive retarding force. This force, however, is slight when the arc is small, but increases rapidly should the arc become longer. At the same time the contact switch, which is actuated by the pendulum, automatically prolongs the circuit when the arc is small, but interrupts the current flow immediately

Some of the material used in this article has been reproduced from "ELECTRIC CLOCKS" by S.J. WISE, 2nd edition, published in 1958.

amplitude increases beyond certain limits. The whole pendulum structure is suspended by means of hardened steel links C.

The contact device is shown in the cut-away space at F. The assembly is pivoted to the pendulum rod and contains two vertical pins. The pin on the left is composed of rare metal and constitutes one contact of the system. Between the two pins, but slightly less in pitch, are two stationary rods, one only of which, that on the left, forms a mating contact with the pin carried by the pendulum. When the pendulum swings to the right on a normal arc the contact and its mating pin are in electrical contact, as shown on the drawing, but should the arc increase beyond certain limits the contact assembly will be tripped to the right, separating the contact pins and interrupting the circuit. Amplitude now falls off until a normal arc is again reached, at which point the contact assembly is tripped back by means of the two non-conducting pins seen on the right.

A pendulum controlled by such a device is practically self-starting because when at rest the two contact pins are in a closed-circuited position.

"ATO" REGULATOR AND COPYING OR RECEIVING CLOCKS

This system (like the domestic clock shown above) was perfected by Leon Hatot of Paris, and consists of an accurate pendulum transmitter arranged to control a number of receiving or copying clocks by a system of pendulum synchronization.

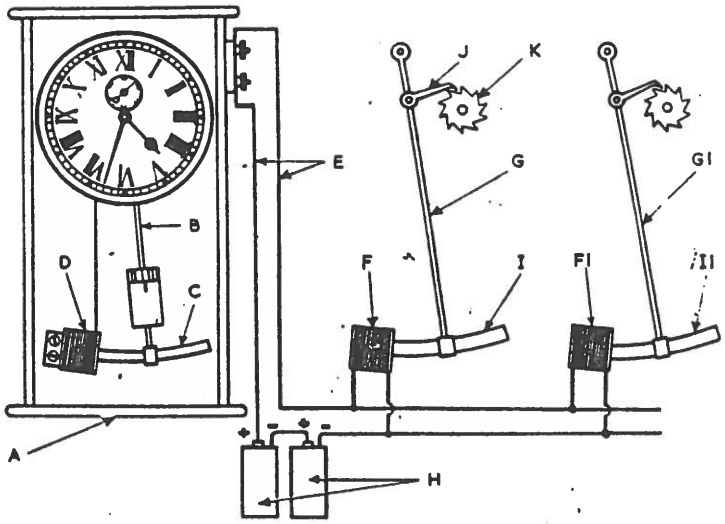


FIG. 48.—LAY-OUT OF "ATO" REGULATOR AND COPYING MECHANISMS

Fig. 48 is a general lay-out of the system. A is the master or transmitter with a half-second pendulum B. A permanent magnet C, carried by the pendulum, is arranged to "thread" the interior of a fixed solenoid D during its travel from right to left. A special contact switch operated by the master pendulum connects

the solenoid D in series with a 1.5 volt cell. The master clock, therefore, works on rather similar lines to that already described for the "Hatot" domestic clock. Its circuit is entirely self-contained.

From HOROLOGICAL JOURNAL
January, 1959

JUNGHANS ATO by E.B.

A transistorised clock which is in current production and available in this country is the Junghans-Ato which had mechanical contacts in its earlier version. A magnet is fixed to the end of the pendulum and swings in and out of the coil. At the centre point of its swing a mechanical platinum contact was closed and a small current flowed for a short time from the battery through the coil to give an electro-magnetic impulse to the pendulum. This arrangement is now superseded by a temperature compensated germanium indium transistor, as shown in Fig. 9.

The tube on the left in the illustration contains an amplitude stabilised damping ring, and that on the right carries the control and working coils. When the permanent magnet on the end of the pendulum swings into the control coil, a negative potential is produced which opens the transistor so that a working current (collector current i_c) flows from the battery through the working coil. This current sets up a magnetic field in the working coil which repels the permanent magnet on the pendulum and thus gives it impulse. During the return swing of the pendulum, a positive voltage is produced in the control coil and the transistor is switched off.

The drive to the hands is made through a lever attached to the invar pendulum which rotates a jumper wheel.

The duration of the pulse of the working current depends upon temperature, and the moment at which the pulse is applied depends upon both temperature and the geometrical arrangement of the coils. By suitable design of the coils and their arrangement it has been possible to apply successful temperature compensation.

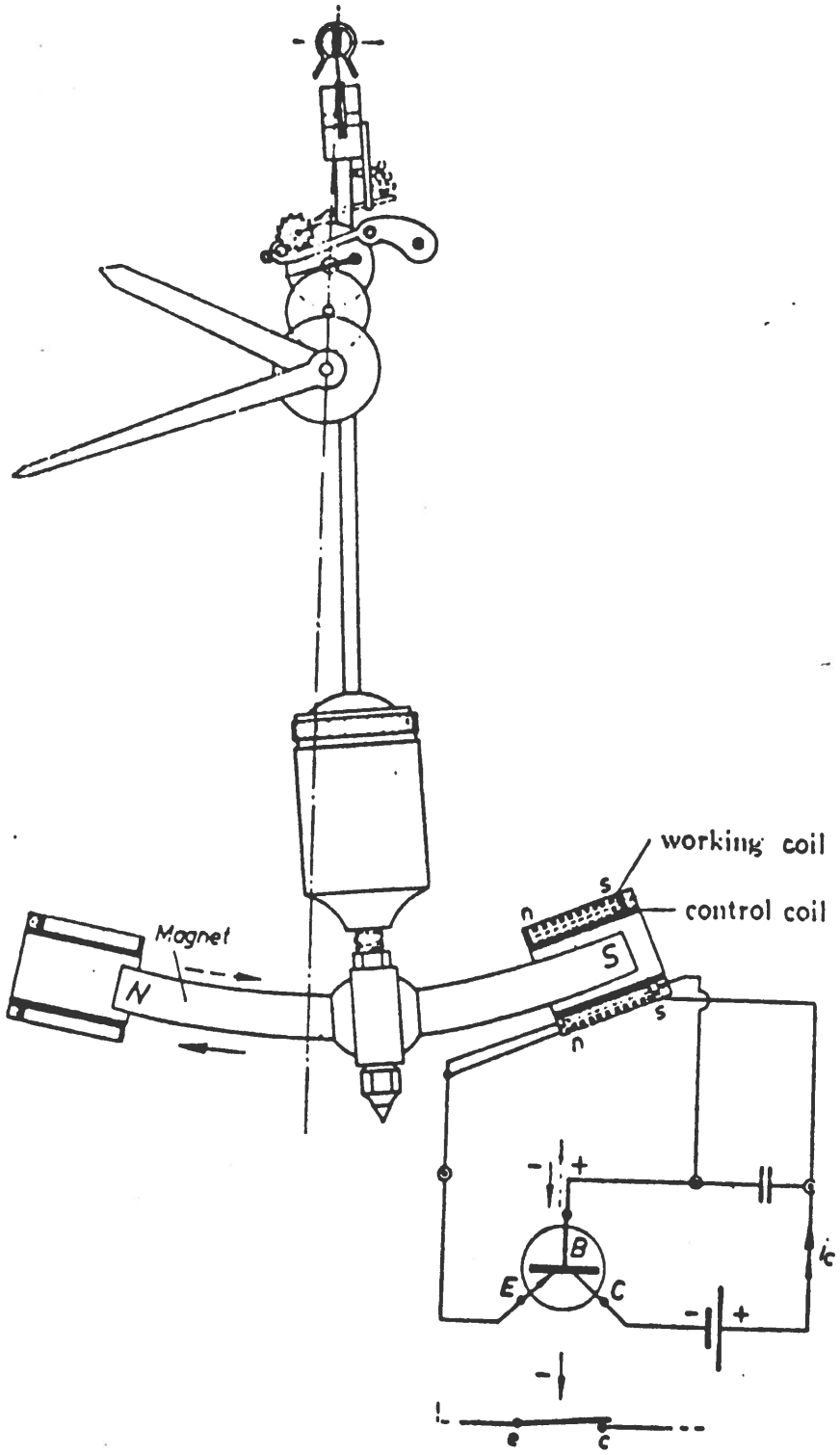


Fig. 9. The ATO transistorised pendulum clock, which is in full production. The little switch diagram below shows how the transistor operates.

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IN

Railway Signal Engineering

FOR

Steam and Electric Railways

THIRD EDITION

Department of Signaling

CHICAGO, ILLINOIS

LESSON XI

Primary Batteries.

A "Cell" is a combination of two metals or metalloids which when immersed in a liquid, called an Electrolyte, and connected outside the liquid by a conductor, will produce an electric current.

Properly speaking, a Battery is a combination of two or more simple cells, although one cell, or unit, is frequently spoken of as a battery. In this course we will consider a single unit a "cell" and a combination of cells will be called a "battery."

Cells may be divided into two classes, called Primary Cells and Secondary Cells. Secondary Cells are usually called Storage Cells or Accumulators.

A Primary Battery is a group of two or more primary cells connected together, which generate a current of electricity by chemical action. They are generally used on open circuit or intermittent work, although some forms are specially adapted to closed circuit (such as track circuits for automatic signals). The common primary cell or battery is often spoken of as the "Voltaic" or "Galvanic" cell or battery.

If a piece of **chemically pure** zinc be immersed in a dilute solution of sulphuric acid containing about twenty parts of water to one of acid, very little or no action at all takes place. If a piece of copper is now immersed in the solution so that it cannot touch the piece of pure zinc, no action will occur. If, however, the zinc be connected to the copper, outside the solution, by means of a wire or other conductor, action in the solution immediately begins. The acid attacks the zinc and gives up hydrogen gas, a part of which collects in the form of bubbles on the copper.

If instead of using pure zinc, **commercial** zinc be used, which contains a small per cent of impurities, it will be found that the

dilute sulphuric acid will attack the zinc whether the electrical circuit be completed outside the solution or not. However, the action is much stronger when the circuit is completed.

When the circuit is completed the current is found to flow through the dilute sulphuric acid from the zinc to the copper and then from the copper to the zinc, through the wire or outer circuit. Thus we say the zinc is positively electrofied or has a higher potential than the copper. However, when speaking of the external circuit we call the copper the positive or plus pole and the zinc the negative or minus pole, because the current flows from the copper to the zinc through the outer circuit.

As stated before, if pure zinc be used, all action will cease immediately upon the outer circuit being broken. However, if commercial zinc be used, untreated, the action will continue to a limited extent when the outer circuit is broken; hence considerable energy is being wasted, as is evidenced by the zinc becoming badly eaten and the acid growing weaker. This is

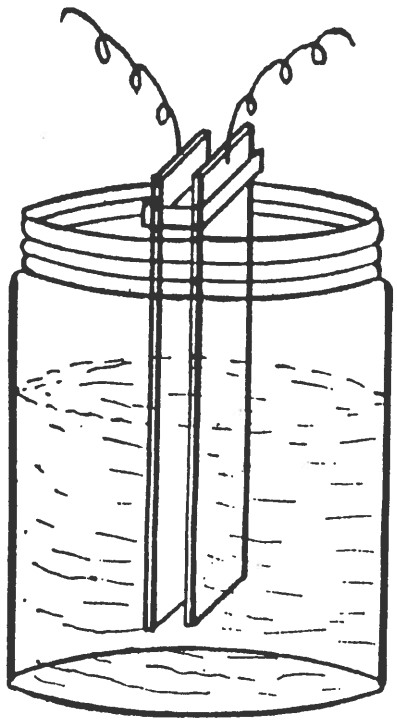

Fig. 206

termed "local action," and it is the aim of every battery manufacturer to reduce this local action to a minimum. Where zinc is used as the positive plate, the amalgamation process is used to reduce local action.

The simplest form of a cell is shown in Figure 206. It consists of a glass jar about 9 inches high and 6 inches in diameter. In the jar are placed two plates, one of zinc, about 6 inches long, 2 inches wide and ⅛ of an inch thick; the other of copper, about the same size as the zinc, but not so thick. These plates are separated by a piece of wood about 4 inches long and 1 inch square. Two strips of wood may be placed outside the plates and the whole fastened together by a piece of waxed cord. The jar is filled about three-quarters full with dilute sulphuric acid, twenty parts of water to one of acid.

In mixing water and acid, **always** pour the acid into the water and **never** pour water into acid. When the zinc, copper and dilute sulphuric acid are placed in one jar, it is called a "cell". When two or more of these cells are properly connected together they form a "battery".

The plates which are placed in a cell are called "electrodes". Many different metals and metalloids may be used as the electrodes in a cell. Practically any two different metals placed in an electrolyte that acts on one of them more than the other will form a cell capable of producing electric current.

In many types of cells, small hydrogen (gas) bubbles are found to collect on the negative plate, and as these bubbles are of high resistance, they materially lower the ability of the cell to generate an electro motive force, and if allowed to collect for a sufficiently long time they will be the means of stopping the flow of current. Such action is called "Polarization".

To overcome this action, use is made of what we term "depolarizers". Depolarizers are divided into two main classes, namely, "liquid" and "solid".

Liquid depolarizers are of two classes, namely, those that are mixed through the solution and those that are separated from the remainder of the electrolyte by means of gravity or by a porous cup.

Solid depolarizers are usually ground up into a powdered form and kept around the negative electrode by means of a porous cup or metal frame.

One of the perplexing facts to a beginner in regards to a cell or battery is that the **size** of a cell or battery has no effect on the voltage or pressure that the cell generates. A cell made in a cup will generate just as much voltage as one that fills a barrel, provided it is made of the same kind of materials. The pressure generated by a cell depends on the kind of plates used, the kind of electrolyte and the temperature of the electrolyte.

The ability of a cell to generate current is greatly affected by the size of the cell and is determined by: the size of the vessel; the size of the plates; distance between the plates; temperature of the electrolyte and kind of electrolyte.

Each cell has a certain internal resistance and when a group of cells are connected in series, their combined resistance is great. Similarly when they are connected in multiple their combined resistance is low. It is a fact that a battery is most efficient when it is connected to an external circuit whose resistance is equal to that of the internal resistance of the battery, hence on circuits of high resistance it is more efficient to connect the cells of a battery in series, and on circuits of low resistance it is more efficient to connect them in multiple.

A Primary cell or Battery is one which produces electrical energy by chemical action, changing the materials in the cell to other forms. Primary cells after being set up are ready for use either immediately or after a short period of time. They require no particular attention, except to see that the materials of which the cells are made are replenished from time to time as they are used up.

Primary cells may be divided into two groups called "Open Circuit Cells" and "Closed Circuit Cells".

Open Circuit Cells are used for intermittent service, such as on door bells, call systems, etc., where they are in use but a very short period at a time. This class of cells become polarized very quickly if used steadily for any great length of time. If allowed to rest between times the polarization will gradually disappear and the cell regain all or most of its former power.

One of the most common types of open circuit cells is the ammonium chloride cell (salammoniac cell). This cell consists of a glass jar fitted with a cover from which the positive and negative plates are suspended.

The electrolyte is a solution of ammonium chloride and water, about five ounces of the chloride to one quart of water being a good mixture.

The Positive Plate* is made of zinc and is usually in the form of a rod about ½ inch in diameter. In order to prevent the solution from attacking the zinc when current is not flowing (called "local action") it is customary to amalgamate the zinc rod. This is done by first thoroughly cleaning the zinc with dilute sulphuric acid and then coating it with mercury. The mercury can best be applied by the use of a clean cloth or chamois skin. Care must be taken not to touch the clean zinc with the fingers, as the mercury will not adhere to these spots.

The negative plate is made of carbon and may be any one of several shapes. Figure 207 illustrates a cell of this type having the negative plate in the form of a hollow cylinder. A hole is left open in the side of the cylinder for the free circulation of the electrolyte. The carbon cylinder and zinc rod are arranged as close as possible to each other without actually touching, in order to keep the internal resistance of the cell as low as pos-

*Remember that the positive plate **inside** of the cell is connected to the negative side of the line **outside** the cell. Hence we say the zinc is the positive plate for the internal circuit and the negative pole for the external circuit.

sible. The upper portion of the carbon and the upper rim of the glass jar are coated with paraffin to prevent creeping salts.

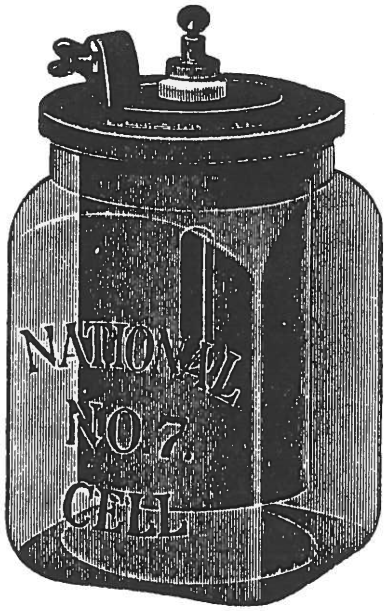

Fig. 207

Creeping Salts are caused by the following action: Where a solution in which is dissolved a salt, such as ammonium chloride, is placed in a vessel made of certain materials, such as glass; evaporation of the solution begins and crystals form on the sides of the vessel near the top of the solution. These crystals are kept moist by the solution below and tend to grow upwards. If not removed, they will grow up to and over the top of the vessel. This action may also occur on the positive and negative plates.

If the creeping salts are not removed the solution will gradually be dried up or the salts on the outside of the vessels may short circuit the cells of a battery. These salts have a highly corrosive action on the binding posts and other connections and should be removed at once and precautions taken to prevent their reoccurrence.

Cells of this type generate a pressure of about 1¼ volts and have a capacity of about 10 ampere hours per ounce of am-

monium chloride. Thus a cell holding a quart of solution would have a capacity of approximately 50 ampere hours.

All that is necessary to set up a cell of this type is simply to place the ammonium chloride in the jar and fill the jar about two-thirds full with pure water. Stir the solution until the ammonium chloride is all dissolved and then put the plates and cover in place and the cell is ready for use. All the maintaining that is necessary in this type of cell is to renew the zinc when it is used up and to renew the electrolyte when exhausted.

Some manufacturers make an ammonium chloride cell with a depolarizer. The positive plate is zinc, usually in the form of a rod, and the negative plate is carbon, usually flat and about 2 inches wide, ½ inch thick and 8 inches long. Some of these cells use a liquid electrolyte and some an electrolyte in the form of a jelly or paste. The Le Clanche, Samson and Gonda cells belong to the first type and the well-known "dry cells" belong to the second type.

The Le Clanche cell makes use of a cup in which the carbon plate and depolarizer are placed. This cup is porous, being made of white, baked, clay. The top of this cup is coated with paraffin to prevent creeping salts. The depolarizer for this type of cell is manganese dioxide and is placed around the carbon plate in the porous cup. The top of the cup is then sealed with sealing wax, with a small hole left for the escape of the gases. The purpose of the manganese dioxide is to prevent polarization by keeping the hydrogen bubbles from reaching the carbon plate.

In the Samson Cell the carbon plate and depolarizer are placed in a canvas bag; this bag, being extremely porous, lowers the internal resistance of the cell.

The pressure generated by this type of ammonium cell is somewhat higher than that of the same cell without the depolarizer, being nearly 1½ volts. The capacity in ampere-hours is practically the same.

In setting up cells of this type it is well to thoroughly moisten the depolarizer with some of the electrolyte, as it takes the solution some time to soak through the porous cup.

To maintain the cells it is necessary to renew the zinc, electrolyte and depolarizer as fast as they become exhausted. It will be found to improve the general condition of the cell if the carbon plate and porous cup are allowed to soak in very hot water for about two hours and then allowed to dry in the sun. It has been found out, by keeping close records, that for every ounce of zinc that is consumed in this type of cell, about two ounces of ammonium chloride and two ounces of manganese dioxide are also consumed. In this way it is possible to ascertain the condition of the electrolyte and depolarizer by carefully watching the zinc. Thus it becomes comparatively easy to tell when the electrolyte and depolarizer should be renewed.

The so-called "Dry Cells" are usually made with an electrolyte of ammonium chloride, which is either absorbed by porous material or made into the form of paste. The main advantage of this type of cell is that they may be used in any position without having the electrolyte spilled.

Fig. 208

Figure 208 shows a cell of this type manufactured by the National Carbon Co., of Cleveland, Ohio.

The total E. M. F. of a cell of this type varies from 1.2 to 1.5 volts, depending on the material used in its construction. Such a cell has a capacity of approximately 25 ampere hours. These cells require no special setting up or maintaining and are ready for use when received from the manufacturer. They are very difficult to recharge and when exhausted are generally thrown away. The dry cell is not used extensively in signal work. It finds its greatest use for door bell systems, motor ignition, pocket flash lamps, etc.

The outside of the dry cell is a cylinder of sheet zinc which forms the positive plate. The cylinder is open at the top and closed at the bottom; all seams being made water tight.

A carbon cylinder or rod is placed inside a canvas bag which is about one-half the diameter of the hollow zinc cylinder and which reaches from within one-half inch from the top, almost to the bottom of the cylinder. In this bag and equally on all sides of the carbon electrode, is tightly packed a paste made of:

Finely Powdered Graphite	5 parts
Finely Powdered Manganese Dioxide	5 parts
Ammonium Chloride (Salammoniac)	1 part
Chloride of Zinc	1 part
Glycerine	1 part
Water	1 part

After the paste has been packed into the bag around the carbon, the neck of the bag is drawn together with a piece of waxed string. The top of the bag when placed in the hollow cylinder should be at least one-half inch below the top.

After the bag has been placed in the cell, the space between the bag and the hollow zinc cylinder should be filled with a paste which has been boiled to get out all the lumps and which contains the following ingredients;

Water	4 ounces
Flour	1 teaspoonful
Zinc Chloride	¼ ounce
Ammonium Chloride	½ ounce
Glycerine	½ ounce

This paste should be of a very thin consistency to permit pouring it around the bag. The cell should be kept still and in a vertical position until the paste has had an opportunity to harden.

A cross section of this cell is shown in figure 209.

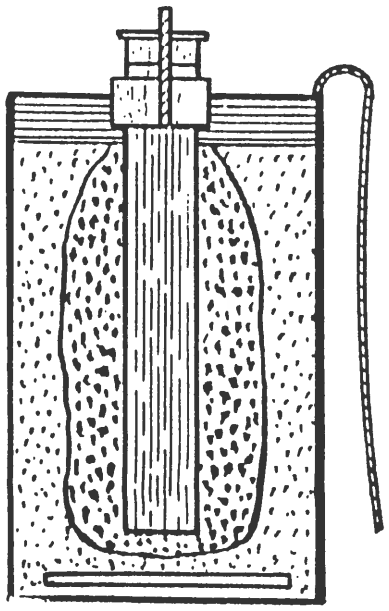

Fig. 209

The cell is next sealed. This is done by heating a mixture of tar, rosin, and paraffin wax, of equal parts, which when it becomes liquid, is poured over the top of the bag and hardened paste, until it becomes level with the top of the hollow zinc cylinder.

In order to permit the escape of gases which are formed in the cell when in use, a small hole is made through the seal by inserting a small glass tube.

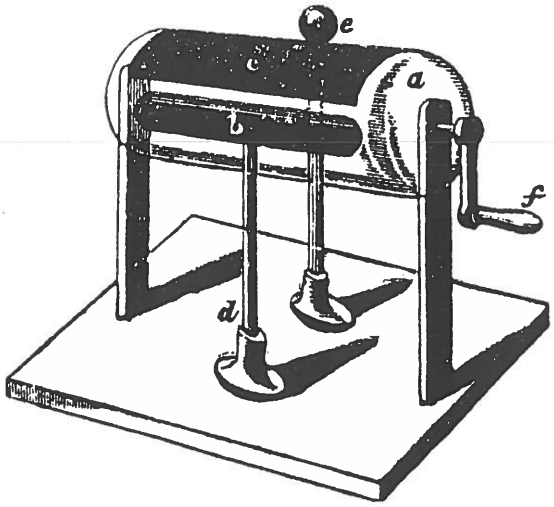

FIG. 1. Frictional electric machine, late 18th century.

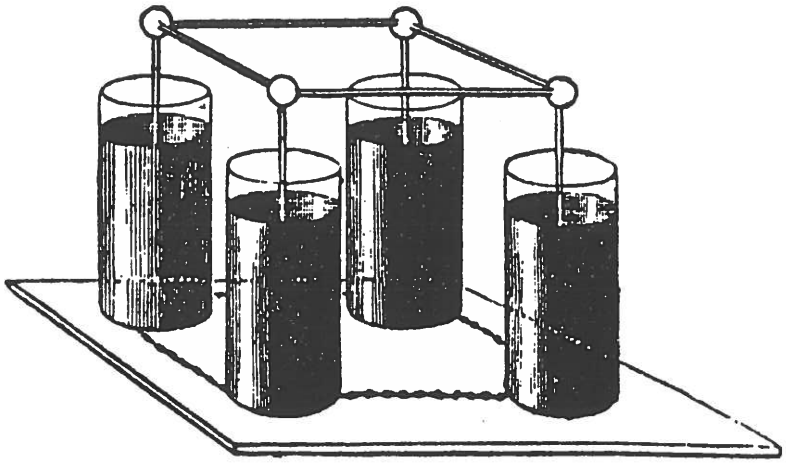

FIG. 2. Battery of Leyden jars, late 18th century.

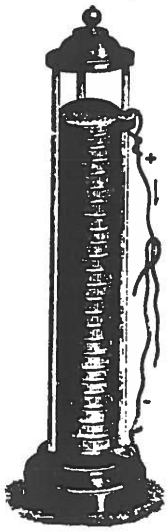

FIG. 3. Voltaic pile, early 19th century.

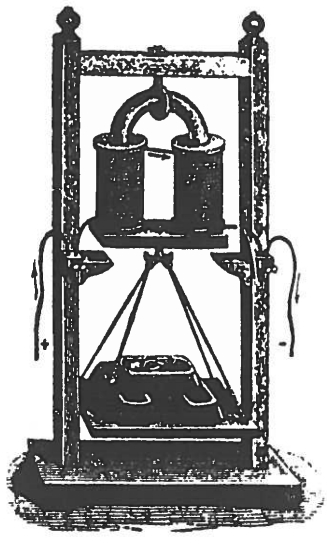

FIG. 4. Demonstration electro-magnet, mid-19th century.

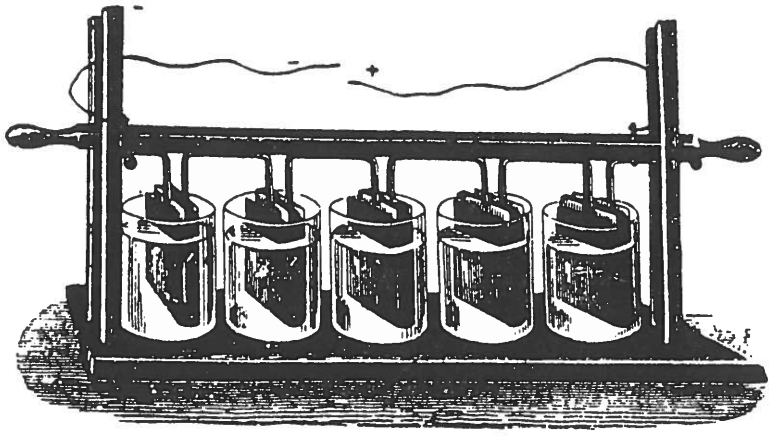

FIG. 5. Wollaston's trough battery. The plates were raised when not in use.

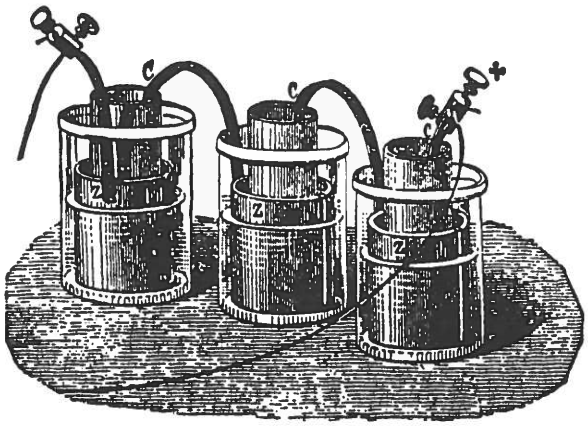

FIG. 6. Battery of Daniell cells. Z indicates zinc; C, copper

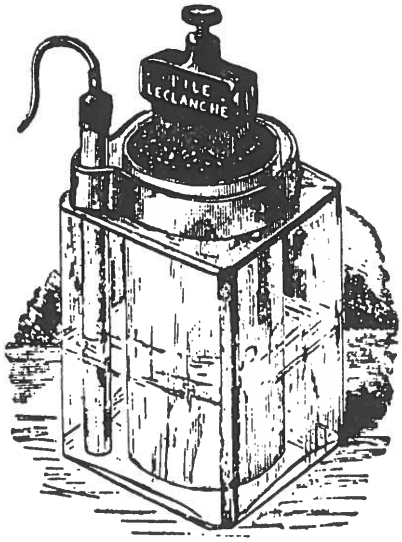

FIG. 7. Wet Leclanché cell, late 19th century.

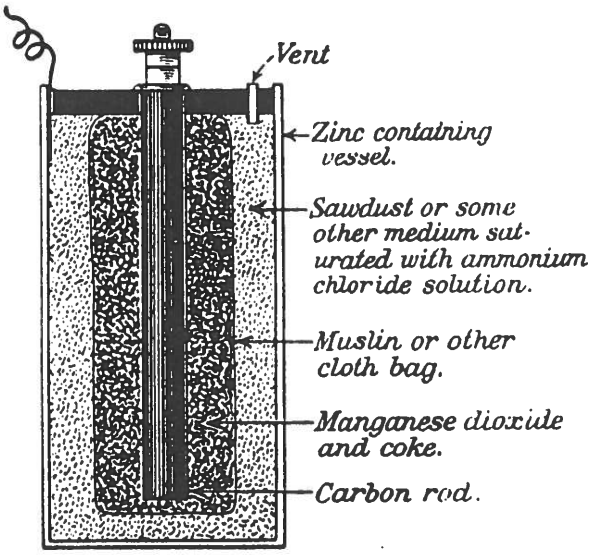

FIG. 8. Dry Leclanché cell, early 20th century.

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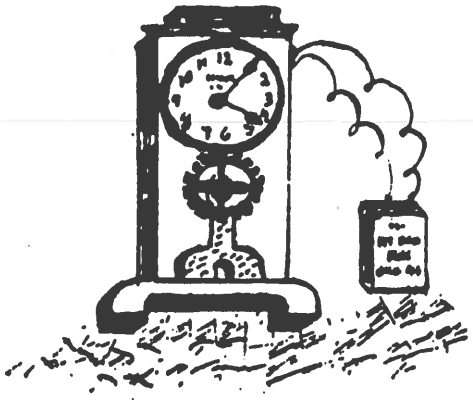
ELECTRICAL HOROLOGY SOCIETY

Chapter No 78



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