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THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78
NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXVII #1, MARCH 2001

Fellow Horologists:

In this issue, the first of the new year, we continue with the reprint of the final section of the English Language Bulle catalog of 1926. In addition, part 2 of the article about Matthaus Hipp's Astronomical regulators concludes the series in this issue of our journal.

We are starting a new reprint of a Self Winding Clock Company instruction manual which covers their synchronizing system using the type FC control box. Self Winding Clock material has always found favor in our publication due in part, to the large number of their clocks and systems still available to collectors. SWCC was one of the more prolific clock makers, with production continuing for more than 60 years, truly a testament to the reliability of their product!

You will note that the Mart segment of the journal has undergone its annual spring cleaning, with many ads deleted. If you would like to enter a new ad, or reinstate an older one, you may do so by contacting our Mart Editor, Dr. George Feinstein at his address on the Mart page.

The members who are delinquent in dues will note a reminder with their copy of the journal. Prompt payment will avoid the removal of their name from the roster, along with the possible loss of future journal issues. Many thanks to those members who have contributed material for publication during the past year. To those who have articles of interest, or hints & tips of their own, why not share them with the rest of us and allow everyone to benefit?

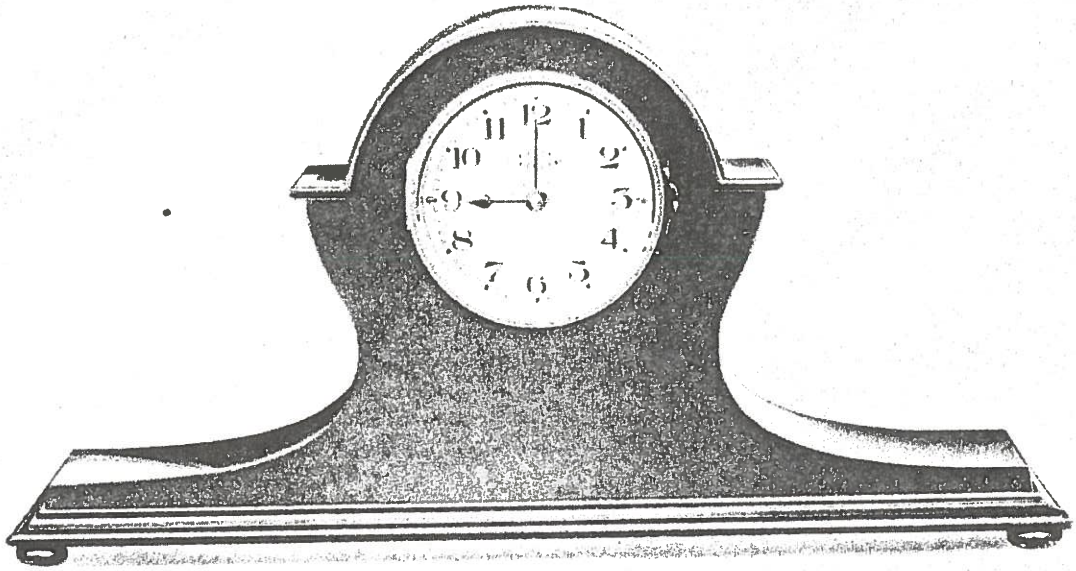
Our quote for this issue, "Real knowledge is to know the true extent of one's ignorance" Confucius

Enjoy this issue, good reading ahead...

Martin Swetsky, FNAWCC,.....President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein,.....Chapter Historian)

Continued from December, 2000 issue.

BULLE-CLOCKETTE. — **Model No 104**. Mahogany. 3 1/2 in. dial.
height 8 in. width 16 in. depth 4 1/2 in.
FIXED PRICE £ 5.5.0.



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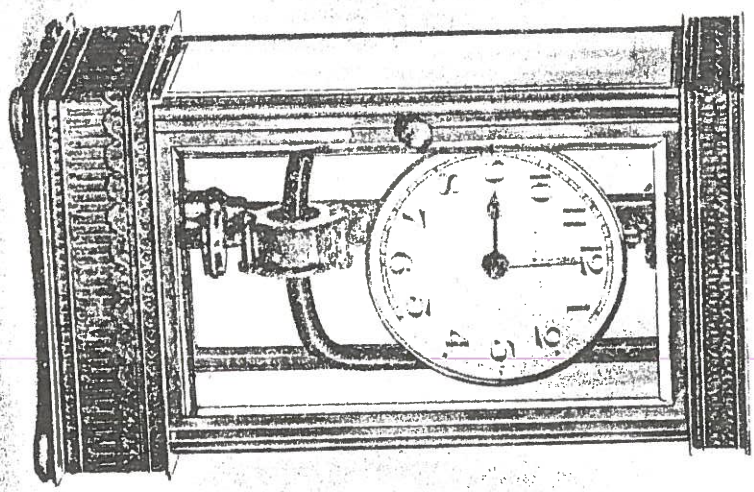
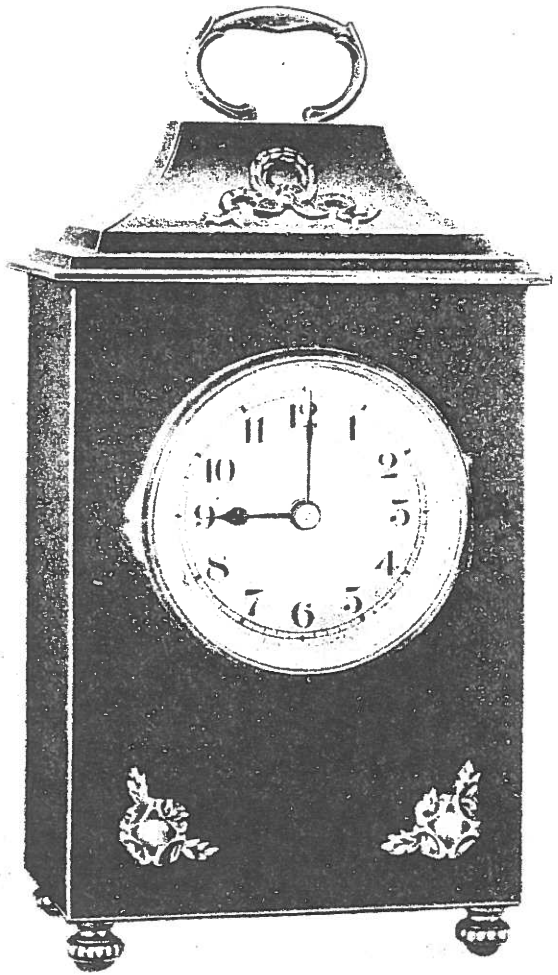
16

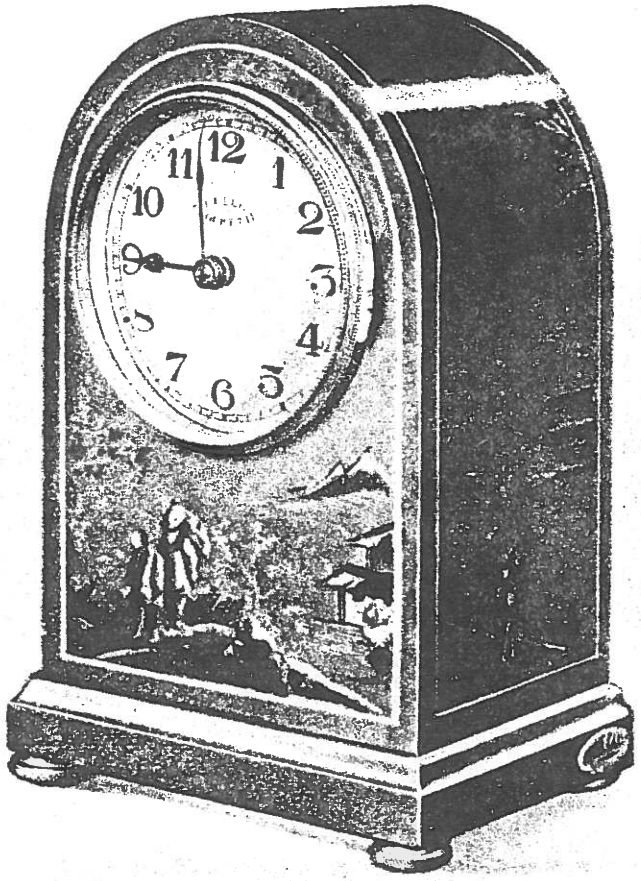
BULLE-CLOCKETTE. — **Model XD**. Duchess regulator type, richly gilt bronze, bevelled edged glasses.
height 10 in. width 5 1/2 in. depth 4 in.
FIXED PRICE £8.0.0.



BULLE-CLOCKETTE. **Model N° 109.** Lantern, silvered mat oxydised, 3 1/2 in. dial.
height 12 in. width 6 in. depth 4 in
FIXED PRICE £ 7.10.0.

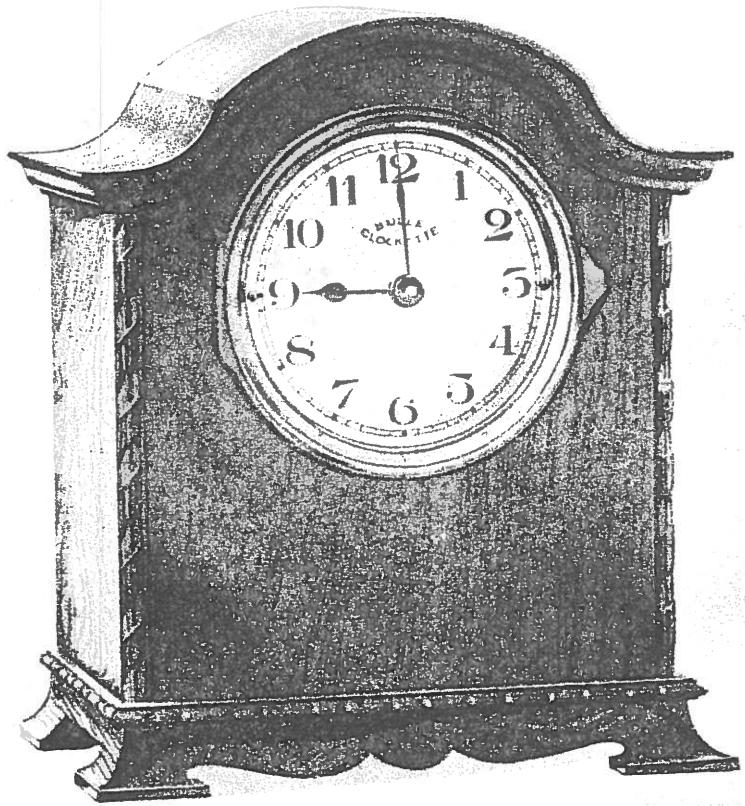


BULLE-CLOCKETTE. — **Model XF.** Japanese lacquer, 3 1 2 in dial.
height 9 in. width 6 in. depth 4 1 4 in.
FIXED PRICE £ 5.10.0.

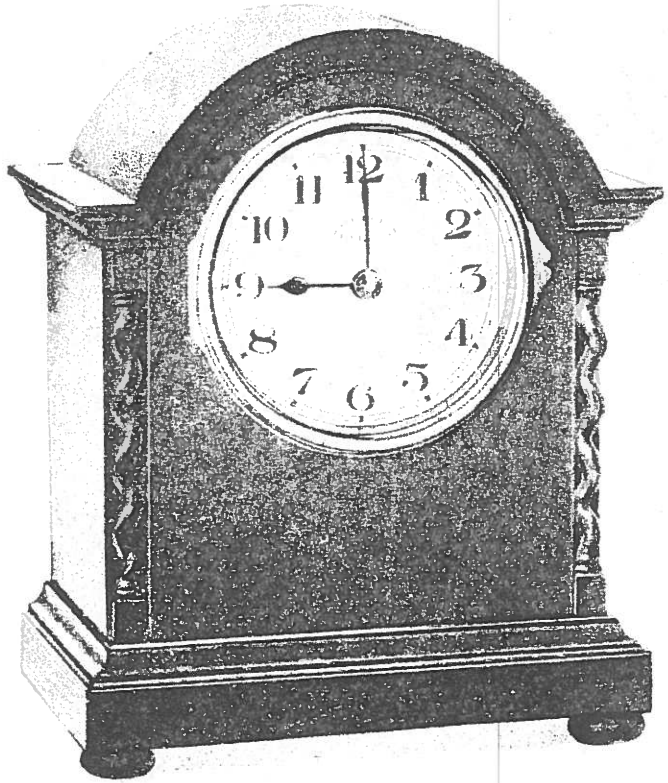


Same shape, **Model XC**, 5 in. dial. Japanese lacquer £ 5.15.6.
Or Chinese lacquer engraved £ 6.16.6.

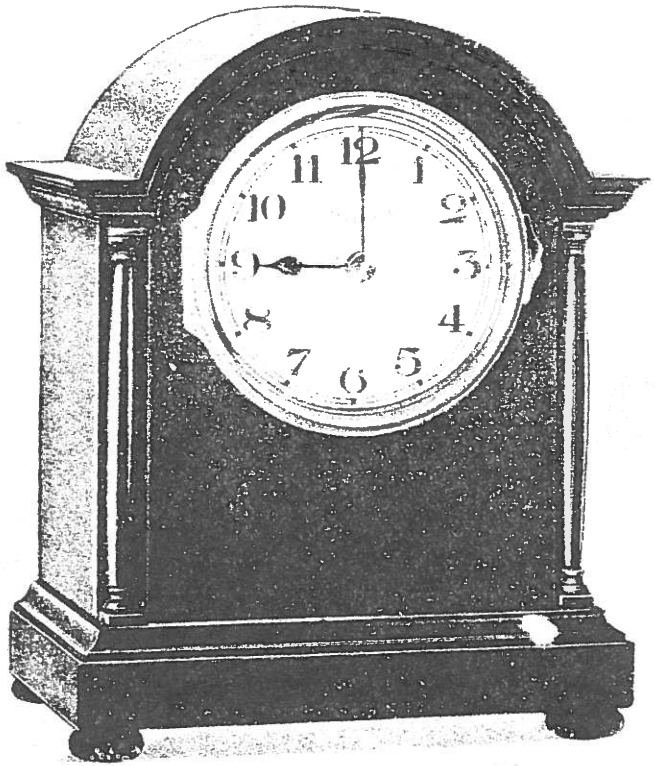
BULLE-CLOCKETTE. — **Model No 113.** Mahogany, carved base 3 1 2 in. dial.
height 8 1 2 in. width 6 1 2 in. depth 4 1 2 in.
FIXED PRICE £ 5.5.0.



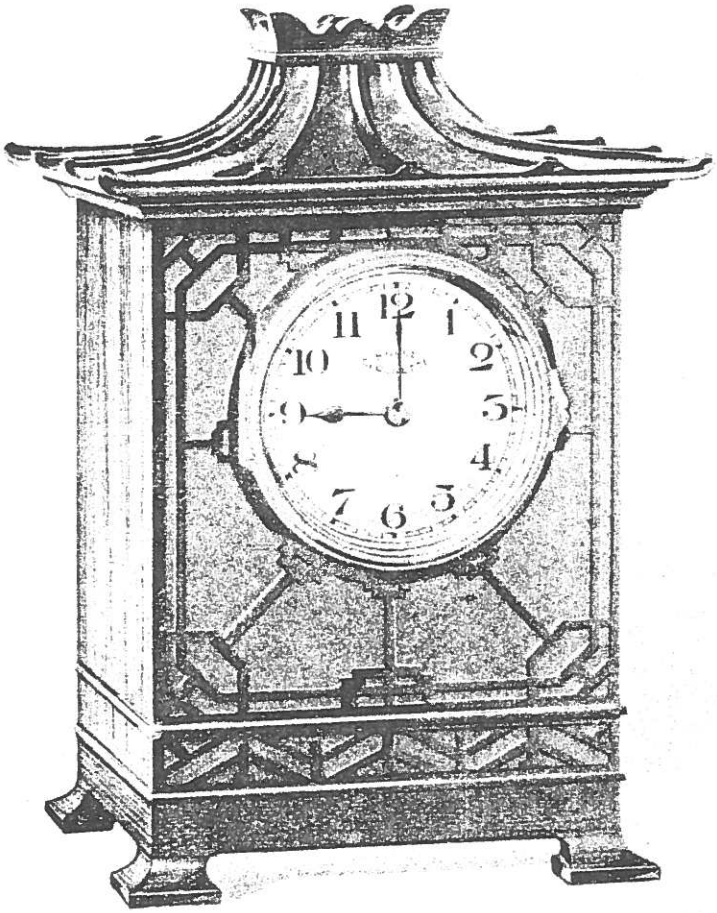
BULLE-CLOCKETTE. — **Model No 112.** Jacobean Oak, 3 1 2 in. dial.
height 8 1/2 in. width 6 1 2 in. depth 4 1/2 in.
FIXED PRICE £ 4.17.6.



BULLE-CLOCKETTE. — **Model N° 102.** Mahogany,
3 1 2 in. dial.
height 8 1 2 in. width 6 1 2 in. depth 4 1 2 in.
FIXED PRICE £ 5.5.0.

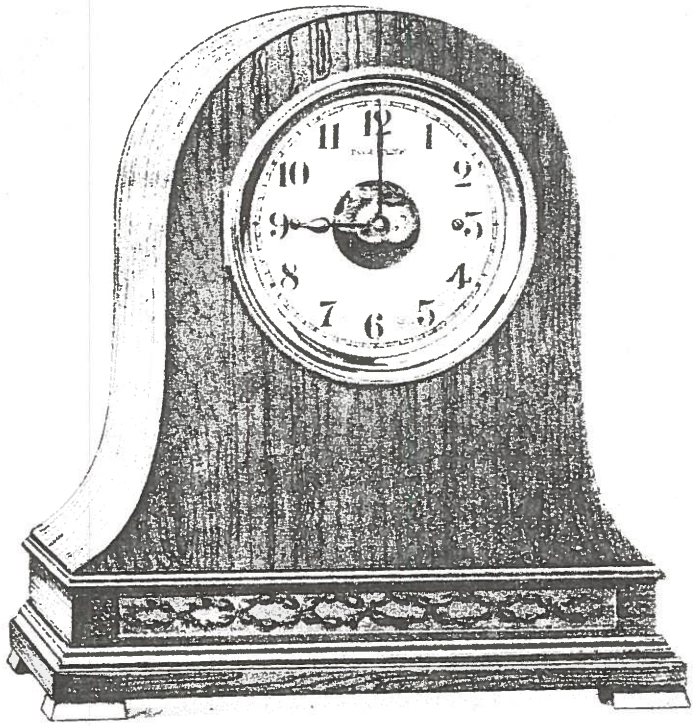


BULLE-CLOCKETTE. — **Model N° 114.** Pagoda, mahogany,
hand carved, 3 1 2 in. dial.
height 10 3 4 in. width 7 3 4 in. depth 6 in.
FIXED PRICE £ 9.0.0.



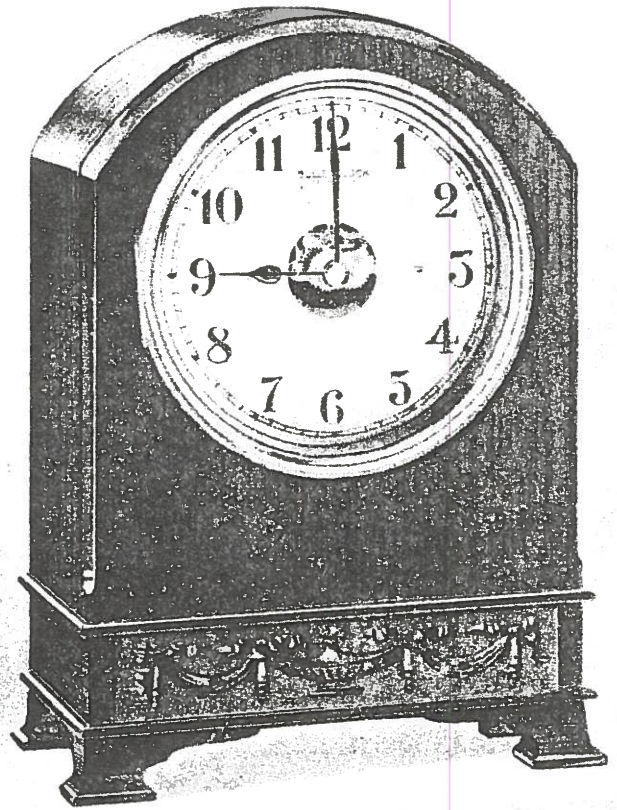
Same model, Japanese lacquer.
FIXED PRICE £ 10.10.0.

BULLE-CLOCK. — **Model No 7.** Mahogany, carved base, 5 1 2 in. dial.
height 12 n. width 10 1 2 in. depth 4 1 2 in.
FIXED PRICE £ 7.10.0.



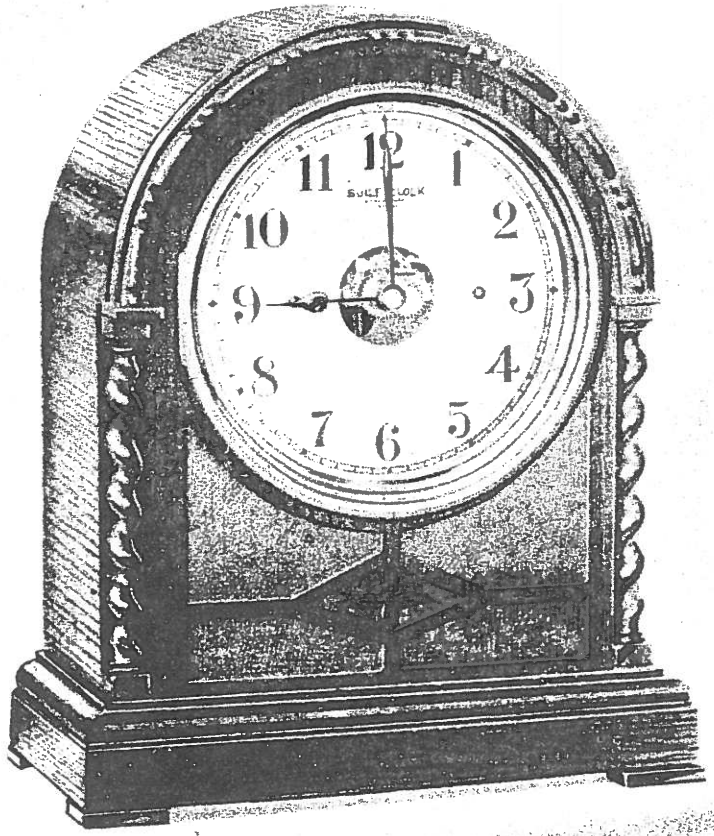
Same model, beautifully figured burr.
FIXED PRICE £ 8.10.0.

BULLE-CLOCK. — **Model No 6.** Mahogany, carved base,, 6 in. dial.
height 12 in. width 9 in. depth 5 in.
FIXED PRICE £ 5.12.6.



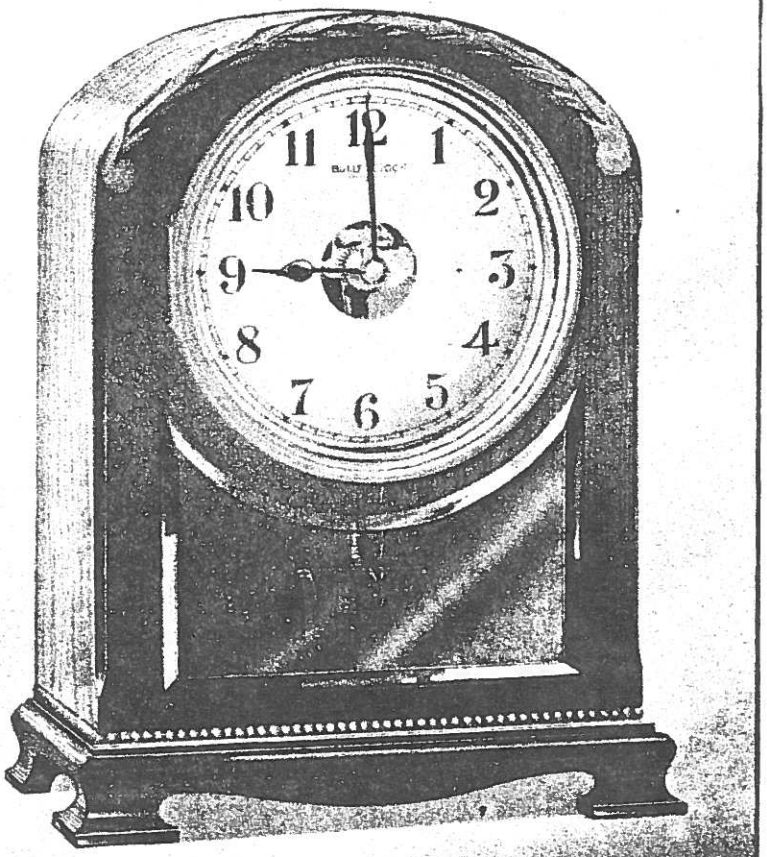
BULLE-CLOCK. — **Model No 10**. Jacobean Oak, 6 in. dial.
height 12 in. width 9 in. depth 5 in.

FIXED PRICE £ **5.12.6.**

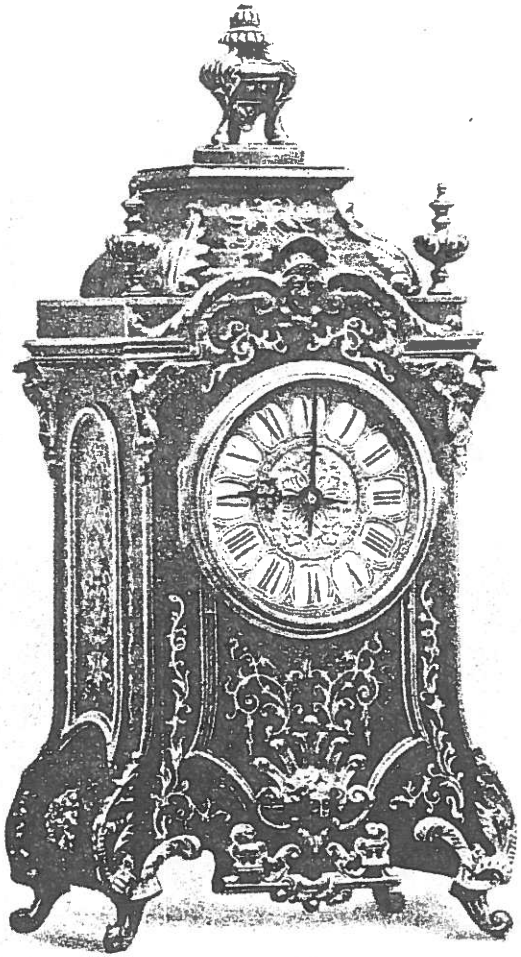


BULLE-CLOCK. — **Model No 9**. Mahogany, carved top, visible pendulum, bevelled glass, 6 in. dial.
height 12 in. width 9 in. depth 5 in.

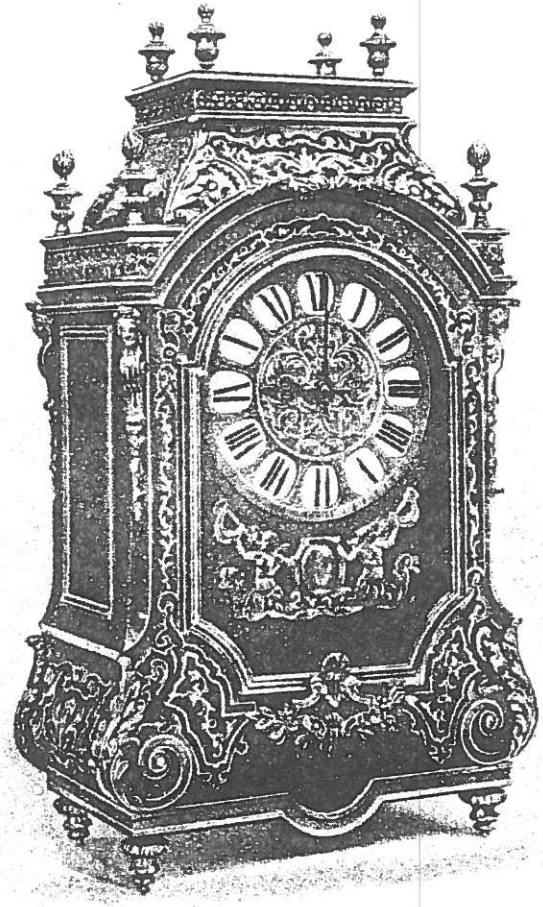
FIXED PRICE £ **5.15.0.**



BULLE-CLOCK. — **Model R. I.** Faithful reproduction of a 17 th. century clock ; bronze decoration after Boule
height 15 in. width 7 in. depth 4 1/2 in.



BULLE-CLOCK.— **Model 10.** Richly decorated, 17th century model
Bronze ornamentation after Boule
height 18 in. width 10 in. depth 6 in.



Continued from December, 2000 issue.

PENDULE HIPP DE L'OBSERVATOIRE DE NEUCHATEL

ANNÉE	Janvier		Février		Mars		Avril		Mai		Juin		Juillet		Août		Septembre		Octobre		Novembre		Décembre		ANNÉE	
	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.	Variat. moyenne	Nombre d'obser.
	±		±		±		±		±		±		±		±		±		±		±		±		±	
1884							s 0,040	21	s 0,040	25	s 0,042	13	s 0,050	28	s 0,034	26	s 0,033	23	s 0,033	25	s 0,036	15	s 0,030	15	s 0,038	191
1885	s 0,034	13	s 0,028	17	s 0,039	18		[1]	0,044	16	0,072	7		[1]	0,058	17	0,031	18	0,030	17	0,038	10	0,043	12	0,042	145
1886	0,026	21	0,018	12	0,018	27	0,048	24	0,066	26	0,047	20	0,064	22	0,043	25	0,051	21	0,032	26	0,026	17	0,026	19	0,039	260
1887	0,021	17	0,032	11	0,022	23	0,043	17	0,029	25	0,045	25	0,039	28	0,047	28	0,037	24	0,044	26	0,030	19	0,027	17	0,035	260
1888	0,047	18	0,022	16	0,029	21	0,030	21	0,040	29	0,035	21	0,028	21	0,033	24	0,020	24	0,038	24	0,020	19	0,022	17	0,030	245
1889	0,026	20	0,028	22	0,020	25	0,022	22	0,022	23	0,021	22	0,020	26	0,022	24	0,026	22	0,017	20	0,018	12	0,021	9	0,022	247
1890	0,017	15	0,015	17	0,018	27	0,024	24	0,023	21	0,019	22	0,023	23	0,019	22	0,024	25	0,017	23	0,018	14	0,010	9	0,019	242
1891	0,020	20	0,025	28	0,015	21	0,014	19																		

[1]) En avril et en juillet 1885, on a fait des séries d'essais pour la fermeture étanche de la cloche.

In the first attempt, which we put to the test in February 1884, we failed through receiving erroneous information on the quantity of mercury with which the pendulum cylinder (bob) had been filled originally, and on the relative weights of the pendulum and of the cylinder. In effect, after having increased this quantity (of mercury), 25th February, 1885, by 53 grammes, the compensation error still remained perceptible, for we found, by the rates in summer and winter, the variation for each degree of temperature:

Summer 1885 to Winter 1885-86	+ 0.062 sec.
Winter 1885-86 to Summer 1886	+ 0.058 sec.
Summer 1886 to Winter 1886-87	+ 0.062 sec.
Winter 1886-87 to Summer 1887	+ 0.060 sec.
Summer 1887 to Winter 1887-88	+ 0.061 sec.
Mean value	+ 0.061 sec.

which means that the compensation was insufficient.

This first experiment allowed us to calculate exactly the quantity of mercury which it was necessary to make the loss of 0.06 second per day disappear; and as 570 grammes of mercury when stirred and poured out represented a height of 19.6 mm., M. Hipp replaced the cylinder by another slightly taller. By means of this operation, which was carried out 7th June, 1888, the regulation was brought much closer, as can be verified by the following determinations of the first coefficient of the compensation, which rests on the combination of rates at temperatures which we had chosen to be as varied as possible, without, however, spreading the intervals too much, and at last we had enough evidence to detect a change to an accelerating coefficient:

	Var./degree	*Temp. diff.*
1888, October 15 - 1889, January 14	– 0.003 sec.	7.87°
1889, January 14 - April 22	– 0.0046 sec.	7.25°
1889, April 22 - July 15	– 0.0037 sec.	10.13°
1889, July 15 - October 14	– 0.0044 sec.	9.47°
1889, October 3 - 1890, February 16	– 0.014 sec.	9.65°
1890, February 16 - August 3	– 0.004 sec.	16.50°
1890, August 3 - December 7	– 0.001 sec.	15.10°
Arithmetic mean	– 0.0049 second	

If one wishes to give a different weighting to these values, following the differences of temperatures which have been deduced one finds almost the same value, – 0.0048 second.

As it was necessary, in order to carry out this operation, to open the bell (glass bell-jar) and dismount the pendulum, opportunity was taken from this occurence to examine the escapement, which had functioned in its previous form for more than four years and, of course, without oil. One examination under the microscope the platinum-iridium pallet, which I described in my first communication, was found to have its edge very slightly worn. M. Hipp therefore decided to replace the old pallet by a new one having an alloy containing 40% iridium in place of 30%, to augment the hardness of the alloy even further, and at the same time he very slightly rounded the bottom of the counter-pallet. In this manner it was hoped to avoid even the slight wear of the escapement on which we remarked, and succeed also in achieving a great constancy of going over a long period.

In effect, whilst in the first years our clock had a very marked tendency to accelerate its rate with time, this tendency is very sensibly reduced in latter years, and save for an accident of which I shall speak about presently, the clock kept a remarkable constant rate during the autumn of 1889. It was proved, by determinations over a long as period as possible, including almost identical temperatures between spring and autumn; that the coefficient of the rate term is proportional to time.

In proceeding thus, it has been found that the daily acceleration has sufficiently different values that they can be grouped into four periods as follows:

1888-89 duration	174 days	– 0.0028
1889	147 days	– 0.0058
1889-90	328 days	– 0.0064
1890-91	230 days	– 0.0014

MARCHE DE LA PENDULE HIPP PAR SEMAINE

Date		Marche diurne	Température	Manomètre	Durée d'impulsion	Remarques
		s	o	mm		
1889 Mai . . .	3-10	—2,85	13,7	34,9	70-72	
	10-17	—2,86	14,9	35,1	70-72	
	17-24	—2,88	14,9	35,5	70-72	
	24-31	—2,89	17,0	36,6	70-72	
	31- 7	—2,90	18,8	37,4	70	
Juin . . .	7-14	—2,92	18,8	37,5	70	
	14-21	—3,03	18,0	37,6	68-70	
	21-28	—3,05	18,2	37,5	68-70	
	28- 5	—3,11	18,2	37,6	68-70	
Juillet . .	5-12	—3,09	19,9	38,0	68-70	
	12-19	—3,21	20,5	39,0	68-70	
	19-26	—3,22	18,8	38,9	66-68	
	26- 2	—3,33	18,1	38,6	66-68	
Août . . .	2- 9	—3,27	20,0	38,4	66-84	Le 5 août on a changé les piles du pendule et des compteurs.
	9-16	—3,25	18,7	38,3	82-84	
	16-23	—3,31	18,9	38,3	82-84	
	23-30	—3,42	16,9	38,3	80-82	
	30- 6	—3,39	19,5	38,3	80-84	
Septemb.	6-13	—3,47	18,2	38,2	80-82	
	13-20	—3,49	17,5	38,2	80-82	
	20-27	—3,51	14,4	38,1	78-80	
	27- 4	—3,48	13,1	38,0	78-80	
Octobre .	4-11	—3,49	12,1	38,0	78	
	11-18	—3,49	11,4	38,0	78	
	18-25	—3,51	10,8	38,0	78	
	25- 1	—3,44	11,1	37,1	78	
Novemb.	1- 8	—3,48	11,4	37,0	78	
	8-15	—3,49	11,0	36,4	76-80	
	15-22	—3,50	9,3	36,1	78	
	22-29	—3,47	7,6	35,7	76-80	
	29- 6	—3,49	6,7	35,3	74-76	
Décemb.	6-13	—3,52	4,0	35,0	74-76	
	13-20	—3,51	3,6	35,0	72-74	
	20-26	—3,45	3,6	34,7	70-78	Le 21 décembre on change les piles du pend. et des compteurs.
	26- 2	—3,35	3,9	34,6	76-78	
1890 Janvier .	2- 9	—3,28	3,2	34,7	76-78	
	9-16	—3,30	3,9	34,5	74-78	
	16-23	—3,35	4,5	34,6	74-76	Le 21-22 janvier un des compteurs est nettoyé et l'huile changée.
	23-30	—3,36	5,6	34,6	72-74	
	30- 6	—3,34	5,0	34,6	72	
Février .	6-13	—3,42	3,4	34,6	68-70	
	13-20	—3,45	3,1	34,4	66-68	
	20-27	—3,43	3,7	34,4	66-68	
	27- 6	—3,45	4,0	34,3	66-68	
Mars. . .	6-13	—3,41	4,1	34,2	66-68	
	13-20	—3,38	6,7	34,3	64-66	
	20-27	—3,40	7,8	34,3	64-66	
	27- 3	—3,43	11,3	34,7	64-66	
Avril. . .	3-10	—3,46	11,2	35,1	66-68	
	10-17	—3,48	10,5	35,3	66-68	
	17-24	—3,57	10,9	35,4	66	
	24- 1	—3,54	10,9	35,4	66	

Date		Marche diurne	Température	Manomètre	Durée d'impulsion	Remarques
		s	o	mm		
1890 Mai . . .	1- 8	—3,50	11,9	35,3	66	Le 6 mai on change la pile des compteurs.
	8-15	—3,51	13,2	35,7	64-66	
	15-22	—3,49	15,5	35,8	64-66	
	22-29	—3,46	16,7	36,3	64-66	
	29- 5	—3,55	15,6	36,2	64-66	
Juin . . .	5-12	—3,56	16,6	36,2	64-66	
	12-19	—3,59	15,5	36,3	64	
	19-26	—3,59	17,3	36,3	62-66	
	26- 3	—3,56	18,1	36,9	64	
Juillet . .	3-10	—3,51	16,6	36,8	64	
	10-17	—3,51	17,3	37,0	64-66	
	17-24	—3,51	18,0	37,8	62-64	
	24-31	—3,53	19,3	37,5	62-64	
	31- 7	—3,53	20,7	37,6	62-64	
Août . . .	7-14	—3,50	20,1	37,9	62-66	Le 6 août on change la pile des compteurs.
	14-21	—3,55	20,0	37,9	62-64	
	21-28	—3,58	19,0	37,8	62-64	
	28- 4	—3,60	15,9	37,7	62-64	
Septemb.	4-11	—3,66	15,0	37,1	62-64	Le 3 septembre on a intercalé une nouvelle boussole sur la ligne des compt.
	11-18	—3,63	16,0	36,8	62-64	
	18-25	—3,71	15,5	37,1	62-64	
	25- 2	—3,69	15,7	37,2	62	
Octobre .	2- 9	—3,70	15,1	37,7	62-64	
	9-16	—3,77	13,8	36,7	62-64	
	16-23	—3,78	11,9	36,5	64-66	
	23-30	—3,78	9,9	36,3	62-64	
	30- 6	—3,80	8,0	35,8	62-64	
Novemb.	6-13	—3,80	8,2	35,4	58-62	
	13-20	—3,77	8,1	35,3	62	
	20-27	—3,74	8,7	35,2	60-64	
	27- 4	—3,77	5,8	34,8	58-62	
Décemb.	4-11	—3,75	4,5	34,3	60-62	
	11-18	—3,77	6,2	34,3	60-62	
	18-25	—3,78	5,5	34,3	60-62	
	25- 1	—3,80	6,6	34,3	60-62	
1891 Janvier .	1- 8	—3,79	6,0	34,2	60-62	Le 19 jan. on change la pile des compt. et on démonte le compt. de l'équatorial pour en changer l'huile.
	8-15	—3,76	6,0	34,2	60-62	
	15-22	—3,80	4,9	34,2	60-62	
	22-29	—3,69	5,0	34,1	60-62	
	29- 4	—3,70	4,8	34,0	60-62	
1891 Février .	5-12	—3,26	4,8	34,0	60-62	Du 4 au 5 févr. perturbation à plusieurs horloges de l'Observatoire, due probablement à un mouvement du sol.
	12-19	—3,23	4,0	34,0	58-62	
	19-26	—3,25	4,2	34,0	56-58	
	26- 5	—3,24	5,6	34,0	56-58	
Mars. . .	5-12	—3,21	6,9	34,0	54-56	
	12-19	—3,25	7,8	34,3	54-56	
	19-26	—3,25	7,2	34,4	54-56	
	26- 2	—3,20	6,1	34,5	54-56	
Avril . .	3-10	—3,17	6,4	34,5	54	Le 2 avril on change la pile des compt. Le 21 on change les piles du pendule et des compteurs.
	10-17	—3,17	7,5	34,4	52-56	
	17-24	—3,26	8,9	34,4	52-70	
	24- 1	—3,34	10,2	34,4	68-72	
Mai . . .	1- 8	—3,29	13,1	34,5	68-70	
	8-15	—3,24	14,2	35,2	68-70	

It is obvious that it would be a little irrational to wish that these could be combined into a single mean value (which would be − 0.0026 second). It is probable that this coefficient depends to a certain extent on the duration of the impulse, in other words, the intensity of the current; now I have varied this duration within wide enough limits, to find out the effect between 90 and 56 seconds, as a result of making experiments on the maximum time during which the same batteries can be preserved without exhausting these completely.

However that may be, one sees that in general the co-efficient has a tendency to diminish on the whole, or in other words the going of our clock becomes more and more constant, that which is evident of the remainder too by inspection of the curve which represents this rate graphically.

This curve shows, however, a single break, and the table of rates (see table II) presents a discontinuity, abnormal and inexplicable. On 4 February the rate of the pendulum changed from one day to the next by 0.43 second, without either the temperature, or the manometric pressure, or the intensity of the current being changed in any way which was sensibly detectable. In view of the constancy of all the elements which can influence the rate, it seemed to me that it was necessary to look for an explanation of this abrupt jump in a movement of the ground, in one of these localised weak tremors of the earth which are not shown by such delicate instruments as delicate as seismometers, baths of mercury or precision clocks. What appears to support this hypothesis, is that two other of our astronomical clocks, the sidereal clock of *Winnerl* and the mean clock of *Kutter,* which have planes of oscillation at a slight angle with that of the Hipp clock, had shown on the same day differences almost as great of 0.41 second and 0.34 second; yet two others which oscillate in a direction almost perpendicular to the first, had shown hardly a trace. It is true that the two other clocks disturbed, which are weight driven and fitted with anchor escapements, have resumed, little by little, their old rates after some days, whereas the Hipp clock has maintained, after the disturbance, its new rate with the same regularity as previously. It seems that for anchor escapement clocks, the impulse given by the shock to the pendulum has simply modified the amplitude, which little by little returned to its normal value, whereas that for the Hipp clock, the amplitude cannot exceed a certain limit, the shock had slightly buckled the suspension spring and slightly modified its co-efficient to elasticity in a more or less permanent way.

Be that as it may, it goes without saying that this accident should not be ascribed to the beautiful clock of M. Hipp, any more than the other which occurred 12 September 1887 when the clock stopped. On this day, a society visited the observatory and one of the visitors inadvertently displaced the switch of the clock battery, in this way putting the latter out of action. Similar accidents outside one's control cannot diminish in any way the value of our electric clock.

Moreover the clock, during all this period of seven years has not stopped without an exterior cause except on one occasion, 7 August 1888; this was some time after the regulation of the compensation and the modification of the escapement which had been in question. It appears that in the reassembly, the craftsman clockmaker had not replaced the escapement completely upright, the pallet was placed slightly eccentrically on the counter-pallet, and compromised in this way the freedom of the escapement. It was sufficient to give slight correction by the regulating screw of the suspension plate to remedy this fault. Since then, no accident of this kind has happened again.

I return once more to the determination of the constants of the rate. Although the determination of the compensation and the annual acceleration by the methods I have indicated have given us very satisfactory results and that a second approximation does not point to a promising result in view of the smallness of the variations from which it is necessary to deduce the co-efficients of the rate, variations which, after what we have already said, are almost at the limit of their uncertainty, in spite of these considerations, I have however kept searching for means to discover if the co-efficient of the second term of the compensation was appreciable. Dr. Hilfiker has therefore attempted to represent the going of the clock during the last years, after having set out in four sections reduced to the same period, by a formula of two terms in which the square of the temperature is included.

The result of the numerous equations which he has formed thus have given a negative result, in the sense that the probable value of the co-efficient of t^2 has been found equal to zero, in other words the compensation of the pendulum is sensibly proportional to temperature. Naturally the co-efficient of t has been found a little less than that by first approximation, known to be − 0.0045 in place of − 0.0048. In effect this formula with two terms does not represent very well the going of the clock, on the contrary, the calculated and observed values are greater than with the first method.

I conclude by confirming that all the other qualities of this instrument, which I pointed out already in 1884, have been maintained and improved. As the battery for the counters (slave clocks) can last for six months without compromising the regularity of functioning, and that for the clock similarly for over a year, all the same, it is the rule that we change that for the hands (of the slave clocks) every three months, and that for the clock every six months.

Next, the airtightness of the bell (clock-case) can be regarded as perfect, since the manometric pressure of approximately 45mm has never varied during the last six years by more than 4mm per annum, and as these extremes values of the manometric readings co-incide with the maximum and minimum temperatures, it is evident that this slight variation is due to the expansion of the air and the water vapour which is contained in the bell. And since a variation of 1mm of pressure causes a variation in the rate of the clock of 0.012 second, one can see that this influence is completely insensible for the diurnal variation, and reduces for the whole year to − 0.05 second.

In this connection, I add that with the co-efficient of compensation indicated, the mean daily variation of the temperature of the building of approximately 1°, produces a daily variation of 0.005 second, and the mean annual temperature variation of the building of about 18°, produces an annual variation of 0.088 second in the rate of the clock; finally that after the two last years the annual acceleration of the daily rate is found a little further reduced to 0.33 second.

Summing up, the result of this study is that the precision of the electric clock of M. Hipp approaches perfection in measure which has not been previously obtained, for it has arrived at a degree of regularity of rate which almost reaches the instrumental and physiological limits of precision with which time can be determined in the best conditions.

Book Review

Gillett and Johnson. *"Gillett": Clocks, Carillons, Bells.* Croydon, 1906, reprinted 1982, 41 pp. Obtainable from Arthur Little Ltd., 23 Princes Plain, Bromley, Kent. £4.25, including postage.

This is an elegant reprint of the 1906 catalogue of Gillett and Johnson, celebrated manufacturers of turret and other clocks for over a century. The original introduction is now supplemented by an afterword, and together they outline the history of the firm and its proprietors since its foundation in 1844. The firm produced a wide range of timepieces—grandfather, bracket and office clocks—and the catalogue illustrates the 1906 stock at what now seems to be mouthwatering prices! But the firm's speciality was in the manufacture of turret clocks and bells, and it supplied a series of great clocks to cities in South Africa, Australia, South America and Canada, as well as to the home market. The buoyant and optimistic attitude of the firm is conveyed, and it shows that one sector of British horology was neither complacent nor in decline in the early 20th century. The Croydon works, covering an acre, had been re-modelled in 1905, and contained "the most up-to-date automatic and semi-automatic machines . . . all parts are manufactured to guage, on the interchangeable system". Among innumerable interesting details we learn that piecework had been abolished as "there was danger of inferior work slipping through", and men were now paid by the hour; also, either Graham's dead-beat escapement, or the more expensive and more accurate three-legged gravity escapement could be supplied. The illustrations are excellent, and there is a comprehensive description of the whole range of products, with prices. It is a publication guaranteed to appeal to all horologists, and to be of especial interest to devotees of turret clocks.

Alun C. Davies.

Music & Automata is a new magazine the first issue of which (March 1983) contains an article on musical clocks which extends that by Ord-Hume in Antiquarian Horology Vol. XIII page 340.

J.P.

The catalogue of Uto Auktions AG of Zurich, May 1983 contains 30 pages of matter dealing with an important collection of clocks by Thomas and James Ferguson Cole. There are many illustrations, some being in colour, and references are given to J.B. Hawkins' Book, "Thomas Cole and Victorian Clockmaking".

The catalogue of Antiquorum, Geneva for April 1983 contains details of a sale of 183 lots consisting of watch stands, and 139 lots consisting of wrist watches.

Members are reminded that many catalogues from Continental Auction houses are received by the Society and are available for reference at the Guildhall.

E.J.T.

INSTRUCTION MANUAL

SELF WINDING CLOCK COMPANY, INC.
NEW YORK, N. Y.
U. S. A.

INSTRUCTION MANUAL

FOR

SYNCHRONIZED SELF WINDING

CLOCK SYSTEM

WITH

F C CONTROL BOX

SELF WINDING CLOCK COMPANY, INC.
41 East 11th Street
New York, N. Y. 10003

TABLE OF CONTENTS

TABLE OF CONTENTS

V. ILLUSTRATIONS

SECTION I

GENERAL DESCRIPTION

1. PURPOSE OF MANUAL

THE MANUAL CONTAINS INFORMATION FOR THE INSTALLATION, OPERATION AND MAINTENANCE OF A SYNCHRONIZED SELF-WINDING CLOCK SYSTEM.

2. PURPOSE OF EQUIPMENT

THIS CLOCK SYSTEM PROVIDES UNIFORM AND ACCURATE TIME INDICATION AND INCLUDES AS MANY CLOCKS AS REQUIRED. THE INDEPENDENT OPERATION OF ALL CLOCKS ASSURES UNINTERRUPTED SERVICE IRRESPECTIVE OF CURRENT SUPPLY OR FREQUENCY.

3. EQUIPMENT SUPPLIED

STANDARD UNITS SUPPLIED ARE AS FOLLOWS:

UNIT	STYLE	PACKED	POWER SOURCE
MASTER CLOCK	No. 61	(1) PER CASE	THREE DRY CELLS
SUB-MASTER CLOCK	No. 81	(1) PER CARTON	TWO DRY CELLS
MANUAL SYNCH. CONTROL	F-1633-A	WITH No. 61	NONE
CONTROL BOX	FC	(1) PER CASE	120 VOLT D.C.
15 IN. WALL CLOCK	25-15	(1) PER CARTON	TWO DRY CELLS EACH
15 IN. CEILING MOUNTED DOUBLE CLOCK	25-15	(1) PER CASE	FOUR DRY CELLS (2) IN EACH CLOCK)
11 IN. WALL CLOCK	25-11	(1) PER CARTON	TWO DRY CELLS EACH

DRY CELLS ARE PACKED SEPARATELY FOR INSTALLATION IN THE INDIVIDUAL CLOCKS AT LOCATION AS SPECIFIED.

REQUIRED, BUT NOT SUPPLIED, ARE:

(A) ALL EXTERNAL WIRING
(B) FM CARRIER LINK BETWEEN REMOTE SITES IN PLACE OF WIRING, WHERE DESIRED.
(C) 120 VOLT D.C. CONNECTION TO THE CONTROL BOX

4. CLOCK SYSTEM (See Illustration 5-1)

Each installation comprises one master clock with manual synchronizing control, as many sub-master clocks with control boxes as there are separate buildings or sites, and any number of clocks in conjunction with each sub-master clock.

Each clock operates from its own power source and is self winding. Uniform accuracy is established by interconnecting all clocks so that they will synchronize with the master clock automatically every hour. Such stnchronized self-winding clocks are called "Subsidiary Clocks".

The manual synchronizing control permits synchronization of the master clock with a radio standard time signal.

5. CLOCK MOVEMENT (See Illustrations 5-3, 5-4 and 5-5)

All standard clocks furnished are equipped with self-winding spring driven pendulum movements and with Graham type escapements, unless otherwise specified. All gears are accurately hobbed, pivots highly polished, steel parts, where feasible, cadmium plated, and coils impregnated.

The mainspring uncoils one turn each hour and, in so doing, closes an electric circuit through a motor which rewinds it quickly. This arrangement maintains constant spring torque and assures, in conjunction with the clock escapement, accurate time-keeping. The dry cells, mounted within the clock case, supply sufficient power for winding the spring and for operating clock relays for a period of not less than one year.

An electric magnetic synchronizing mechanism (coil 12 ohms, 250 ma.) forms part of the clock movement and corrects all clock hands when energized by the electrical synchronizing impulse.

6. CLOCK TYPES (See Illustrations 5-1 and 5-2)

All clocks are equipped with black minute and hour hands and an additional red hour hand that indicates a selected standard time. Dials are enamelled white with an outer ring of black Arabic figures 1 to 12, and an inner ring of bright red Arabic numerals 13 to 24. Master and Sub-Master clocks have a small second hand. A winding contact C-5 is mounted in each clock for initial start of motor M which will thereafter operate automatically, controlled by Contact C-4.

6. CLOCK TYPES (See Illustrations 5-1 and 5-2 Contin'd.)

(A) THE MASTER CLOCK, housed in a finished hardwood case, is equipped with a 60-beat invar pendulum and maintains an accuracy of better than ten seconds per month. Synchronizing magnet S-1 is energized by local dry cells when manual synchronizing control push button C-1 is depressed. Tilting Contact C-6 closes automatically 15 minutes after every hour, thereby closing the battery circuit through coil of relay L-1. The contacts of this relay are wired either directly to the control box or to the FM Carrier System. (Resistor R-4 protects contact C-6 from inductive sparking).

(B) THE SUB-MASTER CLOCK, housed in a finished hardwood case, is equipped with an 80-beat pendulum; its accuracy is 30 seconds per month if not synchronized. Correction from the master clock will narrow this variation to the master clock's rate. The synchronizing impulse, relayed through the control box energizes synchronizing magnet S-2 every hour, from the local battery, 15 minutes after the hour. Tilting contact C-7 closes automatically on every full hour, thereby closing the battery-circuit through coil of relay L-3. The contacts of this relay are wired to terminals 13 and 14 which are connected with the corresponding terminals of the control box. (Resistor R-5 suppresses the spark on Contact C-7).

(C) SUBSIDIARY CLOCKS are contained in stamped and deep drawn metal cases of clean, modern design, and are finished in baked enamel. The clock styles furnished have 15 in. and 11 in. dials respectively, depending on purpose of installation. All subsidiary clocks are equipped with red lamps which flash every hour on the hour, signalling proper synchronization. Available but not furnished as basic equipment, are sweep seconds clocks, program clocks, time stamp control clocks, etc. that may be wired into the clock system when required.

7. CONTROL BOX (See Illustration 5-2)

The control box contains two like control panels which are used in conjunction with one sub-master clock for synchronization of subsidiary clocks.

The components on each control panel are rated to supply synchronizing current for a maximum of twenty clocks.

One operating panel is sufficient for most installations so that the second non-operating one may be used as a stand-by spare. However, if both panels are in operation, (See Illustration 5-2), it is recommended that an additional panel be ordered as a spare part.

7. CONTROL BOX (See Illustration 5-2) cont'd.

The master clock synchronizing impulse, received at terminals (3) and (4), energizes relay L-2 which, through terminals (11) and (12), and the sub-master clock battery, closes the circuit that operates the sub-master correction mechanism.

The sub-master clock relay L-3 closes the following circuit on every full hour:

> Plus 120 V.D.C., fuse F-1, terminal 13, contacts of relay L-3, terminal 14, coil of relay L-4, and minus 120 V.D.C.

Contacts of relay L-4, in turn, close the following circuit:

> Plus 120 V.D.C., fuse F-1, contacts of relay L-4, resistor R-1, rheostat R-2, millameter A, terminal 22, through the series-connected synchronizing magnets of the subsidiary clocks, terminal 21 and minus 120 V.D.C.

Push button C-3 is provided on the panel to permit testing of the subsidiary clock circuit. It is connected so as to close the relay L-4, when depressed.

Rheostat R-2 should be used to adjust the synchronizing current to 250 ma., irrespective of the number of connected clocks.

Spare fuse F-2 is located below relay L-2.

Capacitor CP-1 in series with R-1 and R-2 protects contacts of Relay L-4.

Illustrations 5-2a and 5-2b show connection of control panel and master clock for FM carrier and for direct wiring respectively.

SECTION II

INSTALLATION

1. GENERAL INSTRUCTIONS

   (a) Unpack the equipment near its final location shortly before installation.

   (b) Read carefully individual installation instructions and use special care in unpacking and mounting of master and sub-master clocks.

   (c) Select rigid vertical walls and horizontal beams for mounting wall and ceiling mounted double clocks, respectively.

   NOTE: Numbers in the text of this section refer to the corresponding numbers on the individual illustrations.

2. INSTALLATION OF MASTER CLOCK AND MANUAL SYNCHRONIZING CONTROL (See Illustration 5-6)

   (a) Select suitable location on rigid vertical wall.

   (b) Unscrew and remove top of crate near selected location, remove two cross cleats and lift out clock case.

   (c) Remove hardware from bag that is nailed to one cross cleat, and remove Manual Synchronizing Control (10).

   (d) Insert large hanging screw FH #12 (1) in wall with head pointing slightly up. Select location as per illustration (7-3/16" above desired dial center).

   (e) Hang clock case carefully on wall, and open door, using key from hardware bag.

   (f) Remove cleats (2), holding weights (3) (weighing 20 lbs.) by hand; now lower carefully on to guide pins (4) and remove lower cleats (5). (Be sure that clock case does not swing).

   (g) Remove all remaining packing cleats which are screwed to the side of the inside clock case and plumb clock case, using pendulum rod point and zero of scale (6).

   (h) Spot holes for two steady screws through holes (7) in case. (If necessary to remove case to drill holes in wall, make sure pendulum rests on the back of case while removing to avoid damage to suspension spring on which the pendulum is hung).

   (i) Now place three No. 6 dry cells (8) on top of case and connect as shown in illustration.

To be continued.

"Synchronome Brisbane 1903-1991" The story of the Jackson family of electrical clock makers. An Historical Project by Chapter 104. A 32 page booklet about the operation of the Synchronome Elec. Co. of Australasia. $5.00 Norman Heckenberg, 30 Depper St., St. Lucia, Qld. 4067, Australia

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THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78
NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXVII #2, JUNE 2001

Fellow Horologists:

This journal issue continues the reprint of the Self Winding Clock Company instruction manual covering their synchronizing system using the type FC control box. While it is doubtful that many of us will ever encounter this equipment for restoration, it is none-the-less of interst in the understanding of the scope of the company's product line and the ingenuity involved in the manufacture and marketing of their products.

We are indebted to Mr. A.D. Harris of Great Britain for his submission of the copy of the British patent by Leon Hatot relating to the ATO clock. Mr Harris also provided an article by David Read entitled, "The Transmission of Time Signals by Wireless", which had been previously printed in The Bulletin of the British Vintage Wireless Society, and the Antiquarian Horological Society's Journal.

We are fortunate to have been provided withan assortment of original installation, operation, and maintenance manuals by various manufacturers which will be serialized in the coming issues of our journal. These will cover popular and collectible models, with information very much in demand so we all look forward in anticipation of this series.

Our quote for this issue:
"It is far more impressive when others discover your good qualities without your help."

Good reading ahead, enjoy this issue.

Martin Swetsky, FNAWCC,.....President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein,.....Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

Continued from March, 2001 issue.

(j) Press winding contact (9) on left side behind dial for approximately ten seconds and swing pendulum.

(k) Set hands (by turning minute hand clockwise) to the correct time. Turn the red hour hand to the selected standard time while holding black hour hand in place.

(l) Close and lock door. Keep key in safe place.

(m) Unpack Manual Synchronizing Control (10), unscrew and remove cover. Mount back of push button box on or near a radio set that may be used to receive a standard time signal. Use knock-out holes for wiring connection (to Master clock) and re-assemble.

3. INSTALLATION OF SUB-MASTER CLOCKS (See Illustration 5-7)

(a) Select suitable location on rigid vertical wall.

(b) Unscrew and remove crate top near selected location, remove cross cleats and lift out clock case.

(c) Remove hardware from bag nailed to cross cleat.

(d) Install #12 FH hanging screw (1) in wall, head pointing up slightly, approximately 6" above the desired dial center location.

(e) Remove two nuts (2) holding pendulum in place but do not remove the screws (3) or cleat (4) which will remain in place to hold pendulum steady while mounting the clock.

(f) Hang clock on screw (1).

(g) Open door by using key in hardware bag. HOLD CASE STEADY which will have a tendency to sway while door is open. When case is vertical, remove screws (3) and cleat (4) and plumb pendulum rod point at zero of scale (5), fasten case to wall with two #10 RH wood screws 1-1/2" long, using the pendulum blocking screw holes.

(h) Install two No. 6 dry cells (6) in case, as shown, by connecting proper terminals and sliding them on to the battery shelves past the bottom of dial.

(i) Press winding contact (7) on left side of case, behind dial, for approximately ten seconds and swing pendulum.

(j) Set hands (by turning minute hand clockwise) to correct time. Turn the red hour hand to the selected standard time while holding black hour hand in place.

(k) Close and lock door. Keep key in safe place.

4. INSTALLATION OF CONTROL BOX

(a) Place case near point of installation, which should be close to the sub-master clock, and unpack control box.

(b) Unscrew door frame and remove . (Do not unscrew hinges).

(c) Unscrew two control panels and remove.

(d) Drill four 1/4" holes in back of box, located as desired for wall mounting.

(e) Make holes to suit on the left top or bottom and on the right top or bottom of the box for conduit or BX connections. These holes should be located so that the wires will enter the box in front of the surface of the panels and will not obstruct the panel components.

(f) Fasten box to wall and remove burrs and chips from the box.

(g) Reinstall panels and door frame.

(h) Connect conduits and wires as per practical system wiring diagram No. 5-2.

5. INSTALLATION OF WALL CLOCKS (See Illustration 5-8)

(a) Select suitable clock location on a rigid vertical wall.

(b) Remove individual clocks from packing case, loosen knurled screw (2) at bottom and lift clock case front (1) off pin (3).

(c) Remove screws from bag on left hand battery shelf (4) and mark location of large wood screw directly above desired dial center point. (Distance between dial center point and screw location is 6" on 11"-dial clocks, and 8-5/16" on 15"-dial clocks). Insert #12 FH mounting screw in wall with head pointing slightly up.

(d) Hang metal back on mounting screw and unfasten screws (6) holding the pendulum to the back. Plumb metal back on wall by shifting slightly until the line on the pendulum bob coincides with the line marker (8) on the clock back. Be sure pendulum swings freely.

(e) Insert the two small screws in holes (9 and 10). (Do not use nails for this fastening). If it is necessary to remove case for drilling the holes for these two screws, re-block pendulum to avoid breaking of suspension spring. When case is firmly fastened to wall, insert two No. 6 dry cells in metal holders (11) and connect wiring harness to the Fahnestock connectors of the dry cells, as shown on illustration.

5. INSTALLATION OF WALL CLOCKS (See Illustration 5-8) cont'd.

(f) Wind the clock movement by pressing contact (12) at left hand side of movement plate for about ten seconds, and swing pendulum to start operation. Now set black hands by turning minute hand clockwise only. Red hour hand is set by holding black hour hand and turning the red one to the desired position. Connect synchronizing wires as shown in illustration. When re-installing front, make sure to hang front on pin (3) first and then to press lower part of case front over clock back. Turn knurled screw (2) at bottom until finger-tight.

6. INSTALLATION OF CEILING MOUNTED DOUBLE CLOCKS (See Illustration 5-9)

(a) Unscrew and remove crate top (1). Remove six screws (2) from interior panel, lift out complete assembly and unwrap.

(b) Stand double clock on bracket, place on bench and remove four carriage bolts (3).

(c) Select location on horizontal beam and use interior panel (4) as template for spotting four mounting holes.

(d) Mount bracket to ceiling with four 1/4" bolts or studs (not furnished, as their type depends on the beam material). Remove case fronts, if necessary, to simplify mounting. Shim the bracket head, if required, and check on lower edge of bracket with level as well as for free swinging of both pendulums.

(e) Remove pendulum bolts, install batteries, connect wires, wind clocks and set hands as described under Section II, 5e and f.

7. CONNECTION OF CLOCK SYSTEM (See Illustration 5-2)

(a) All wiring within the various equipment units is furnished and connected to terminal blocks.

(b) No. 18 gage wire, for 110 volts, is recommended for inter-connection of all units, unless the applicable electrical code requires a heavier gage (No. 14).

(c) Rigid or flexible conduit is to be used from the D.C. power source to the control box; twisted pair or non-metallic sheathed cable is recommended for all other connections.

(d) All inter-connections between units require two leads each, except for the wiring between sub-master clock and control box which requires four leads.

(e) Connect wires to corresponding terminal numbers as follows:

7. CONNECTION OF CLOCK SYSTEM (See Illustration 5-2) cont'd.

No.	Connection from	To
1, 2	Man. Synch. Control	Master Clock
3, 4	Master Clock	Control Box
11, 12, 13, 14	Sub-Master Clock	Control Box
21, 22	Control Box	Subsidiary Clocks
120 V. D.C.	Control Box	D.C. Power Service

SECTION III

OPERATION

1. PREPARATION FOR USE (See Illustration 5-2)

(a) Check whether all clocks are operating and whether they indicate the correct time. (Installation instructions in Section II describe initial winding, setting and starting of all clocks).

(b) Be sure that knob for rheostat R-2 is first turned counter clockwise to its stop, and then connect to D.C. power.

(c) Check external wiring for continuity as per diagram 5-2. Press push button C-3 on connected control panel and observe milliameter A. Adjust rheostat so as to read 250 ma. and release push button. (Make this adjustment at any time except near the full hour, as false synchronization may result otherwise)

(d) Synchronize master clock by pressing the push button C-1 of the manual synchronizing control exactly on any full hour for about one second.

The system is now ready for use.

2. NORMAL OPERATION (See Illustration 5-2)

All functions listed in the following table are fully automatic except for the synchronization of the master clock.

FUNCTION	OPERATION	TIME
Synchronization of Master Clock	C-1, S-1	Full hour
Synchronization of Sub-Master Clock	C-6, L-1, L-2, S-2	1/4 after full hour
Synchronization of Subsidiary Clocks	C-7, L-3, L-4	Full hour
Winding of all clocks	C-4, M	Once an hour

3. REGULATION OF CLOCKS

All clocks are factory-regulated and require no adjustment as long as they are connected in the synchronizing system.

It may be necessary to regulate them, however, if they are used independently. In such cases, observe the gain or loss and adjust the pendulum nut as follows:

One full turn on master clock pendulum nut is equal to - 30 sec. per day
" " " " sub-master " " " " " " - 55 " " "
" " " " all other clock " nuts " " " - 100 " " "

Turn the pendulum nut right if the clock runs slow, and vice-versa.

SECTION IV

MAINTENANCE

1. ROUTINE INSPECTION AND SERVICING

All units of this clock system are designed so as to require a minimum of servicing. Routine inspection, therefore, is limited mainly to the accurate and uniform operation of all timekeepers.

Routine Servicing:

(a) Dry cells	Replace dry cells in all clocks once every year.
(b) Master Clock	Synchronize once every month (or more often if desired).
(c) Movements	Remove and return to factory for cleaning and re-oiling every fifth year. (See Section IV-5b or proceed as per Section IV-6.

2. CORRECTIVE MAINTENANCE

TROUBLE REMEDY CHART

SYMPTOM	PROBABLE CAUSE	PROCEDURE
Time indication is not uniform.	(a) Synchronizing wires broken.	(a) Check wiring. (Illustration 5-2)
	(b) No D. C. power.	(b) Check source and fuse.
	(c) Less than 250 ma. synchronizing current.	(c) Adjust rheostat on control panel for 250 ma. (See Section III-1c)
Time indication is uniform but inaccurate.	(a) Master clock not synchronized.	(a) Synchronize master or reset manually. (See Section II-2 k or m)
One clock is inaccurate	(a) This clock is outside its synchronizing range due to false initial setting.	(a) Reset hands manually, clockwise. It should then remain on time. (See Section II-k)
	(b) Synchronizing mechanism defective.	(b) Check as per illustration 5-5.

2. CORRECTIVE MAINTENANCE (Cont'd.)

TROUBLE REMEDY CHART

SYMPTOM	PROBABLE CAUSE	PROCEDURE
One clock stopped	(a) Not winding properly	(a) Wind, reset as per Section II .
	(b) Faulty dry cell	(b) Replace. (See Section II)
	(c) Movement damaged	(c) Repair, (See Section IV-3) or replace. (See Section IV-5)

3. MOVEMENT ADJUSTMENTS

(a) Adjustment of Hourly Winding Contact.
Proceed as per Illustration 5-11

(b) Adjustment of Winding Motor Contact.
Proceed as per Illustration 5-12

(c) Adjustment of Winding Motor Armature.
Proceed as per Illustration 5-13

(d) Adjustment of Synchronizing Mechanism.
Refer to Illustration 5-5 which shows the general arrangement on seconds clocks (master and sub-master clocks).
Minute clocks (no second hand) lack the upper synchronizing lever.

4. LIST OF REPLACEABLE PARTS (See Illustration 5-2)

Symbol	Name	Specification
A	Milliameter	0-500 ma. Simpson No. 25
C-1	Manual synchronizing Control	SPST NO, Special
C-2	Not used	None
C-3	Test Push Button	DPST NO, 12 amps., Arrow
C-4	Hourly Winding Contact	Special, S.W.Cl. Co.
C-5	Winding Key	" " "
C-6	Tilting Contact (Master)	" " "
C-7	Tilting Contact (Sub-master)	Same as C-6

To be continued.

THE TRANSMISSION OF TIME SIGNALS BY WIRELESS

by David Read

(Based on an article which appeared in the *Bulletin of the British Vintage Wireless Society*)

TWO EVENTS marked 1997 as the end of an era as far as time and radio are concerned. The first of these was the death of Louis Essen on 24 August. Essen joined the National Physical Laboratory from Nottingham University College in 1929, and from the beginning worked on quartz crystal oscillators. Essen-ring quartz oscillators became the pre-war time standard in Britain and were followed in due course by his achievement in establishing the caesium beam resonator as the method of comparing atomic time with astronomical time scales in 1955.

The second event occurred on the last day and at the last moment of the year when Morse as the international language of emergency and distress passed into history. British Telecom closed its Morse monitoring service on 500 Hz, recognising that under the requirements of the International Maritime Organisation, Morse must be replaced by the Global Maritime Distress and Safety System using satellites by February 1999. The Americans and French had already stopped their Morse monitoring services, and in any case the Royal Navy had ceased training its sailors in the use of Morse code for wireless transmission in the summer of 1996.

As far as navigation is concerned, a family of twenty-four satellites now constantly send out time signals and enable the operation of the GPS – the Global Positioning System. Provided that a special radio can receive the time signals of three satellites, it can calculate how far away each satellite is and use triangulation to work out its own position anywhere in the world. This contrasts with the situation in 1905 when the first formal and regular spark transmission of time and weather signals was started from the US Naval Observatory in Washington, in order to provide safety in navigation and the avoidance of severe weather at sea. This was followed in Europe by regular spark transmissions of time and weather which started from the Eiffel Tower in 1910. By 1913 a network of observatories around the globe were pooling

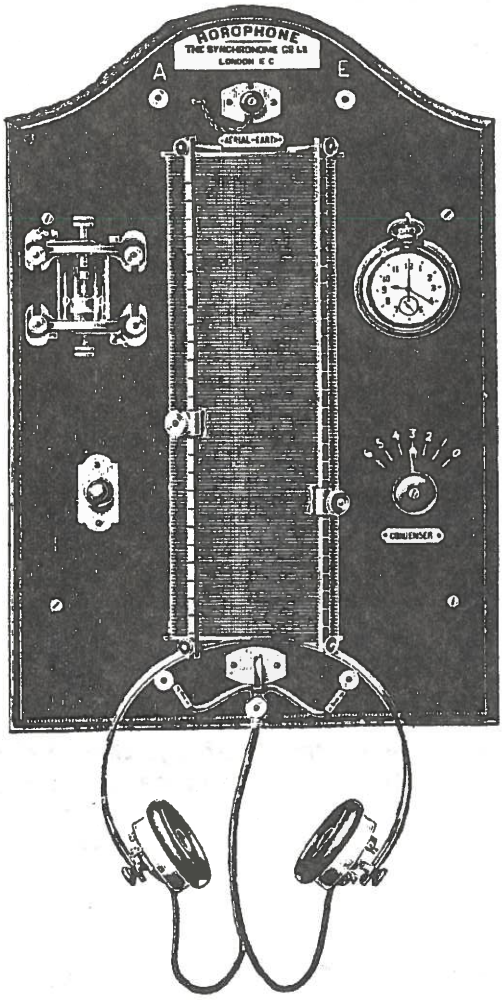


Fig. 1. The Horophone time signal receiver.

the time from their clocks by radio to arrive at a time standard of coordinated accuracy.

In 1976, the *Bulletin of the British Vintage Wireless Society* contained a brief mention of the Horophone, a crystal set (wireless receiver) offered for sale in 1913 by Frank Hope-Jones through his Synchronome Company, and designed specifically for the reception of time signals. A picture of the receiver was illustrated in the Bulletin (Fig.1) together with operating

instructions first published in *The Book of Electrical Installations* published by Caxton in 1915. Twenty years later in 1996, and more than eighty years after the Horophone was first offered for sale to the watch and clock trades, the *Bulletin of the BVWS* reported that an example had at last been found. I was fortunate at the time to be able to examine the instrument carefully, because (so far as I am aware) no one in modern times in the fields of horology or wireless research had ever seen one.

Hope-Jones was of course a seminal figure in the development of time distribution as well as Chairman of the Wireless Society of London. Dr D.J. Boullin, the Editor of *Radio Time*, has written most interestingly on the newly found Horophone in issue 20 of that journal.[1] In a nutshell Dr Boullin through conversation with the son of the original owner is able to postulate that this particular Horophone was actually used by Frank Hope-Jones, the inventor of the Synchronome Clock System, as it was in use at his workshops in Clerkenwell Road, London EC. In the latest edition of his authoritative book *Radio! Radio!*, the wireless historian Jonathan Hill has provided a full discussion on the provenance of this holy grail of early British wireless receivers.[2] By an extraordinary coincidence, another crystal set, the Tempus time signal receiver (Fig. 2), made specifically for the reception of time signals from the Eiffel Tower appeared in the auction rooms of Bonhams shortly after the Horophone was found, and I will return to it in a moment. The Horophone was not typically English and would appear to have been made in France. For instance the detector is marked SGDG (*Sans Garantie du Gouvernement*). Indeed the French maker of *Appareils & Instruments de Précision*, Louis Ancel of 91, Boulevard Pereire, Paris, had very similar *Recepteurs Horaire* for sale in their 1914 catalogue. The basic model was on sale for twenty-five francs whilst complex ink recording models were on offer to observatories for nine hundred francs.

This article now places crystal sets such as the Horophone and the Tempus in their historical context. Time signals transmitted by wireless were originally used for the monitoring of ships' chronometers and hence

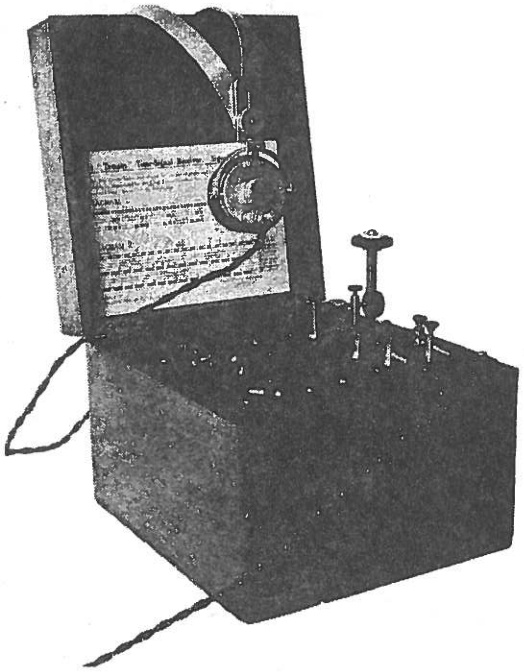


Fig. 2. The Tempus time signal receiver.

improving the accuracy of navigation at sea. An example in the *Year Book of Wireless Telegraphy and Telephony* of 1918 provides an account of the captain of a Dutch liner informing his owners that he 'gave the most precise orders that the ship's Chronometers should be rigidly controlled by wireless time signals daily provided through the long distance stations at Paris and Washington'. The reliability of detectors was as essential an operating criterion as sensitivity was, and as far as ships were concerned crystals with cat's whiskers although sensitive were not suitable in a marine environment. The Marconi Wireless Telegraph Company's magnetic detector first developed in 1903 had been in continuous use for about six years in ships' receivers when the Time Signal Service first started at the Eiffel Tower. It also formed part of an instrument specifically made for detecting time signals (The Marconi Special Magnetic Receiver for Time Signals) and was extensively advertised before and after the first world war in connection with the Eiffel Tower. It is mentioned by R. D. Bangay in his book *The Elementary Principles of Wireless Telegraphy* where he writes 'Experience has

1. D. J. Boullin, 'The Horophone Found' *Radio Time*, 7/1 (Autumn/Winter 1995/6), 6; repr. in the *Horological Journal*, 138 (February 1996), 58. See also P. R. Joyce, 'The Two Models of the 1913 Horophone' *Radio Time*, 7/2 (Spring 1996), 43.

2. Jonathan Hill, *Radio! Radio!*, 3rd edn (Sunrise Press, 1996).

Fig. 3. An advertisement for a time signal receiver which appeared in the *Horological Journal* for April 1913.

shown that the magnetic detector is quite the most reliable and robust form of receiver invented'.[3] Of course crystal sets such as the Horophone and the Tempus were manufactured outside the requirements of the commercial and military market place and were relatively cheap since the domestic (let alone the Clerkenwell watch trade) market could hardly afford professional apparatus manufactured by Marconi and others.

It is interesting that General Ferrié was in charge of the French military telegraphic service and not only instrumental in the time signals from the Eiffel Tower, but was also responsible for the development by the French of the triode valve (vacuum tube), leading the way for European nations to mass-produce the triode for wartime purposes. In this, General Ferrié recognised the importance of wireless for time coordination and navigation in military operations. No comparable figure existed in the British military establishment except perhaps Henry Jackson who, as captain of HMS *Defiance*, first demonstrated wireless communications in 1895, a year before Marconi's historic first patent.

The British, having solved the longitude problem by developing the detent chronometer and established Greenwich as the zero meridian (combined with the world-wide use of the British *Naval Almanac*), did not introduce a service of time signals transmitted by wireless in these early years. As Hope-Jones wrote in his preface to the first thorough book on the subject:[4]

> The average Englishman imagines that Greenwich time comes from Greenwich. This book will set him right. It used to, but unfortunately this country did not take the lead, did not take a fair share, nor in fact any share at all in the establishment of the International Service of Wireless Time Signals in 1912. Hence the Englishman who regarded Greenwich time as something

3. R. D. Bangay, *The Elementary Principles of Wireless Telegraphy*, 2nd edn (The Wireless Press, 1917)
4. W. G. M. Mitchell, *Time and Weather by Wireless* (The Wireless Press, 1923).

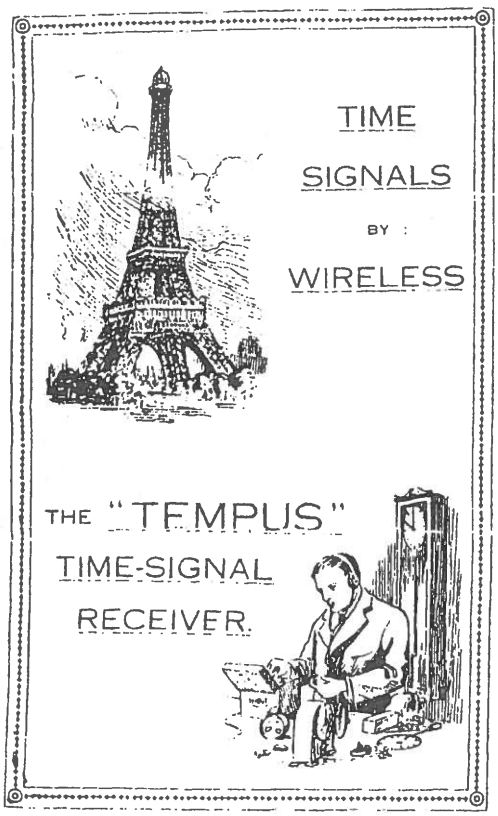


Fig. 4. The tempus instruction manual.

particularly British has been getting it from observatories and countries of his neighbours to an increasing extent for the last ten years

In 1913 the existing arrangements at the Eiffel Tower for the wireless transmission of time signals was taken over by the Bureau des Longitudes together with a new international time transmission code. The time of several observatory clocks was now pooled. Military navigation was still the key concern. A point to remember is that whilst the Eiffel Tower could be received by a crystal set such as the Horophone, after the First World War anyone seriously concerned with reliable reception would use a one or two-valve receiver. This way, not only could all European time transmissions be received, but even the high powered American stations could be tuned in. As far as early crystal sets in the pre-broadcasting period were concerned it was perfectly normal for a Paris coil to be provided and indeed many crystal sets had Paris engraved as a switch setting on their panels. The Horophone is therefore not a unique crystal receiver for time signals (as can be seen from the advertisement shown in Fig. 3) although of great interest through its connection with Hope-Jones. Figure 4 shows the cover illustration to a booklet of

The "Tempus" Time-Signal Receiver. Signal Charts.

On the two Charts below are shewn by means of short and long strokes, the "dots" and "dashes" exactly as transmitted by the Eiffel Tower Wireless Station, and exactly as heard in the form of short and long "buzzes" in the telephones.

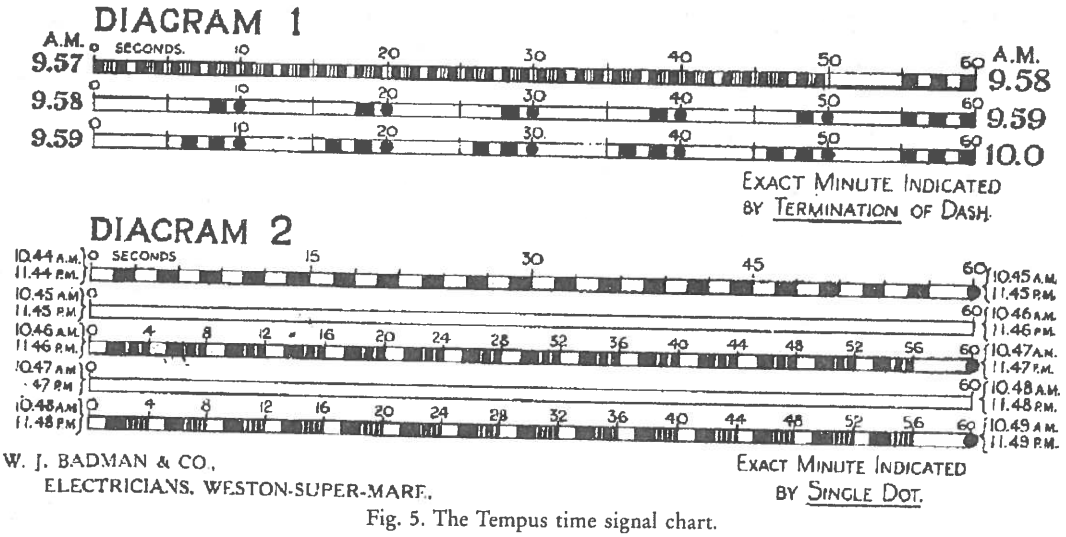


Fig. 5. The Tempus time signal chart.

instructions provided with the Tempus time signal receiver, a British made crystal receiver designed specifically for reception of signals from the Eiffel Tower. In the illustration a watchmaker is shown at his bench timing a watch against time signals which are read in conjunction with the chart shown in figure 5 and provided by W.J. Badman & Co, the manufacturer of the Tempus. Like the Horophone, the Tempus has a buzzer to help select a sensitive spot on the crystal before tuning in the signal. In the case of the Horophone it is likely that its extreme scarcity is due to the restriction of ownership of wireless apparatus on the start of WWI. If one accepts that the only known example was never sold, then indeed perhaps the war killed the business opportunity. In the case of the Tempus its date of manufacture can be fixed at about 1919, i.e. after the war but before the start of public broadcasting. Although free of the wartime restrictions it too would not have had much of a commercial life because radio amateurs, and anyone needing time signals, now had the very sizeable war surplus market in component and complete receivers, all made to a very high standard and sold in Gamages as well as the usual channels for surplus equipment.

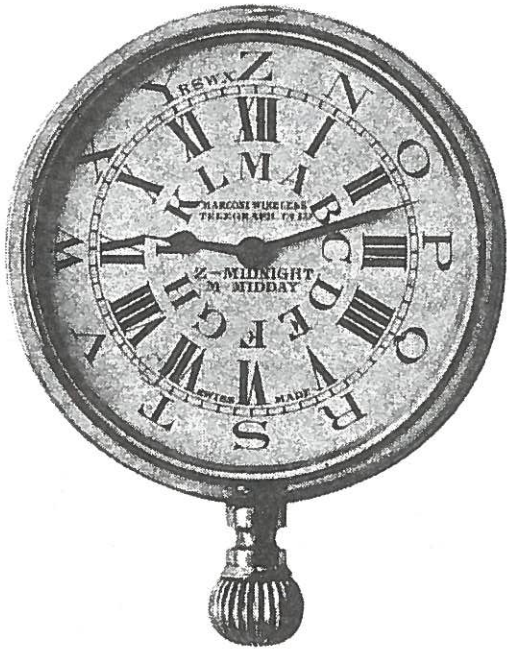


Fig. 6. Marconi watch, used for sending time signals by Morse code.

Finally, it should be remembered that the automatic transmission of time through coded signals was not the only method used. The Marconi Wireless Telegraph Company had an instrument panel watch on the market with a special dial for sending and receiving time by Morse code. Such dials were in use as early as 1885 for Post Office telegraphs, though not at first using wireless telegraphy. The watch is shown in figure 6, and it can be seen that differentiation is provided between hours relative to midday or midnight by alphabetic additions to an otherwise normal dial. Such a method of sending time by Morse would have enabled the rapid transmission and receipt of time by wireless operators, and established the convention that the time given was pinpointed by a final signal at the end of the message. This idea is of course equivalent to the automatic system in which the time is announced in advance and the moment then pinpointed by a final pip.

As far as the British public (as distinct from observatories, navigators, radio operators, and other specialists) was concerned, the advent of public broadcasting and the BBC brought time (and weather) signals into every home. From November 1922 time signals were transmitted before the news, at 7 p.m. and 9 p.m., by an announcer playing the Westminster Chimes, firstly on a piano and then on tubular bells installed for the purpose; hardly the last word in accuracy, and not to be compared to listening to the Eiffel Tower on your Tempus crystal set! This proved so popular with the listeners that an order was placed with the Synchronome Company for master clocks and slave dials to be installed. The tick of a master clock was provided by microphone to the announcer who could then count down the last five seconds and sound a gong on the hour. It was Frank Hope-Jones who proposed in 1923 that a regular service of accurate pips might be provided by the Royal Observatory and broadcast by the BBC. Equipment was duly designed and the Greenwich Time Signal was broadcast from 5 February 1924, the signal consisting of six pips starting five seconds before the time and ending on the precise minute. The coordination of several observatory clocks to provide mean time was now available to anyone with a radio. The age of watch and clock makers requiring a Tempus were certainly over, and with Louis Essen aged 16 and in secondary education, a new age was just around the corner.

286,701 COMPLETE SPECIFICATION

[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 1

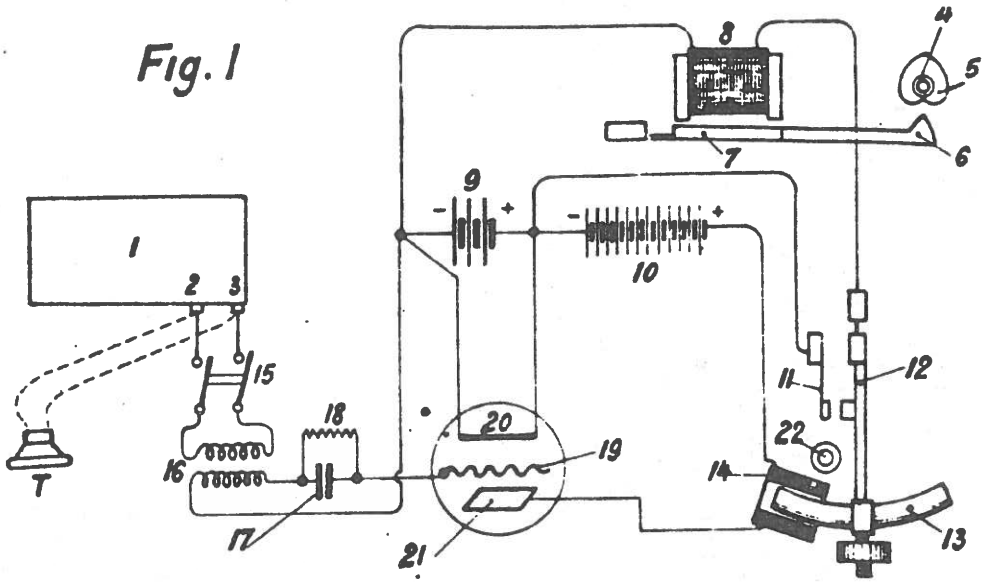


Fig. 2

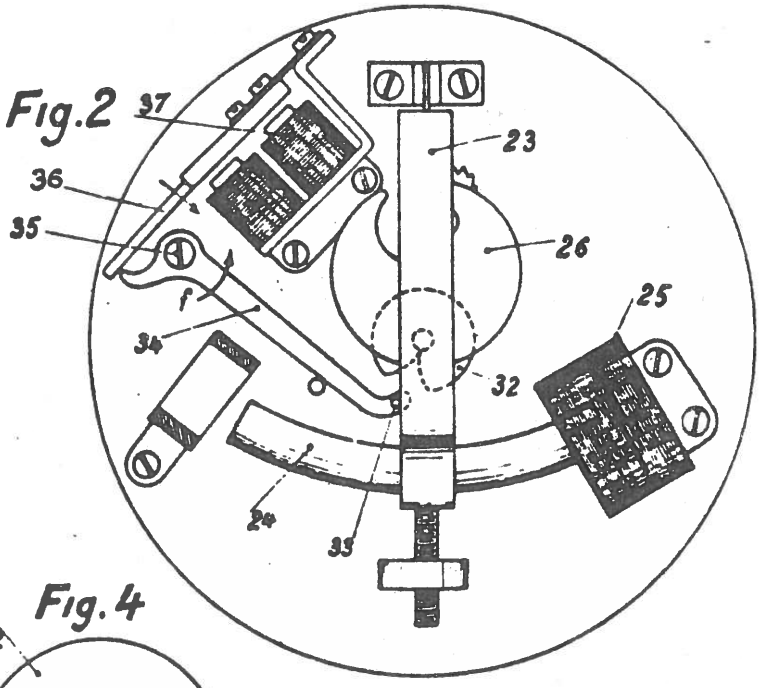


Fig. 4

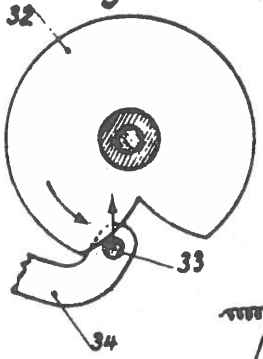


Fig. 5

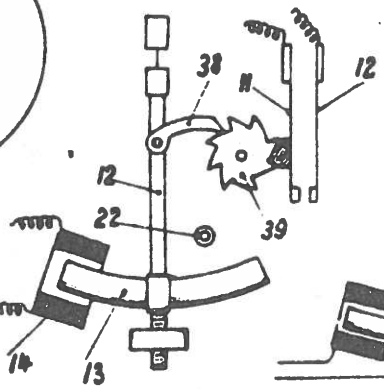


Fig. 9

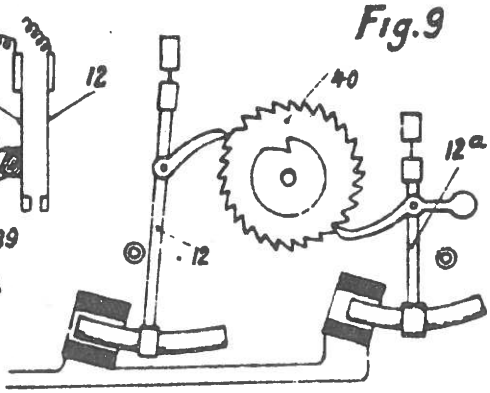


Fig. 3

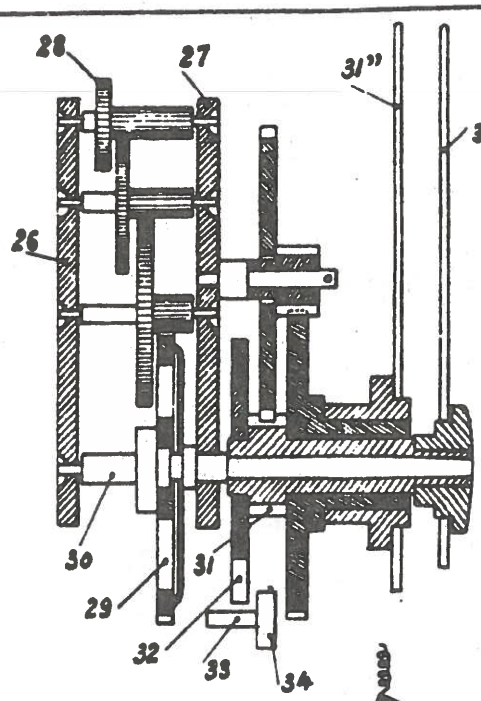


Fig. 6

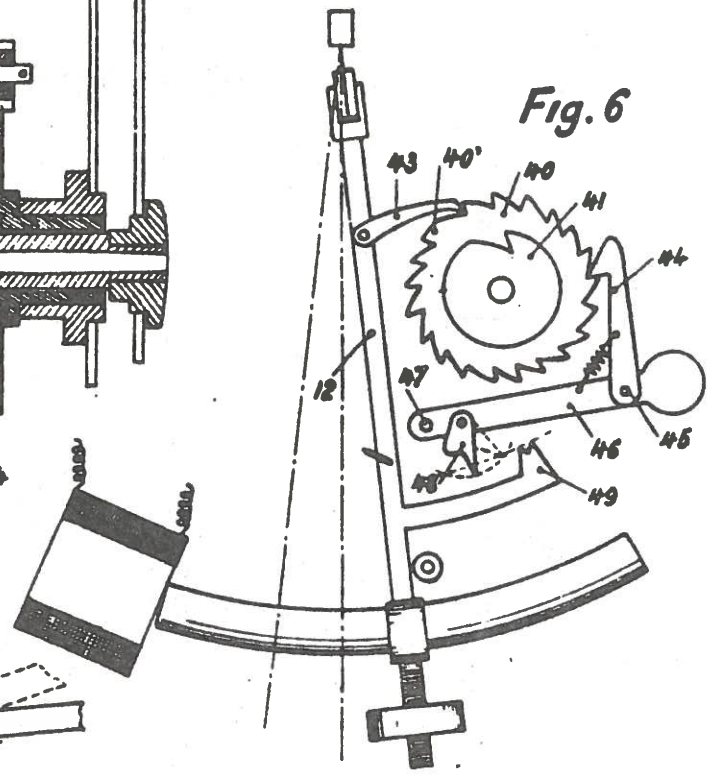


Fig. 8

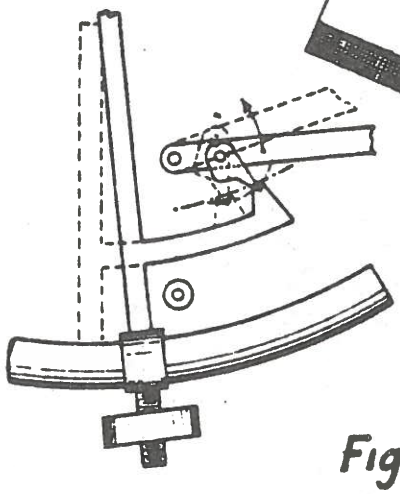


Fig. 7

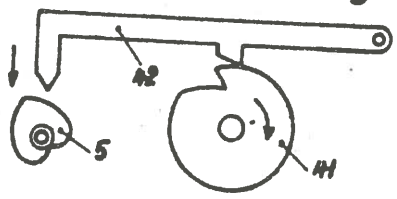
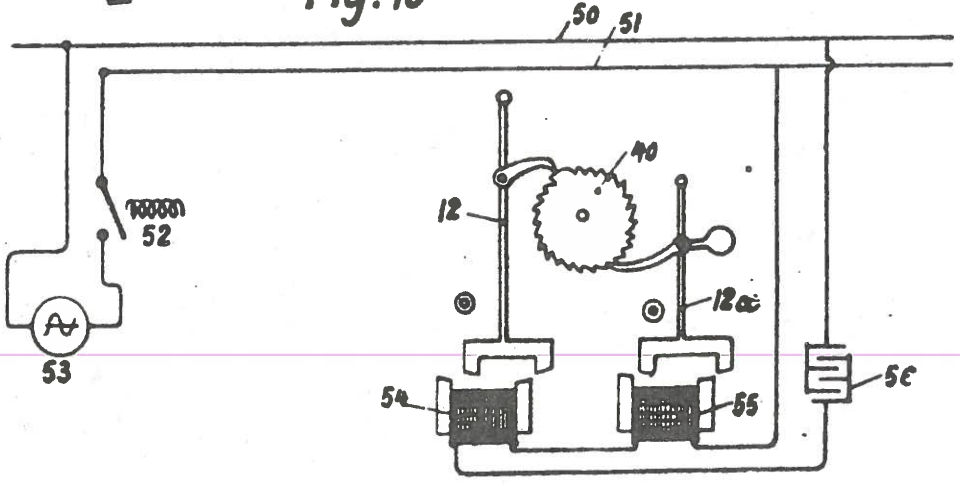


Fig. 10



Charles & Read Ltd. Photo Litho.

PATENT SPECIFICATION

Convention Date (France): March 9, 1927. **286,701**

Application Date (In United Kingdom): March 8, 1928. No. 7265/28.

Complete Accepted: June 10, 1929.

COMPLETE SPECIFICATION.

Method and Device for Setting Clocks Right from a Distance.

We, ETABLISSEMENTS LÉON HATOT, of 23, rue de la Michodière, Paris, France, a corporate body organised under the laws of the French Republic, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Our invention relates to distant control devices of the type wherein rhythmical electric impulses forming a signal are adapted to make a pendulous relay start oscillating gradually, the said relay closing the control circuit when the gradually built up amplitude has reached a predetermined value Such devices should possess the following qualities:

a) a good selectivity which may be obtained by means of a feebly damped oscillating receiving system, the natural period of which remains exactly equal to that of the incoming signal to be received, the value of the impulses and its variations having a very small influence on this period and not being liable to put the device out of order.

b) the responsive relay should be adapted to be actuated with a very little energy so as to allow the control to be effected at great distances, for instance through radio communication methods requiring very little energy.

c) the desired control should be effected at a very precise moment in spite of the irregularities in the intensity of the signal received which may cause variations of the initial speed of the oscillating relay.

Now the object of our invention is to provide improvements in distant control devices of the above mentioned type, which improvements fulfil the above stated conditions and allow use to be made of tuned relays working with a very small damping and starting gradually under the action of a series of very small impulses which may have comparatively irregular strengths without preventing a proper working of the device.

According to our invention the relay is constituted by an isochronous beam oscillating through the action of a magnet on a copper wire coil without any iron core, the shape and arrangement of said magnet and coil being such that this action is comparatively small and substantially constant for a given current passing through the coil and throughout the oscillations of the beam, the coil being moreover fed by an impulse receiving circuit which is supplied normally with unidirectional current the intensity of which decreases when the signal impulses are received.

In a preferred embodiment the current for starting the relay pendulum is very small so as to avoid the necessity of a sensitive receiver and of amplifiers. The amplitude grows only if the periodical impulses are kept up during a long time at a period near the pendulum period whereby selectivity is simply obtained. Signals at a different frequency have no action, whereas under the action of the impulses at the proper frequency, the pendulum accumulates energy which may be used for a sudden important work such as the actuation of a switch or of parts setting the clock right.

It is preferable for the period of the pendulum to be at least 1/2 of a second. The pendulum is at least 6 cm. long so that it is possible to use large electric driving means with a good electrical efficiency requiring a small output of current. The impulses due to the signals are applied during the whole oscillation of the pendulum in one direction after which they stop. The signals are then constituted by emissions separated by silences the duration of which is equal to that of the emissions. Thus the pendulum reaches a given amplitude for a minimum current strength. With shorter emissions the strength required would be greater and the selectivity less. The reason is that if the period of the signal is one second and its duration 1/100 second the system might be started by any emission lasting 1/2 second which produces an impulse 50 times greater than each emission of the signal, that is it produces the same effect as 50 successive emissions and if the reception is stronger or fortuitous long

emissions are produced at a frequency near that of the pendulum, the latter would start at an undesired moment.

We may use as a time signal an emission introduced in a broadcast concert, which emission may be constituted by sounds separated by silences and the frequency of which corresponds to that of the selecting relay pendulum. These sounds may be of any kind, e.g. musical notes or a sentence the syllables of which are emitted according to the desired rhythm and announce the signal. This may be provided by a phonograph synchronised by a clock.

The setting right may be controlled by an ordinary wireless receiver. For each sound signal an alternating current at audio frequency is emitted. After amplification if desired, the pendulum will start gradually and finally close a switch over an electromagnet acting on the hands through a cam or otherwise. Details of such and similar devices are described hereinafter.

The selecting pendulum may be started as follows:

The pendulum carries a permanent magnet passing through a hollow coil acting on the pendulum as in usual electromagnetic clocks with a driving pendulum.

In this case, alternating current would have no action and rectification is necessary or one of the polarities should be suppressed, for instance by a detecting and amplifying vacuum tube. The undulating current is then fed to the coil. Of course, the known connections used in radio communication and telemechanical devices may be employed. The current actuating the selecting pendulum may be an undulating or continuous current periodically damped by the elementary signals.

The use of an air cored coil, attracting a magnet secured to the pendulum is of advantage because much weaker current is necessary than when it is necessary to magnetize soft iron.

The current can be further decreased by using a pendulum oscillating in a vacuum and provided with one or more powerful magnets and large coils so as to reduce the mechanical and electric losses as is known in the art for electromagnetic clocks.

The pendulum period being adjusted so as to be near that of the signals, a heavy pendulum may be actuated by a very weak electric power comparable to that required by telephones. The commercial interest of our invention is considerable as it allows the setting right of clocks to be effected by means of very simple receivers without amplifiers. The working is very reliable as the work which the relay pendulums can give out suddenly after storing energy gradually is considerable.

In all the above described systems the selecting pendulum does not start at once. The start is more or less slow according to the quality of the telephonic or telegraphic reception. After the signals have ceased, the oscillations continue for a time depending on the amplitude of the oscillations at the end of the signals.

The accuracy may nevertheless be made very great by making the pendulum reach an amplitude which is always the same at the interruption of the signals. At each emission which makes the pendulum start and stop after a variable number of oscillations, a predetermined movement of a controlling part is obtained and its return to its original position. For instance, two series of emissions at different periods may be used. At the receiver two pendulums are tuned to the two periods respectively, and are actuated by the two parts of the signal. One of the pendulums may make a ratchet wheel or the like rotate, which ratchet wheel is brought back to its starting position by the other pendulum as will be described hereinafter.

Our invention may be used with radio communication methods along telephonic wires or electric mains of any kind without troubling the normal work thereof.

Our invention may further be used for other applications, chiefly for telemechanical devices where the control need not be very rapid. For instance, it may be used for controlling a switch for public lights, for effecting the modification required when the tariff applied in a meter is to be changed, say every evening and morning, and for the control of electric substations and the like.

The selecting pendulum may work with intermittent current or continuous slightly undulating current. In the latter case we use, in addition to the coil fed with undulating current, a coil fed with D.C. and acting in a contrary direction to the former so that the total action on the pendulum is equal to the action of a coil fed with A.C., the intensity of which is equal to the difference between the undulating current and its mean value. Thus the setting right in time distribution systems may be provided by using a series of small periodical variations of the current distributed by electric mains. This variation of the voltage constituting the signal may be obtained at the central station by acting on the voltage regulator through a relay controlled by a pendulum. If the voltage is modified by less than 2%, the satisfactory working of the pieces of

apparatus fed by the mains is not disturbed as such variations occur normally in electric mains.

We have described hereinafter with reference to the appended drawings a form of construction of a clock adapted to be set right by wireless waves according to our invention. The casing of this clock may contain the pendulum relay and the parts necessary for amplifying the signals and setting the hands right. It is sufficient to connect it with an ordinary broadcasting receiver. All the parts are very simple and cheap.

Fig. 1 is a general diagrammatic view.

Fig. 2 shows an electromagnetic clock wherein an electromagnet sets the minute hand right when the clock is a few minutes fast or slow.

Fig. 3 is a cross section of the clockwork.

Fig. 4 shows at an enlarged scale a heart-shaped cam and its control.

Fig. 5 shows diagrammatically a modified form of the switch controlled by the pendular selecting relay.

Fig. 6 shows diagrammatically a device wherein the pendular relay makes the cam rotate by one revolution for each signal.

Figs. 7 and 8 are detail views of the same device.

Fig. 9 shows diagrammatically a receiving station with two pendulums actuated in succession so as to make a ratchet wheel rotate exactly by one revolution.

Fig. 10 shows diagrammatically a distant control arrangement connected to energy distributing mains.

Fig. 1 shows at 1 a wireless receiver of a usual type. The terminals usually connected with a telephone receiver T are shown at 2 and 3. The pendulum which is to be set right automatically may be of any desired type. On fig. 1 the spindle 4 of one of the hands is shown alone. This hand is secured to a sleeve frictionally driven by the spindle 4 and is rigidly secured to a heart shaped cam 5. This cam may be actuated by a tooth 6 borne by the armature 7 of an electromagnet the coil of which is shown at 8. Each time the electromagnet 8 is excited the tooth 6 adjusts the cam so that it settles in the bottom of the cam notch and sets the hand back into a predetermined position corresponding to the minimum radius of the heart shaped cam 5.

The receiver comprises generally two batteries adapted to heat the filaments of the three electrode valves of the receiver and to feed the anode circuit. The connections of these batteries 9 and 10 with the receiver 1 are not shown, for sake of clearness.

The electromagnet 8 is connected in a circuit compriaing in series the battery 9 and a switch formed by a spring 11 and the rod 12 of a small pendulum forming the selecting pendular relay. This pendulum is provided at its lower end with a magnet 13 one end of which is inside the hollow coil 14; the natural period of the pendulum 13 is chosen very near that of the time signal given out every day by the wireless emitting station.

The terminals 2 and 3 of the receiver are connected with the coil 14 through a switch 15 and detecting means adapted to cut off one half of the pulsations of the undulating current from the receiver so that the coil is only fed with current of a given polarity, which current excites the electromagnet in such a manner that it attracts the magnet 13.

The diagram in Fig. 1 shows by way of example a vacuum tube connected as a detector. The connections comprise a transformer 16, a condenser 17 connected to the grid 19 of the tube and a resistance 18 connected across the condenser; the filament 20 of the tube is connected with the 4 volt heating battery 9 and the coil 14 is inserted in a circuit comprising the 80 volt battery 10 and the anode 21 of the tube.

This arrangement is set up and adjusted in the manner well known in itself so that when an alternating voltage at audio frequency is produced between the terminals 2 and 3, the plate current is caused to pass through the coil 14.

The spring 11 is suitably held away from the rod 12 so that the electric contact 11—12 is made only when the amplitude of the oscillations of the pendulum 12 is sufficiently great.

The operation is as follows:

When a non-periodic signal is given out by the emitting station, the coil 14 is fed with a very weak undulating current which cannot set the pendulum 12 going. On the contrary, during the time signal, the coil 14 receives a current the strength of which varies periodically according to a curve corresponding to the natural period of the pendulum which starts moving and ultimately comes against the spring 11 at the left end of its periodical swing.

When the contact 11—12 closes, the electromagnet 8 attracts its armature 7 and the tooth 6 acts on the cam so as to bring the hands back into a predetermined position. When the time signal stops, no more impulses are given to the pendulum 12 which is damped. As soon as the contact 11—12 is no more closed, the armature 7 is no longer actuated and

no longer comes into contact with the cam 5, so that the hand continues to move freely under the action of the clockwork. The time which elapses between the stopping of the time signal and the moment when the electromagnet ceases being excited can be ascertained and the hand suitably shifted with reference to the cam 5 so as to take into account the time thus elapsed and move the hand into a position indicating approximately the right time.

Means may be provided for giving the pendulum 12 an amplitude which is always the same at the end of the time signals, whatever the irregularities in the reception may be.

For this purpose we use a pendulum 12, the natural period of which for small amplitudes is slightly greater than the period of the time signals. A stop 22 is disposed near the rod so that, a little before the end of the signal, the pendulum reaches the amplitude for which it comes against this stop. The arrangement of the receiver is such that this amplitude is reached in all cases, even with a poor reception. Experience shows that towards the end of the signals, the amplitude of the pendulum remains substantially constant and strikes the stop lightly.

Therefore at the end of the daily time signals the oscillations of the pendulum have always the same amplitude corresponding to the position of the stop, in spite of the irregularities in the reception. Therefore it is sufficient for the time signal of the emitting station to end always at a predetermined time. The pendulum 12 then continues to oscillate so as to close the contact 11—12 and cause the tooth 6 to come against the cam 5, during a period which is always the same as it depends solely on the damping conditions of the pendulum. It can thus be taken into account for setting the hand with reference to the cam 5 and the result is thus obtained that when the pendulum ceases to establish the contact 11—12, the hand gives the right time.

Figs. 2 and 3 show by way of example a preferred construction of the device as applied to an electric clock of the type described in our prior patent 222,432.

This clock comprises a pendulum 23 carrying a magnet 24 and receiving a periodical impulse from a coil 25 through a contact not shown. The pendulum moreover actuates gearing controlling the hands and shown on Fig. 3. The wheels are mounted between the plates 26 and 27. The movement of the ratchet wheel 28 is transmitted through reduction gears to the wheel 29 which is frictionally mounted on the spindle 30 of the minute hand 31^{I}. A spring provides a small amount of friction between the spindle 30 and the wheel 29 whereby the spindle is driven by the latter; but a very small effort makes the spindle rotate in the wheel. The end of the spindle is frictionally wedged in the socket 31 rigidly secured to the minute hand 31^{I} and controlling the hour hand 31^{II} through the usual gearing. The socket 31 is secured on a notched disc 32 (Fig. 4) performing the function of the cam 5 of Fig. 1. The disc is under the influence of the pin 33 borne by the bent lever 34 (Fig. 2). This lever is pivotally secured to the spindle 35. The armature 36 of a small electromagnet 37 is disposed so as to act on the small arm of lever 34 which is caused to rotate in the direction of the arrow *f*. It is easy to see that this is sufficient to bring the minute hand back into the proper position if it is fast or slow by less than 5 minutes. This form of construction is of great interest because a very small effort is sufficient for moving the hand and the electromagnet may be fed with current of small strength as the movement of the armature is multiplied through the lever 34 and the air gap of the electromagnet may be very small.

The contact 11—12 Fig. 1 may be replaced by the contact shown on Fig. 5 of a type known in itself. The pendulum 12 is provided with a pawl 38 which actuates the ratchet wheel 39 when the oscillations have a sufficient amplitude. The electric contact 11—12 is provided between a spring contact 12 and a detent 11. This allows a very sudden closing and breaking of the first contact part and sufficient pressure of contact due to the fact that the ratchet wheel is rotated with all the potential energy of the pendulum to which it has been gradually imparted through the impulses given to it for starting.

Instead of acting on the cam through an electromagnet 8, the pendulum may act directly on the cam without any electric contact device. Figs. 6 and 7 show an arrangement devised to this purpose.

The relay pendulum 12 (Fig. 6) when it starts oscillating makes the ratchet wheel 40 rotate, which wheel is rigidly secured to the cam 41 adapted to raise and let fall a lever 42 (Fig. 7) acting on the heart shaped cam 5 of the hand to be set right.

In order to obtain an accurate working, it is necessary for the ratchet wheel 40 to rotate exactly by one revolution when the time signal is given out. Now it is impossible to make the number of oscillations of the pendulum always correspond

exactly to one complete revolution of the wheel 40; in order to solve this problem we use a ratchet wheel of the type shown in Fig. 6, which has a blank 40^1 in the place of one tooth gap whereby for a given position of the wheel, the latter can no more be actuated, the end of the pawl 43 not finding any further grip on the wheel teeth. The catch or detent 44 is pivotally secured at 45 to the end of the movable lever 46 pivoting round the spindle 47. A knife shaped part 48 pivots freely round a point of lever 46. On the rod of the pendulum 12 is secured a part 49 provided with a narrow slot parallel to the edge of the knife 48.

The operation is as follows: at the beginning of the time signals, the ratchet wheel is at least one tooth further in the anticlockwise direction than is shown in Fig. 6. Therefore when the pendulum oscillates sufficiently it makes the ratchet wheel move tooth by tooth until the closed tooth gap 40^1 appears in front of the pawl 43. The wheel 40 is then no longer actuated. It should be noted that when the amplitude of the pendulum 12 is great, the part 49 passes freely under the knife 48 which it pushes away from its path.

When the time signal is at an end, the pendulum is damped and a moment comes where the return oscillation occurs exactly at the moment when the edge of the knife 48 is in the slot in the part 49. The knife is thus wedged therein (Fig. 8) and the arm 46 rises and falls and thereby makes the ratchet wheel advance by the value of one tooth interval. But this rotation is discontinued since the pendulum 12 stops very soon after. The ratchet wheel is then adapted to be actuated again at the next time signal. The manner of working of the parts 48 and 49 is similar to that of the current closing device used on the old clocks of the well known Hipp type, which device works in a most satisfactory manner.

Instead of the above described arrangement comprising the lever 46, any other suitable arrangement may be used for setting the ratchet wheel in the desired position after the end of the time signal. For instance the clockwork may act on a cam controlling an arm which makes the ratchet wheel move by one tooth a little before the time signals whereby the ratchet wheel is brought into a position where the pawl 43 may move it.

We may use an auxiliary pendulum 12*a* (Fig. 9) having a length different from that of pendulum 12 and controlled by a special signal emitted at a frequency corresponding to its natural frequency.

The coils for keeping up the oscillations of the pendulum 12 and 12*a* are inserted in the receiving circuit and the said pendulums start oscillating according to the frequency of the signal received.

An arrangement shown on Fig. 9 makes the ratchet wheel 40 advance at each signal by a given angle, this wheel being under the action of two pawls borne by the rods of the two pendulums respectively.

The signal should in this case comprise two parts in succession at the frequency of the pendulum 12 and 12*a* respectively.

The above described devices may be used for other purposes than setting clocks right, in all cases where a distant control need not be instantaneous. It may be adapted to wired and to wireless telegraphy and telephony. It may be used for a distributing system of electrical energy wherein a single masterclock controls the change over from one tariff to another in subscribers' meters, the lighting and extinguishing of public lights, the switching on and off of local or subscribers' transformers or of heating appliances and so on.

As known in the art the receivers may be connected with the central station through one wire of the mains and so-called control wires, these wires being fed by current impulses through the masterclock with a view to exciting the receiver electromagnets as shown in Fig. 10, 50 being a wire of the mains and 51 the pilot wire. The switch is shown at 52 and the A.C. or D.C. electric supply at 53.

A receiver comprises for instance, a pendulum 12 having a natural period T and the pendulum 12*a* having a natural period T^1, both acting on a ratchet wheel as on Fig. 9. The pendulums are provided with two coils 54 and 53 which attract the soft iron cores carried by the end of the pendulum and are connected with the wires 50—51 through condenser 56 if required by the voltage of the mains. The circuit may be tuned to the frequency of the A.C. from 53.

In order to make the ratchet wheel 40 rotate by one revolution it is sufficient to close the switch 52 periodically at the frequency T^1 first and T afterwards. This affords a very secure control of the wheel 40 as the device only works if the periodic impulses T and T^1 are continued for a sufficiently long time. Thus short induced currents operate the receiver and if any impulses are missed, the manner of working is not modified. The wheel 40 may moreover be actuated by a current of very small strength.

The different receivers may be provided with pendulums of different periods the coils of which are inserted in the same

wires. According to the frequency of the supply current, some receivers may work and the others remain at rest.

In order to connect the transmitter with the receivers at the subscribers we may use known devices wherein no complementary wire is necessary. For instance, in the case of D.C. mains, a small alternator may be used at the central station, one of the terminals of which is earthed and the other of which is connected with the mains. At the subscribers a condenser may be inserted in series with the coils 54 and 55, one terminal of the condenser being earthed.

With A.C. mains a dynamo machine would replace the alternator and an induction coil would replace the condenser. The distant control without any pilot wire could be made by means of high radio or audio frequency auxiliary currents.

Our invention may be used with the usual time distributing systems to set receiving clocks right instantaneously by means of periodical impulses sent through the connecting wires between the master-clock and the receivers. The coil of the selecting relay pendulum would then be connected in series with the winding of the receiving pendulum and the device would have to work in a manner such that the periodical signals do not influence the oscillations of the receiving pendulum and the normal impulses do not act on the selecting relay pendulum.

In the case where the time distribution is provided through synchronization, a periodical current may be used for setting the clocks right, the period of said current being different from that of the current impulses controlling normally the receiving clocks.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1—A distant control device for synchronising clocks, of the type wherein rhythmical electric impulses are adapted to make a pendulous relay start oscillating gradually, said relay closing the control circuit when it has reached a predetermined amplitude, wherein the relay is constituted by an isochronous beam oscillating through the action of a magnet on a copper wire coil without any iron core, the shape and arrangement of said magnet and coil being such that this action is comparatively small and substantially constant for a given current passing through the coil and throughout the oscillations of the beam, the coil being moreover fed by an impulse receiving circuit which is supplied normally with uni-directional current the intensity of which decreases when the signal impulses are received.

2—A device as claimed in claim 1 wherein the pendulous relay is constituted by the known arrangement of a pendulum rod having a certain length and provided with a comparatively heavy magnet curved to a circular arc engaging the coil.

3—A device as claimed in claim 1 adapted to receive radiotelephonic impulses constituted by waves rhythmically modulated wherein the coil of the relay is inserted in the plate filament circuit of the ionic valve of a rectifying amplifier of the station adapted to receive the impulses.

4—A device as claimed in claim 1 comprising means adapted to give the amplitude of the oscillations a value which is always the same at the end of the signal whatever the length thereof, these means comprising for instance a stop in the path of the pendulum or beam, the desired control being provided at the moment when the amplitude of the oscillations decreasing after the end of the signal impulses passes below a given value at a predetermined moment with reference to the end of the signal, this control being effected in the case of the setting right of clocks by a heart shaped cam secured to the minute hand and engaged by a tooth actuated by an electromagnet the supply circuit of which is closed periodically by the relay as long as its amplitude is above the said predetermined value.

5—A device as claimed in claim 1 wherein all the gradually built up energy stored by the oscillating part is released suddenly in order to actuate the switch arrangement, this being provided for instance by the pendulum acting through a pawl on a ratchet wheel having a comparatively small number of teeth and causing it to rotate by one tooth only for a predetermined amplitude of oscillation, the ratchet when moving pushing a spring detent which closes a contact which is thus made and broken suddenly.

6—A distant control device as claimed in claim 1 wherein the receiver acts through a driving pawl on a ratchet wheel the interval between two adjacent teeth of which is solid, the signal being long enough to make the ratchet wheel rotate in all cases by more than one revolution, the ratchet stopping even when the signals continue when the driving pawl comes upon the solid interval, the ratchet being provided moreover with a detent pivotally secured to a rocking arm bearing a freely oscillating knife engaging a

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"Synchronome Brisbane 1903-1991" The story of the Jackson family of electrical clock makers. An Historical Project by Chapter 104. A 32 page booklet about the operation of the Synchronome Elec. Co. of Australasia. $5.00 Norman Heckenberg, 30 Depper St., St. Lucia, Qld. 4067, Australia

Collection of about 200 electric clocks (50 master, 80 independent, 30 secondary, 20 synchronous, 10 quartz) for $35,000. Details open for discussion. The clocks are in Switzerland. Michel Viredaz, Home +41 21 784 05 38, e-mail viredazepal@bluewin.ch

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Dr. George Feinstein 75-19 195th Street Flushing, NY 11366

notched part secured to the pendulum whereby when the oscillations decrease at the end of the signal, the two parts are wedged together at a given moment so as to raise the detent and engage it with the next tooth and make the ratchet wheel rotate by one tooth after the fall of the detent bearing arm, the driving pawl being then in front of the first tooth after the solid interval which makes the working again possible at the next signal.

7—A distant control device as claimed in claim 1 wherein the impulse emitted comprises in succession two signals having the frequencies T and T^1 to which correspond two relay pendulums of corresponding period both acting on the same ratchet wheel having a solid interval, the first pendulum, serving for the reception of the control signal and having a frequency T, making the wheel rotate until its pawl falls on the solid interval and effecting the desired control whereas the second pendulum makes the ratchet rotate by a few teeth so as to allow its actuation at the next signal by the first pendulum.

8—A device as claimed in claim 1 for setting a clock right wherein the minute hand is frictionally secured to its spindle and can be returned to a given position with reference to the dial by the armature of an electromagnet acting on a cam to which the hand is secured, the hour hand being controlled by the minute hand and the time signals acting on the device ending always at the same minute of any hour corresponding to the setting right of the minute hand so that the time signal may be given every day at any one of twenty four predetermined moments.

9—A distant control device chiefly for setting clocks right substantially as described with reference to and as illustrated in the appended drawings.

Dated this 8th day of March, 1928.

MARKS & CLERK.

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THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78
NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXVII #3, SEPTEMBER 2001

Fellow Horologists:

This journal issue continues with the Instruction Manual for Synchronizing Self-Winding clocks with the FC control box.

We also include the Bulletin from Telechron, General Electric describing their A & B Power Station Master Clocks. These were in use during the early days of AC power to allow the generator control engineers to monitor the generator output frequency, and make the necessary adjustments to compensate for load variations which influenced the generator speed as well as the frequency. The model B (wall mounted) and the model A (free standing) are now considered extremely collectible, since most have been discarded, now replaced by modern automatic controlling devices.

Also included is a reprint of a pamphlet describing a Battery Service to owners of Cloister clocks, outlining their battery replacement program, and copies of correspondence from 1959 from the National Magnetic Clock Co. showing their relationship with Tiffany Never Wind and Cloister Clock Corp. The actual relationship between Tiffany and these companies remains in doubt, with many opinions favoring a licensing agreement or a sales program in which mechanisms, in part or whole were sold for installation in housings of their own. Anyone with another point of view is encouraged to communicate with us to help put this issue in perspective since those organization's true participation has always been somewhat vague.

Bill Ellison presided at the chapter's meeting at the NAWCC National Convention in New Orleans, and provided the attendees with a fascinating presentation on the subject of repairing Telechron rotors (capsules). We've asked Bill to repeat his talk at other chapter meetings since the attendance at the convention was limited mostly to nearby residents, and so many of us missed the program. We may even be able to encourage him to prepare the material for a future journal article, if we're lucky!

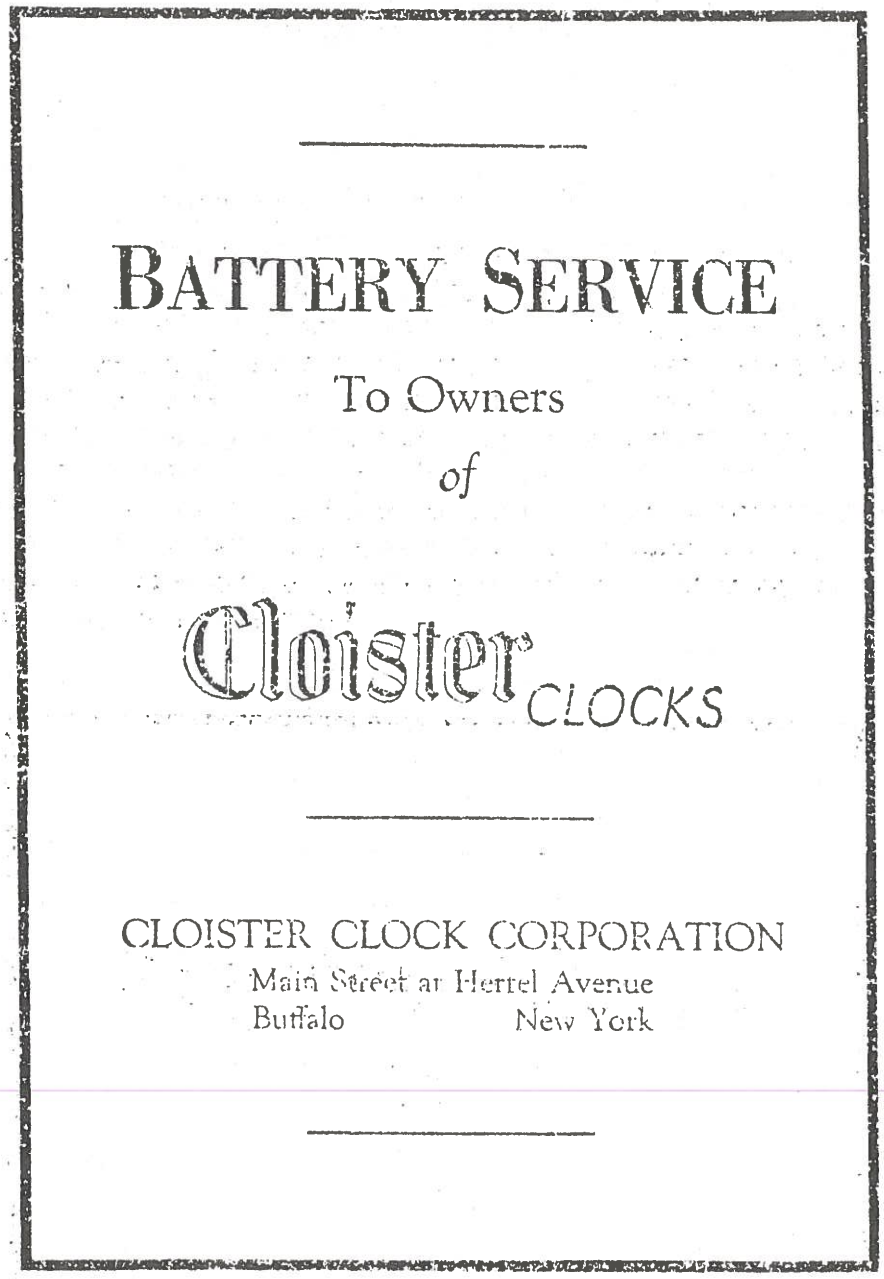
Our quote for this issue: "Never be afraid to try something new or innovative, remember that the ark was built by amateurs, and the Titanic by professionals!"

Good reading ahead, enjoy this issue.

Martin Swetsky, FNAWCC,.....President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein,.....Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

Most of us are familiar with the various licensees of the Tiffany Never Wind clocks. Names like Cloister, National Magnetic and Niagara are the most often seen on Tiffany-type mechanisms, and their actual relationship to the Tiffany company escapes us. The most popular opinion appears to indicate that they enjoyed a licensing agreement, although the alternate theory claims that the Tiffany folks used these names themselves in an attempt to broaden their marketing base. In any event, the battery service program offered by Cloister appears to be little known, and the accompanying material describes this novel offer in detail. It was a valuable service to the clock owner that could have served as an example to other battery clock makers, creating an immeasurable degree of consumer satisfaction!



BATTERY SERVICE

To Owners

of

Cloister CLOCKS

CLOISTER CLOCK CORPORATION

Main Street at Herrel Avenue

Buffalo New York

The Reason for Cloister Battery Service—

On Numerous occasions enthusiastic owners of Cloister Clocks have remarked—"Your Clock ran fine for over a year, but I can never remember when to put in a new battery,—so I always wait till it stops."

Right there is the reason underlying this new battery service to owners of our clocks. Cloister Clocks need so little attention, and keep such accurate time, that owners often forget that after a year or fifteen months the battery becomes exhausted and should be replaced with a fresh one.

In order to insure the **uninterrupted** time-keeping service of Cloister Clocks, we have inauguarated the following system of battery service, which will take from owners of our clocks the burden of "having to remember when to replace the battery"

The Service in Detail—

Attached to each clock shipped from our factory is a stamped, self addressed, post card enclosed in a manila envelope. On this card is stamped the number of the clock and the date of the battery shipped with the clock, along with a brief description of this battery service. Also, on this card the owner is requested to fill in his name and address, in the space indicated, and mail it back to us immediately. These cards are kept on file at our Buffalo office, and at the proper time the owner of the clock is sent a fresh battery, **free of charge,** (for the first year only). Each year thereafter the owner is personally notified when it is time to replace the battery with a fresh one, and is informed how and where he may most easily obtain one.

Why We Undertake This Service—

Everyone knows that a dry cell battery will deteriorate in time, even though not in use. It is our aim to see that Cloister

Clocks give uninterrupted service, year after year. For this reason we not only intend that every clock that leaves our factory shall contain an absolutely fresh battery, but that the owner of each clock shall be able to receive a fresh battery each year at the proper time. We are in a position to furnish that service.

We believe that this service will be of as great advantage to our Dealers as it will to the owner of the clock. It relieves the Dealer of any responsibility to the Purchaser regarding the life of the battery. It enables the Dealer to sell Cloister Clocks with the assurance that they will give uninterrupted service. And he will be able to assure his customer that when the battery then in the clock becomes exhausted, he will be furnished a fresh one, free of charge, and that every year thereafter he will be notified when, how and where to obtain a fresh one.

Furthermore, the Dealer is not in a position to furnish a customer with an *absolutely* fresh battery. If the Dealer orders in large lots, some of the batteries will naturally have deteriorated somewhat before they are disposed of. There is very little profit to the Dealer in the sale of batteries. It is for the most part a nuisance to him, and he does it as only an accommodation to his customers. Through this Service we are taking this burden from his shoulders.

We intend to conduct this service at cost, and are not undertaking it as a source of revenue.

Satisfied Owners—

What we desire most is to have satisfied owners. What you want most of all is satisfied customers. With this new battery service you can sell Cloister Clocks with the firm assurance that they will give satisfaction,—you can *guarantee* their uninterrupted timekeeping service. This service also takes from the shoulders of the owner the burden of having to remember

when to replace the battery, and prevents his waiting until the clock has stopped before realizing the need of a fresh battery.

The Success of This Service—

To insure the success of this service we will need the co-operation of the Jobber and the Retailer. This co-operation will consist in calling the customer's attention to the Cloister battery service, and impressing him with the value and necessity of returning the post card to us, so that we may place the card on file. Unless the card is returned to us the customer naturally cannot expect to avail himself of this service.

We feel certain our Jobbers and Retailers will recognize the value and benefits of this battery service, and will gladly co-operate with us to insure its successful operation.

(Facsimile of post card attached in manila envelope, to all Cloister Clocks.)

IMPORTANT NOTICE

Regarding Our Battery Service

No. of Clock..... Date of Battery.....

Style.....

As part of this company's service to owners of the Cloister Clock, we keep on file a record of every clock that leaves our factory, which includes the date of the battery shipped with the clock.

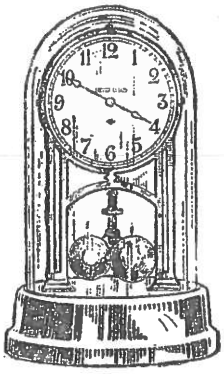
If you will fill out this card, we will send you a new battery, *free of charge*, at the proper time. Thereafter, we will annually advise you when it is necessary to replace the battery, and advise you where you may most conveniently obtain one.

In order that we may place this card on file, please fill in your name and address below, and mail it to us immediately.

Name.....

Street and No.....

City or Town.....State.....



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National Magnetic Clock Co.

Manufacturers

ELECTRO MAGNETIC CLOCKS

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Dunkirk, New York

Oct 17 1959

Dear Mr. Dow:

We have your letter of the 13th and sorry to learn the pendulum wire of the small clock was broken. We have assembled a new pendulum for insertion in the clock. As you may recall, these wires are of torsional steel the strength of which governs the time of the clock. We have timed it as close as we can with another pendulum weight as we thought you would have trouble assembling and thinning it to fit your clock. We think it is close enough so you can make any necessary adjustment for time with the knurled nut, turning it up for faster and down for slower. Hope it works. After inserting this pendulum in the clock hang on the weight and make sure the platinum contact pin practically touches the contact wire. If necessary pinch the pendulum post either way with a screw driver for this adjustment.

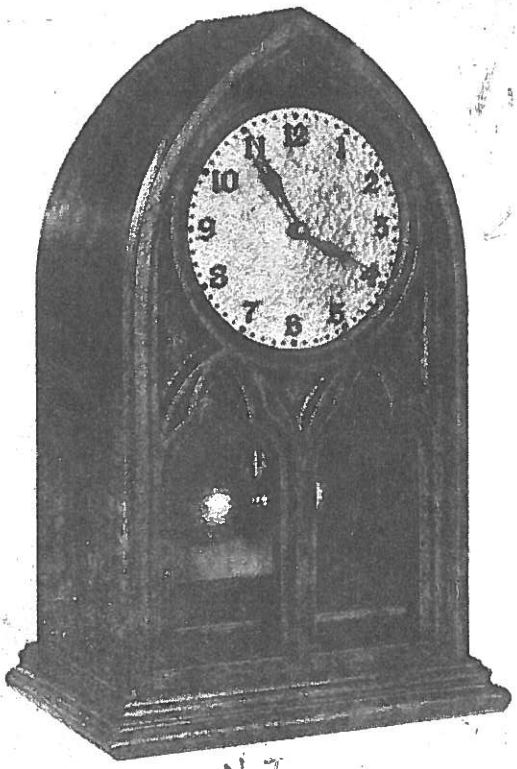
About a square brass clock-- we have been experimenting to see if we can fit one of the old Tiffany movements in the case. As mentioned to you the original movements for these cases are no longer available and they were constructed with white metal superstructures to hold the pendulum, etc, anyway and were not satisfactory. We will keep at it and will let you know later how we make out and what the cost would be. These old clocks originally sold for over $100 according to some of the old records we found many years ago.

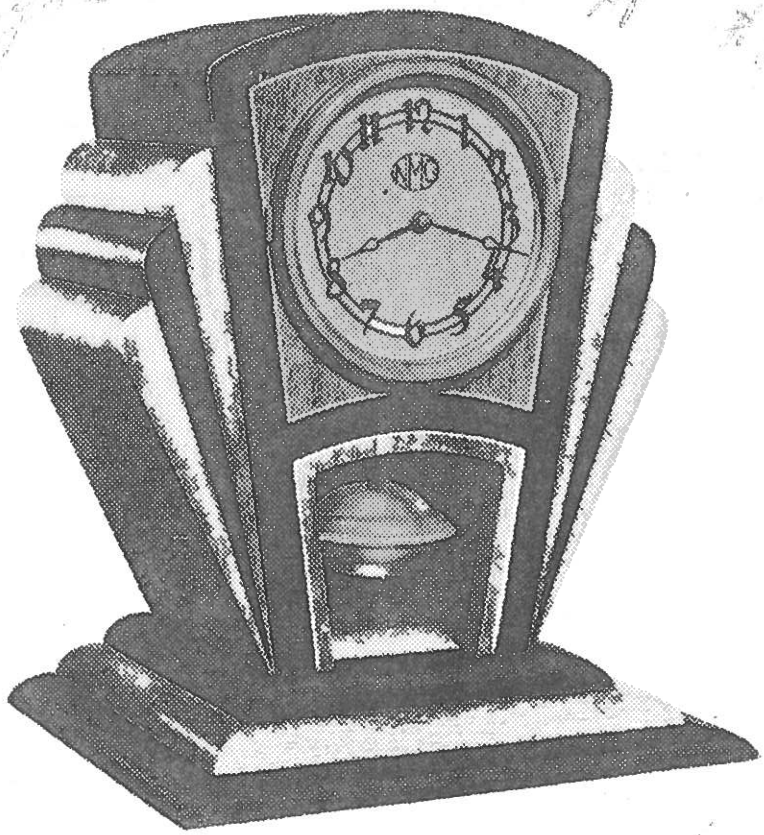
In this connection, you may recall the smaller clock with bronze finish, square glass enclosed case. We have been checking this clock and find we could install a new movement, using the Tiffany dial. This would entail considerable work and a fair price would be $25.00 which would include battery and shipping and packing expense.

In making up the pendulum for your square clock we have used an old style "travel", the part with the knurled nut, which has considerable more room for the nut to go up or down for adjustment, which may help you in timing the clock.

Sincerely,

NATIONAL MAGNETIC CLOCK CO
DUNKIRK, N. Y.





CLOISTER CLOCK CORPORATION

3M-1-24

CREDIT STORES FOR FOLLOWING DATE

QUANTITY	MATERIAL	CHARGE

FOREMAN

CLOISTER CLOCK CORPORATION

P.S.
WOULD YOU BE INTERESTED IN THE HAND CARVED WOODEN GOTHIC CLOCK WITH HAMMERED BRASSDIAL WHICH MRS JOHNSTON TOLD YOU WE HAD BEEN THINKING PERHAPS WE WOULD GIVE AWAY AS A WEDDING GIFT??
THIS IS ONE OF THE OLDER CLOCKS WITH ORIGINAL PRICE OF $42.50 AS PRINTED ON THE LITERATURE SHOWN YOU. HOWEVER WOULD MAKE THE PRICE $20.00. PLEASE ADVISE SO WE WOULD KNOW WHETHER OR NOT TO WORK ON IT.

Continued from June, 2001 issue.

4. LIST OF REPLACEABLE PARTS (CONT'D.)

SYMBOL	NAME	SPECIFICATION
CP-1	CAPACITOR	.5 MFD. 400 V.D.C.
F-1	FUSE HOLDER & FUSE	BUSS HKP, 3AG, 1 AMP., 250 V
F-2	SPARE FUSE HOLDER & FUSE	LITTLE FUSE TYPES 357001, AS FI
L-1	MASTER CLOCK RELAY	1.5 VDC 50 OHM, SP ST GUARDIAN SERIES 5
L-2	RECEIVING RELAY	120 VDC, 4000 OHM SPST, DB, ND CUTLER-HAMMER D 602673A
L-3	SUB-MASTER CLOCK RELAY	SAME AS L-1
L-4	TRANSMITTING RELAY	SAME AS L-2
R-1	FIXED RESISTOR	100 OHM, 25 WATT, OHMITE
R-2	RHEOSTAT	400 OHM, 100 WATT, OHMITE
R-3	NOT USED	
R-4	RESISTOR F. RELAY L-1	500 OHMS, 1/2 WATT
R-5	RESISTOR F. RELAY L-3	SAME AS R-4
S-1	SYNCHRONIZING MAGNET (MASTER)	12 OHM, 250 MA., S.W.CL.CO.
S-2	SYNCHRONIZING MAGNET (SUB-MASTER)	SAME AS S-1

5. REPLACEMENT OF DEFECTIVE PARTS

(A) REPLACEMENT OF COMMERCIAL COMPONENTS.
UNSCREW DEFECTIVE PART, UNSOLDER WIRE CONNECTION, MOUNT REPLACEMENT PART, AND RE-SOLDER. REFER TO SECTION IV-4 FOR SPECIFICATIONS.

(B) REPLACEMENT OF DEFECTIVE MOVEMENTS. (SEE ILLUSTRATION 5-10)
LOOSEN NUT (2), LIFT CASE OFF PIN (3), PULL OUT FRONT BOTTOM AND REMOVE CASE FRONT. UNSCREW KNURLED NUT (4) AND PRY OFF HANDS. NOTICE POSITION OF MINUTE HAND. REMOVE FOUR SCREWS (5). DISCONNECT ALL WIRES, REMOVE THREE SCREWS (6) AND LIFT OFF MOVEMENT.

PROCEED IN REVERSE ORDER TO REINSTALL REPLACEMENT MOVEMENT AND TO RE-ASSEMBLE CLOCK. (BE SURE TO MOUNT MINUTE HAND IN ORIGINAL POSITION ON SQUARE SHAFT END).

(C) REPLACEMENT OF OTHER PARTS ON ASSEMBLY.
REQUEST INFORMATION FROM SELF WINDING CLOCK CO., INC.

6. CLEANING AND OILING OF MOVEMENTS (See Illustration 5-10)

Remove movement from clock case following the instructions in Section IV-5 (b).

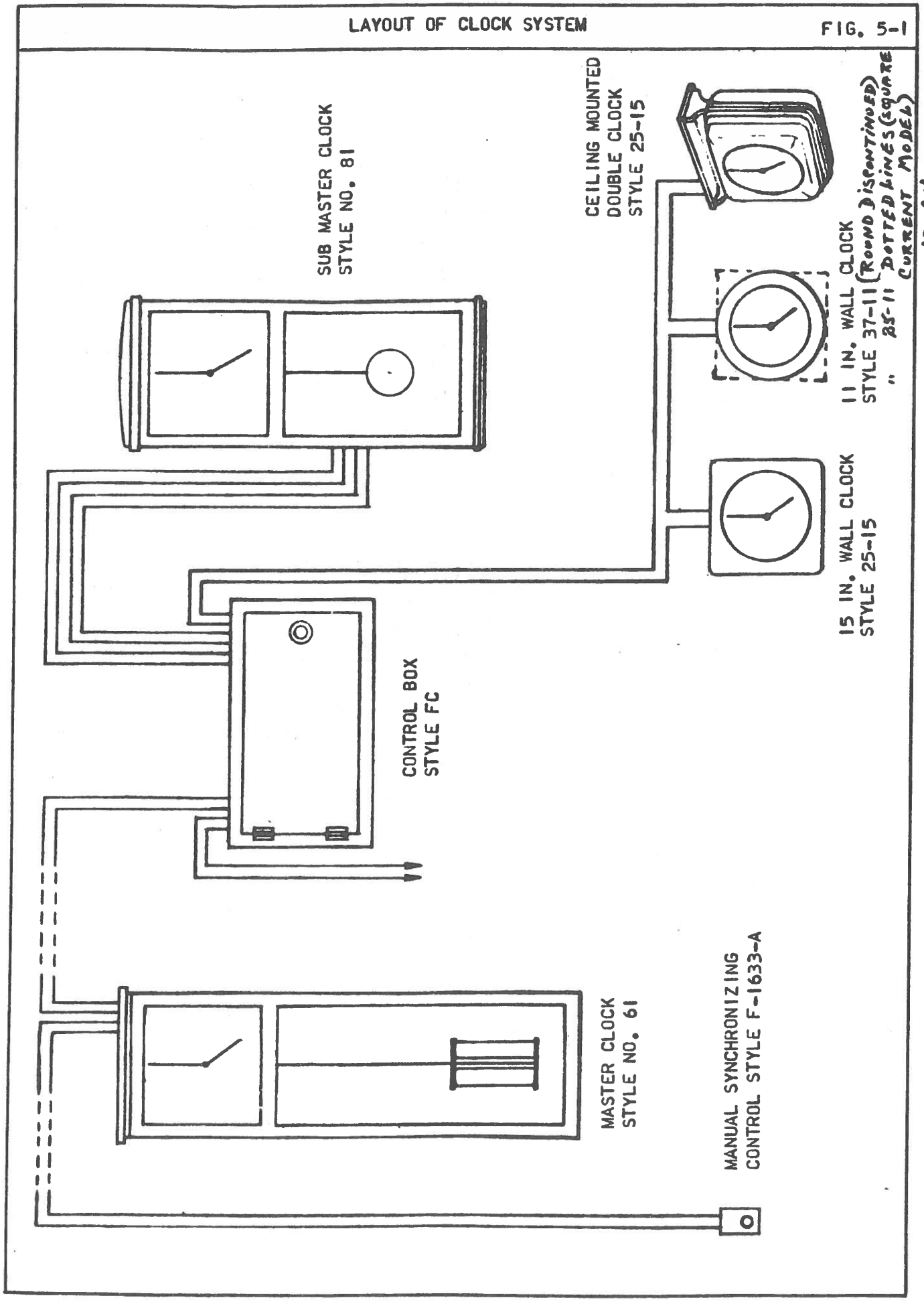
Brush: All bearings and pivot holes. Use non-combustible cleaning fluid on stiff marking brush. Allow to saturate for several minutes.

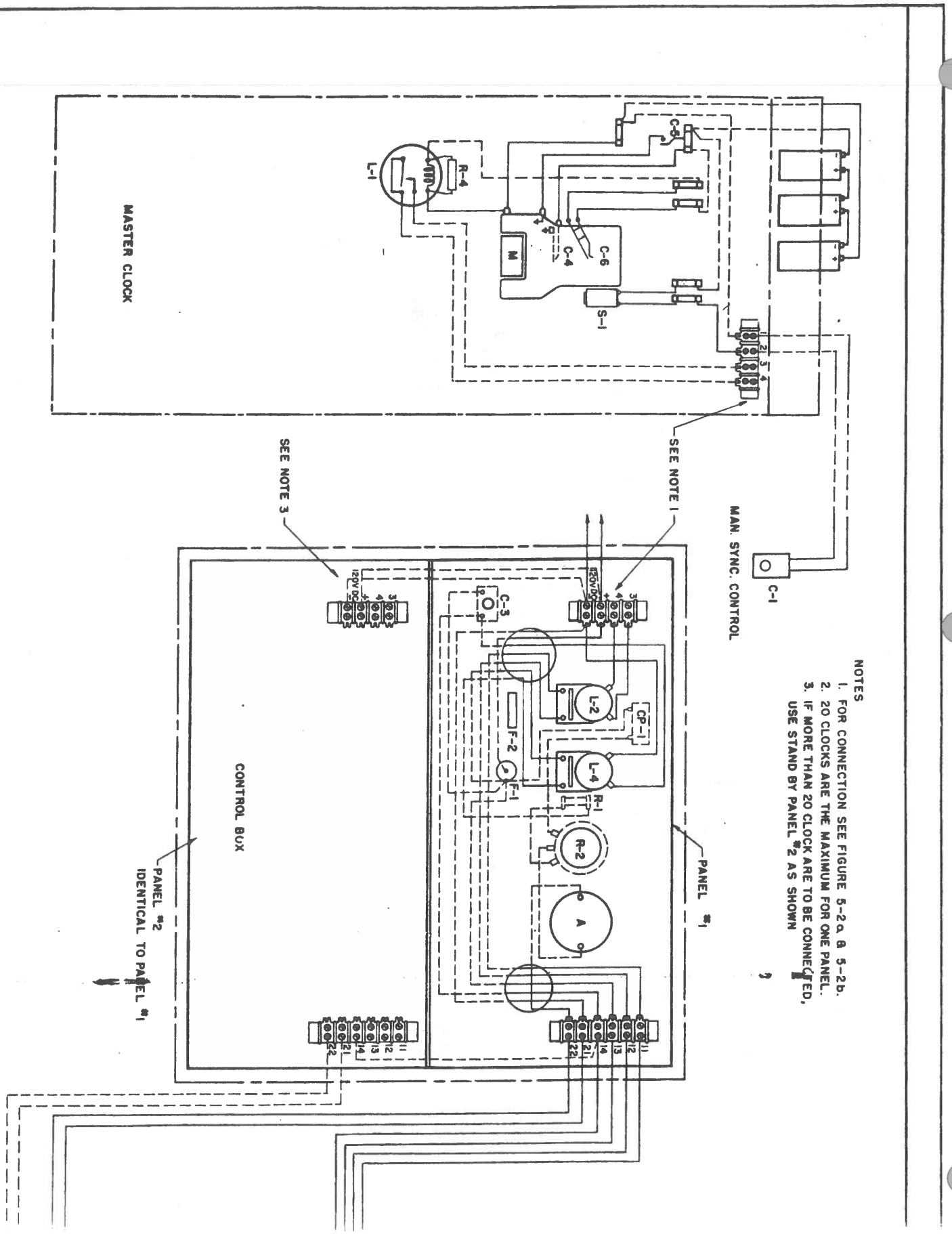
WIPE: Plates and arbors (shafts). Use cheese cloth on flat wood piece.

OIL: All bearings and pivots. Use fine wire or heavy needle. One drop of oil on all pivots. Trace of oil on nut (4) and pallets. Vaseline on winding lever and pin of motor armature.

CHECK: All contacts. Smooth out all grooves with fine contact file. All contacts must be dry and clean.

Reassemble in reverse order.


LAYOUT OF CLOCK SYSTEM
FIG. 5-1
SUB MASTER CLOCK
STYLE NO. 81
CEILING MOUNTED
DOUBLE CLOCK
STYLE 25-15
11 IN. WALL CLOCK
STYLE 37-11 (ROUND) DISCONTINUED
" 85-11 DOTTED LINES (SQUARE
CURRENT MODEL)
12-64.
15 IN. WALL CLOCK
STYLE 25-15
CONTROL BOX
STYLE FC
MASTER CLOCK
STYLE NO. 61
MANUAL SYNCHRONIZING
CONTROL STYLE F-1633-A



NOTES
1. FOR CONNECTION SEE FIGURE 5-2a & 5-2b.
2. 20 CLOCKS ARE THE MAXIMUM FOR ONE PANEL.
3. IF MORE THAN 20 CLOCK ARE TO BE CONNECTED, USE STAND BY PANEL #2 AS SHOWN

FIG. 5-2

'R CONNECTION SEE FIGURE 5-2a & 5-2b.
) CLOCKS ARE THE MAXIMUM FOR ONE PANEL.
MORE THAN 20 CLOCK ARE TO BE CONNECTED,
.E STAND BY PANEL #2 AS SHOWN

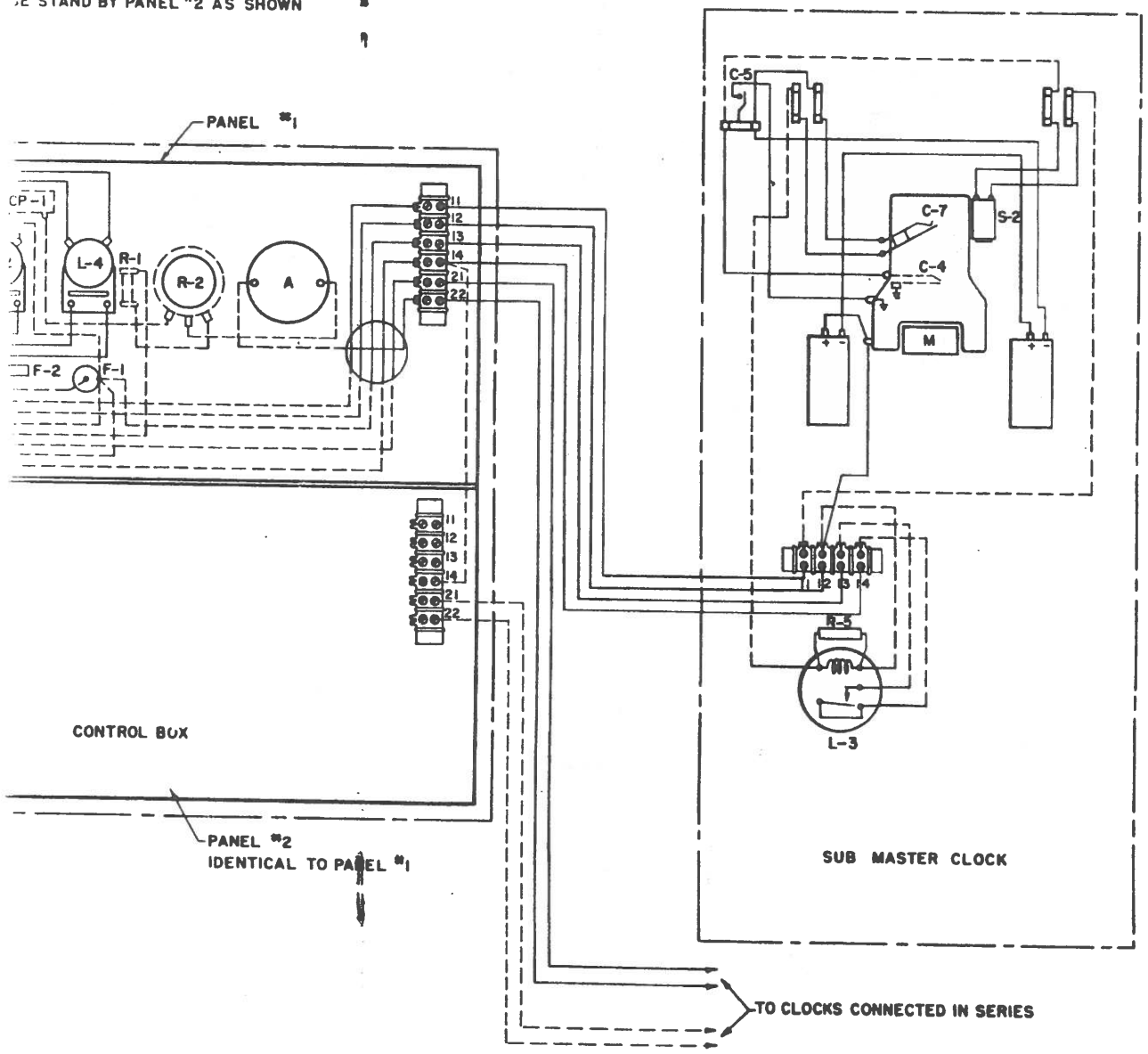


FIG. 5-2

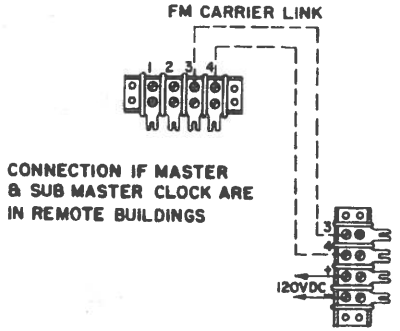


FIG. 5-2a

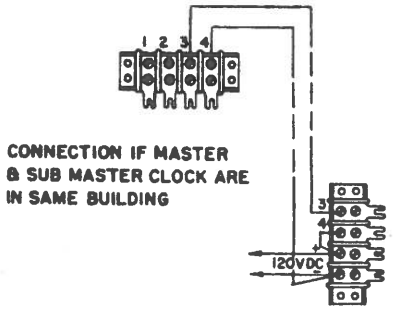
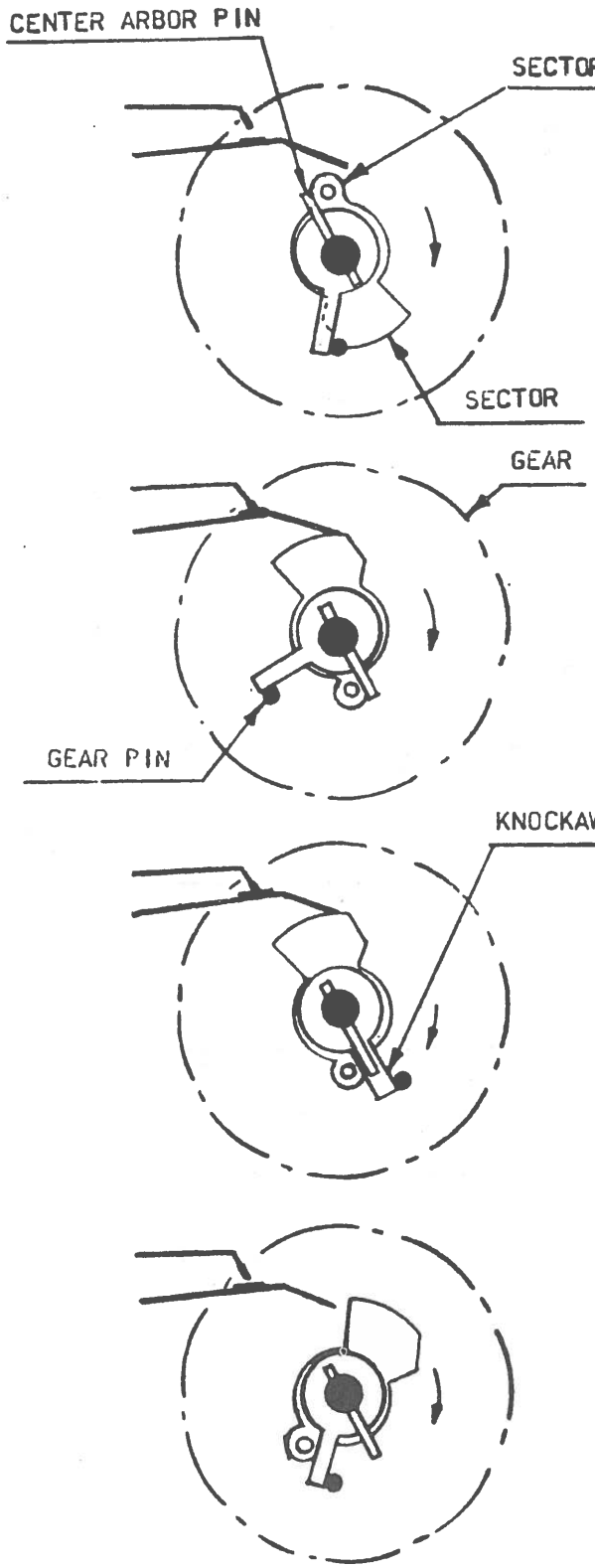


FIG. 5-2b

HOURLY SELF-WINDING CONTROL — FIG. 5-3



"CENTER ARBOR PIN" ENGAGES "SECTOR PIN" AND DRIVES "SECTOR" TO

"CONTACT - ON" POSITION.
WINDING MOTOR DRIVES "GEAR" (WINDING MAINSPRING). "MAINSPRING BARREL WHEEL PIN" ENGAGES "KNOCKAWAY-PIECE"

"KNOCKAWAY PIECE" REACHES "SECTOR PIN" AND ROTATES SECTOR TO

"CONTACT - OFF" POSITION.
WINDING MOTOR STOPS; "GEAR" RESTS; "CENTER ARBOR PIN" REVOLVES; ENGAGES "SECTOR PIN" AGAIN; ETC.

To be continued.

Telechron®

MASTER CLOCKS

BULLETIN M-12

TELECHRON
DEPARTMENT OF GENERAL ELECTRIC COMPANY
ASHLAND, MASSACHUSETTS, U. S. A.

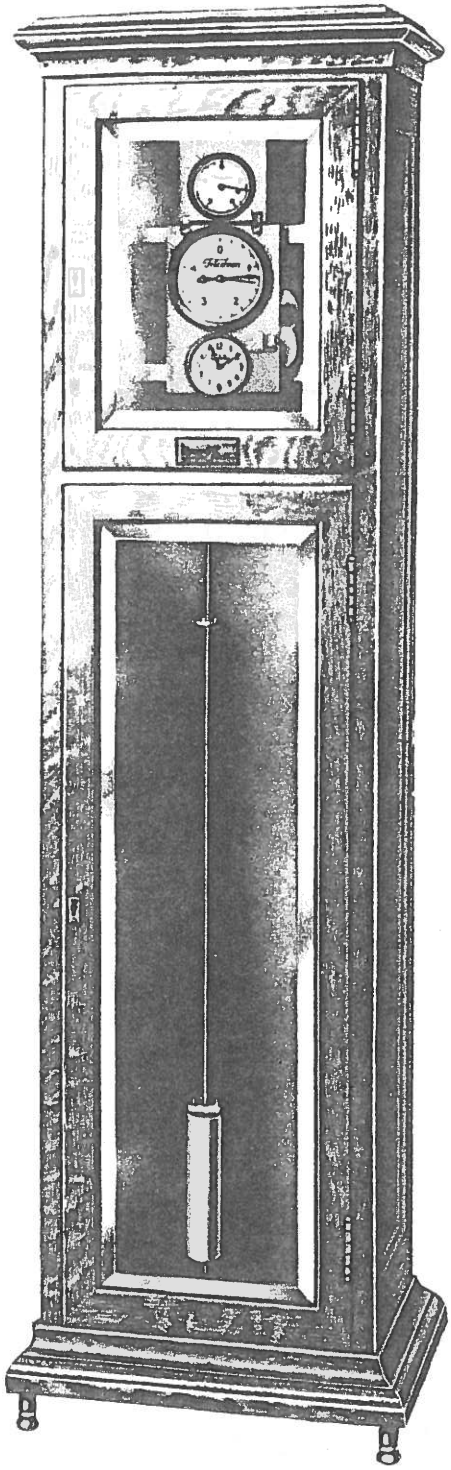


Fig. 1. Front View of Telechron Type "A" Master Clock

Telechron Master Clocks

FREQUENCY! One of the most important problems confronting a station operator is that of maintaining correct frequency at all times. Not only is this close control necessary for the proper operation of interconnected power stations and systems, but also to satisfy the strict requirements of the majority of industrial customers.

When the generation of alternating current first came into general use, the control of frequency was a very minor problem. Prime movers were equipped with governors which were entirely satisfactory if they maintained the speed within five per cent of normal while the basic frequency depended, as a general rule, upon the fancy of the designing engineer.

However, due to increased load demands, it soon became necessary to interconnect individual generators and then stations. This interconnection required a single standard of frequency and, in addition, a means whereby this frequency could be accurately measured and controlled. As the vibrating reed type of frequency meter was available, it was used to give a fairly close control of the frequency.

In time, as the development of electrical motors advanced, their use became more and more universal in the large manufacturing plants of the country. This resulted in the interconnection of entire power systems in order that a continuous supply of energy might always be available. This interconnection increased the necessity of using a standard operating frequency throughout the country and of obtaining a means whereby frequency might be accurately measured to a small fraction of a cycle.

In addition, the use of electric motors in industrial processes also caused a demand for accurate frequency control as modern manufacturers, who designed their equipment for certain operating speeds, found that frequency below normal was resulting in decreased output while frequency above normal was injurious to their product. This was especially true of machines driven by synchronous motors as their speed varies directly in proportion with the frequency.

This demand for accurate frequency control resulted in the development of the bridge circuit type of frequency meter which, in commercial use, is accurate to about one-twentieth of a cycle and which indicates or records the slightest fluctuations in frequency. But even this advancement in the measurement and subsequent accuracy of control of the frequency was not sufficient to meet the demand of large industrial plants nor the requirements of heavily loaded transmission lines between interconnected systems.

The difficulty of accurate frequency control of a power system is still further increased by its many varying characteristics which may cause it to quickly oscillate in one direction or the other. Thus, a system operator is confronted with the problem of making these minute periodic changes come equally above and below the basic standard. In other words, it is the average of the entire number of oscillations which he must consider in order to maintain correct frequency. What could be a better aid to him than a frequency meter which works on the principle of averages? Telechron Master Clocks do just this.

The value of the Telechron Master Clock has been further enhanced by the development of the power system. When one or more groups of generating stations, each group having a capacity of hundreds of thousands of kilowatts, are connected together through a relatively low capacity line, the basic frequency must be maintained within very close limits. It is disastrous to permit large variations in frequency or to use meters which may be interpreted differently by different observers especially when, as is so often the case, communication from group to group is limited.

Because of this difficulty of interpretation and because instantaneous frequency meters shift their calibration so readily, such meters cannot be relied upon as a standard for the accurate frequency control which is in demand at the present time. However, such difficulties are not encountered in the Telechron Master Clocks as they are not affected by normal variations in temperature, wave form, voltage, or current. They indicate, at all times, a true value of average frequency with unfailing accuracy. Furthermore, the maintenance of correct average frequency can be accomplished through the use of Telechron Master Clocks with very little effort on the part

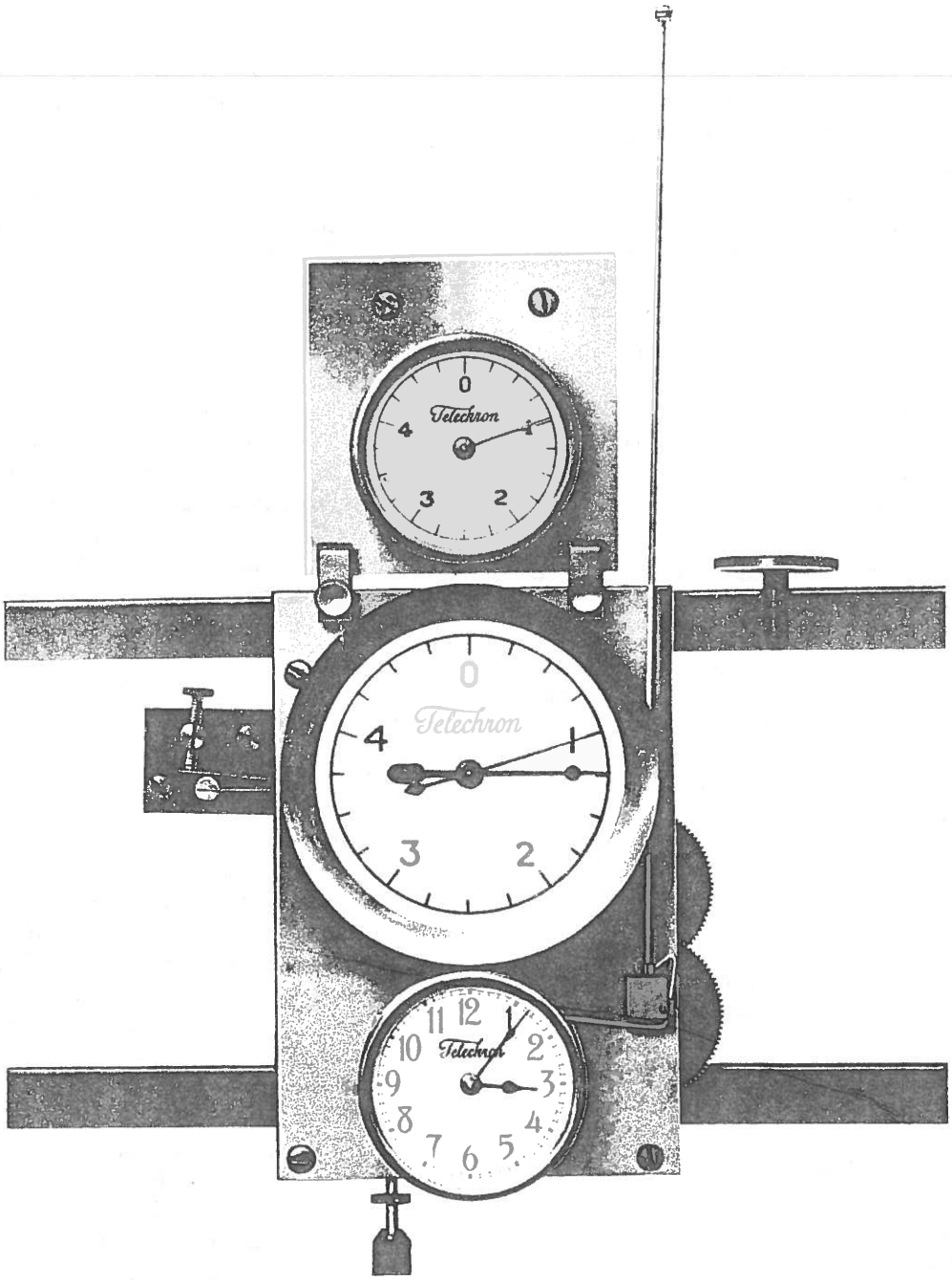


Fig. 2. — Operating Dials of Telechron Type "A" Master Clock

of the operators.

The principles, on which the Telechron method of frequency regulation depends, may be briefly outlined as follows:

1st: The speed of a synchronous motor is directly proportional to the frequency of the energizing electrical system.

2nd: A gear train may be designed for such a motor which will drive a shaft, carrying a hand,

at one revolution per minute under correct frequency conditions.

3rd: If another hand is concentrically mounted on the above mentioned shaft and driven by a clock movement at exactly one revolution per minute, any diversion between the two hands will directly indicate an error in the frequency.

The Telechron Type "A" Master Clock carries out this method of measuring frequency with extraordinary precision. This instrument has a large dial, in front of which are two concentrically mounted hands of different colors. One hand shows true time and the other "system time", measured in terms of frequency. Having once been set, one over the other, the two hands will move together around the dial and remain in coincidence with each other as long as the average frequency is correct. Any variation in the average frequency from its normal value will cause the motor hand to lag or lead the clock hand according to whether the average frequency is below or above its rated value.

The Telechron Type "A" Master Clock, shown in Fig. 1, consists of a very accurate pendulum-driven clock movement and a separate timing mechanism actuated by a Telechron Synchronous Motor. The clock mechanism is a very carefully made time-keeper with a 60-beat pendulum and a Graham "dead beat" escapement. The pendulum rod is made of invar; a metal having such a low coefficient of expansion that the rate of the clock is not affected by normal variations of temperature. The driving spring is kept wound at a constant tension by means of the Telechron Motor which actuates the frequency hand.

The operating dial of the Type "A" Master Clock is shown in Fig. 2. It consists of the operating dial in the center, about which the indicating hands rotate once in five, minutes. The standard, or correct time, hand is black while the frequency hand is gold. Below the operating dial is a twelve-hour dial which permits the operator to tell the time of day and the five-minute interval during which the main dial is operating. An auxiliary dial is mounted above the main dial and has but one hand which is actuated by a second Telechron Motor. This dial permits the control of a second separate system or may be used for auxiliary purposes in case the main motor should, for some reason, be out of use.

The Type "A" Master Clock is furnished with an oak case and should be mounted in a place free from vibration, preferably upon a solid pedestal, in full view of the switchboard operator or the load dispatcher. The operator should be instructed to adjust the frequency so as to constantly keep the two hands on the main dial in coincidence. A divergence of one second between the hands can easily be seen, and, if this should take place over a period of an hour, it would indicate an error in the average frequency of one thirty-sixth of one per cent. The operator can correct such errors by an occasional manipulation of the speed control switches. In power stations where the load is fairly steady, it may be found unnecessary to adjust the speed more than once an hour. When the load is rapidly changing, more frequent speed adjustments may be necessary but under no conditions will as much care be needed as when the control is accomplished through the use of a frequency meter. The reason for this reduction in attention is that the Master Clock indicates only the accumulated errors in frequency after averaging the low values against the high values so that the result which appears on the face of the dial shows only the real gain or loss in average frequency. The operator, guided by the Master Clock, may, therefore, be sure that the generators are rotating at the proper speed to maintain the frequency at the correct average value. A check on the system frequency can be obtained by means of a standard Telechron Electric Clock which is included with the Type "A" Master Clock and which should be mounted on the wall near the Master Clock.

The Telechron Motor, which actuates the frequency hand, is accepted as the best small self-starting synchronous motor ever developed for a practical commercial use. The motor is small and compact, as shown in Fig. 3, and comes up to full speed, under rated load, practically instantaneously with no measurable lag. It is self-lubricated, and, as the rotating parts are entirely enclosed, there is no danger of the gearing being jammed by accumulations of dust and dirt. The motor is not affected by large changes in voltage, current, or temperature and may be built to operate on any commercial frequency or voltage.

The accuracy of the clock movement in the Type "A" Master Clock is very high due to its excellent design, its thoroughness of construction and test, and its sensitive means of regulation. Two means of regulating the pendulum are provided: (*a*) by small weights on a pan attached to the pendulum rod and (*b*) by a rheostat control

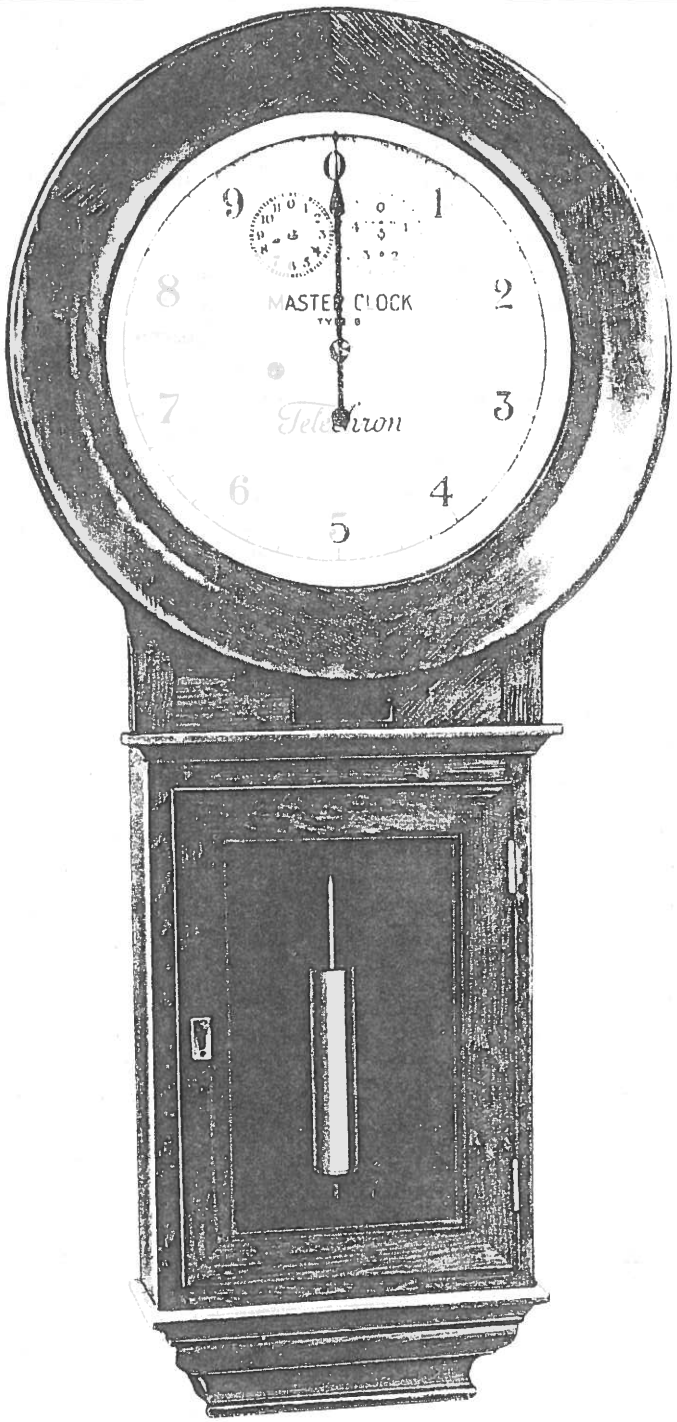


Fig. 4. Front View of Telechron Type "B" Master Clock

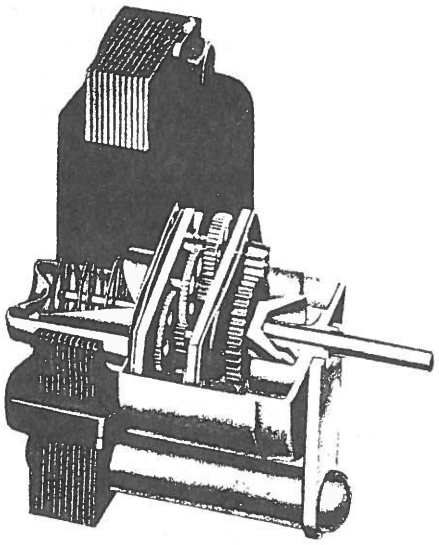


Fig. 3. — Cutaway View of Telechron Type "B" Motor

of a magnetic field through which a permanent magnet in the base of the pendulum bob passes. By the use of either or both of these methods excellent time keeping may be obtained.

In order to maintain absolute accuracy, the timing of the pendulum controlled clock movement should be checked daily with the radio time signals broadcast by the United States Naval Observatory at Washington, D. C., or by some other reputable astronomical observatory. In this manner, the time standard of the clock may be kept correct at all times.

In addition to the Type "A" Master Clock, a second or Type "B" Master Clock has been developed for use in small generating plants or in sub-stations which may or may not be continuously connected to a larger system and which will not require the larger Master Clock. The Type "B" Master Clock, shown in Fig. 4, operates on the same general principles as the larger Master Clock. The escapement is the same as in the Type "A" Master Clock except that the pendulum makes 80 instead of 60 beats per minute. The pendulum rod is constructed of invar, which eliminates variations due to temperature changes, and correct timing is obtained by varying small weights on a pan attached to the pendulum rod. Like the Type "A" Master Clock, the clock spring does not require rewinding, after having once been wound, as long as the Telechron Motor has been in constant operation.

In the Type "B" Master Clock, the spring and motor movements both act on the same index hand through suitable gearing. The spring tends to drive the hand in a counter-clockwise direction and the motor in a clockwise direction. If the rates of the spring and the motor mechanisms are the same, the hand will remain at rest. If the average frequency should rise above normal, the increased motor speed will cause the hand to move to the right and vice versa if the average frequency is low. In operation, the average frequency should be controlled so as to keep the hand continually pointing to zero.

The Type "B" Master Clock has an operating dial which is approximately 12 inches in diameter and, in addition, has a small five-minute and a small twelve-hour dial. The hands of the two smaller dials are actuated by the pendulum alone and serve to allow the operator to check the time of the pendulum. The case is furnished in oak and is designed for either wall or switchboard mounting. When a Type "B" Master Clock is installed, it is recommended that a standard Telechron Electric Clock, furnished separately, be mounted within sight of the Master Clock for auxiliary use.

Aside from the decided advantage of standardizing and maintaining a close and accurate frequency for load and interconnection purposes through the use of Telechron Master Clocks, such exact frequency control also allows Telechron Electric Clocks to be connected to any alternating current line energized by such a regulated central station. These individual clocks are operated and kept in synchronism with the station generators through the use of self-starting synchronous Telechron Motors of various types. Such motors, when arranged with suitable gearing, will actuate the hands of any Telechron Electric Clock, regardless of size, so that they will keep accurate time. Telechron Clocks are widely used in homes, places of business, and public buildings. Naturally, Telechron Electric Clocks are valuable load builders and obviously have a one hundred per cent load factor.

In addition, all types of recording instruments, or devices in which time is a factor, may be similarly equipped with Telechron Motors. The advantages of synchronized records requiring no supervision are, as can be expected, very great.

The principal advantages of the Telechron method of frequency control may, therefore, be summarized as follows:

1. A standard of frequency has been set up and a basis for comparing this frequency has been established.

2. A method of maintaining correct average frequency is available with a reduction in the effort and attention formerly required of station operators.

3. A simple and effective means has been established whereby interconnection between systems can be maintained with a minimum of effort.

4. An increase in efficiency can be obtained over the entire system whereby both producer and consumer will benefit through the operation of their electrical equipment at the designed and therefore the most efficient frequency.

5. An assurance can be given to all customers that correct average frequency is being maintained at all times.

6. An increase in revenue can be obtained through the power used by Telechron Electric Clocks for, although the demand per clock is small, the actual load developed will be considerable due to their continuous operation and to the large number which will be connected to the system.

7. An additional sales product has been created for the Merchandising Department and the popularity and advantages of the Telechron Electric Clock have long been proven.

8. A new service, costing the company practically nothing, can be extended to the public and thereby increase that intangible but ever important factor,—customer good will. Such a service will allow a power company to sell Light, Heat, Power, and Time.

The effect of controlling the frequency by means of a Telechron Master Clock is shown on Page 9.

TELECHRON
DEPARTMENT OF GENERAL ELECTRIC COMPANY
ASHLAND, MASSACHUSETTS, U. S. A.

Replacement Field Coils for **SESSIONS** and **HAMMOND** synchronous clock movements. Wining's Clock Service, 2910 Farmdale Rd., Akron, OH 44312 (330) 628-9655

BANGOR Electric Clock Parts, New Factory original parts too many to list separately. Call or e-mail with your needs. Elmer Crum, (727)868-0181, electrichorology@juno.com

"Synchronome Brisbane 1903-1991" The story of the Jackson family of electrical clock makers. An Historical Project by Chapter 104. A 32 page booklet about the operation of the Synchronome Elec. Co. of Australasia. $5.00 Norman Heckenberg, 30 Depper St., St. Lucia, Qld. 4067, Australia

Collection of about 200 electric clocks (50 master, 80 independent, 30 secondary, 20 synchronous, 10 quartz) for $35,000. Details open for discussion. The clocks are in Switzerland. Michel Viredaz, Home +41 21 784 05 38, e-mail viredazepal@bluewin.ch

Glass Domes for the **Tiffany Never Wind** and other early electrical & battery clocks. If I don't have it in stock I'll try to get it. E-mail www.glassdomes.com
Ben Bowen, Rt. 3 Box 134C, Monticello FL 32344, (850) 997-3797 phone & fax.

Electronic "master clock" for old slave dials: $50. "Governor" makes Eureka clocks keep quartz-accurate time with no change to the clock: $95. Voltage regulators: $35 to $55.
Bryan Mumford, 3933 Antone Road, Santa Barbara, CA 93110; (805) 687-5116; www.bmumford.com

D.E.H.O. (German), self-winding, weight driven wall clock. **RECLUS**, French late 19th century battery-driven electric clock. **ARON** system, electrically re-wound, spring driven movement.
See pages 88, 94, and 98 of "150 Years of Electric Horology".
L.A. Seymour (206) 842-5835 seymochla@aol.com.

Sangamo and **Hamilton Sangamo** movements, motors, platforms, and other parts. Send SASE for list. Harvey Schmidt, 75-80 179th Street, Flushing, NY 11366 wwlathlot@AOL.com

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FOR SALE: **SWCC** Western Union, 15-1/2" convex "glass". Actually it is plastic, but it beats a naked dial. $20.00 (I'll pay UPS up to $5.00) Paul M. Hopkins, 2717 Millwood Rd., Birmingham, AL 35243 (205) 967-1237

THE JOURNAL OF THE ELECTRICAL HOROLOGY SOCIETY

CHAPTER #78
NATIONAL ASSOCIATION OF WATCH & CLOCK COLLECTORS

VOLUME XXVII #4, DECEMBER 2001

Fellow Horologists:

It's good news time again, and lots of it! The first item is that dues are due and **still only $10.** How many chapters can lay claim to such a distinction? Thirty years without a dues increase!!! The next item is the annual Mart ad cleanup. The next Journal will have the Mart ads deleted that have not had a request to be continued. Mail new ad copy or request to continue the old one to our chapter Historian and Vice President, Dr. George Feinstein at the address at the bottom of the Mart page. We are proud to announce Dr. Feinstein's appointment as an NAWCC Fellow. Long overdue and well deserved for a hard-working chapter member who has contributed greatly to the chapters success. Hearty congratulations George!

Another word on the subject of Fellow Awards; I believe that we are unique in the fact that **every** officer and director of Chapter 78 holds the distinction of NAWCC Fellow! Our three principal officers along with directors Elmer Crum and H. William (Bill) Ellison have all been honored with this award!

This issue concludes the series on Instruction Manual for Synchronizing Self-Winding clocks with the FC control box. A new two part series covering ATO's Time Distribution system using their Regulators and Receiving Clocks begins, this rare English language pamphlet was provided by our member from Switzerland Michel Viredaz. Many thanks. In addition, a descriptive article about the Secticon clocks rounds out the current issue.

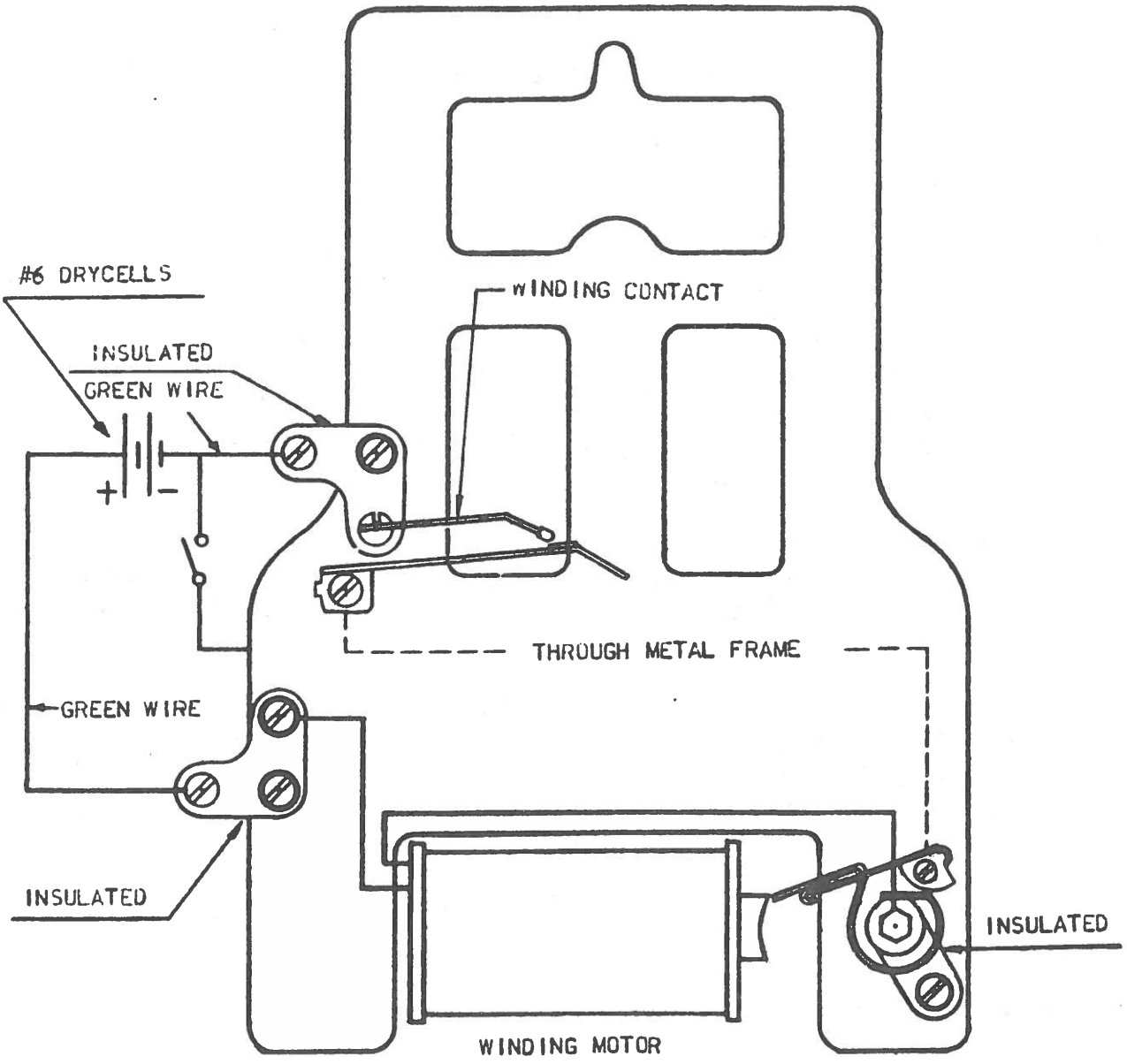
Our quote for this issue comes from Mark Twain: "There are three kinds of lies; Lies, Damned Lies, & Statistics!"

Enjoy this issue. Good reading ahead.

Martin Swetsky, FNAWCC,.....President)
Harvey Schmidt, FNAWCC,.....Secretary-Treasurer) Co-editors
Dr. George Feinstein, FNAWCC..Chapter Historian)

HARVEY SCHMIDT, FNAWCC, Secretary-Treasurer, 75-80 179th ST. FLUSHING NY 11366

Continued from September, 2001 issue.



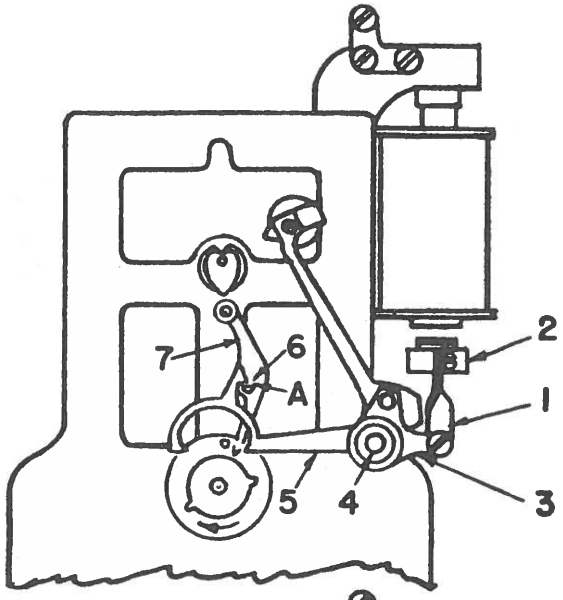
SYNCHRONIZING MECHANISM — FIG. 5-5

SYNCHRONIZING MAGNET IDLE

CONNECTING PIECE (1) LINKS ARMATURE (2) WITH LEVER ARM (3) WHICH IS PLACED ON STUD (4).

MINUTE SYNCHRONIZING ARM (5) IS LOCKED ON PIN (6) OF SYNCHRONIZING LATCH (7) AT ALL TIMES EXCEPT TWO MINUTES BEFORE AND AFTER SYNCHRONIZING TIME.

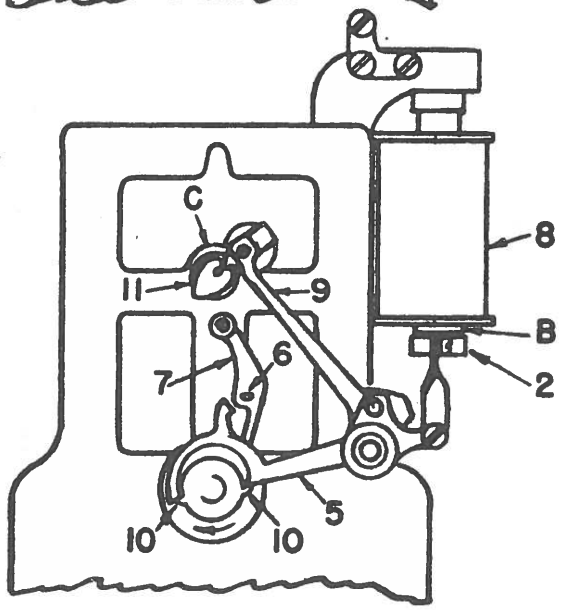
NOTE: 1/64 IN. CLEARANCE AT A



SYNCHRONIZING MAGNET ENERGIZED

SYNCHRONIZING LATCH (7) WITH PIN (6) MOVED LEFT AND UNLOCKED MINUTE SYNCHRONIZING ARM (5).

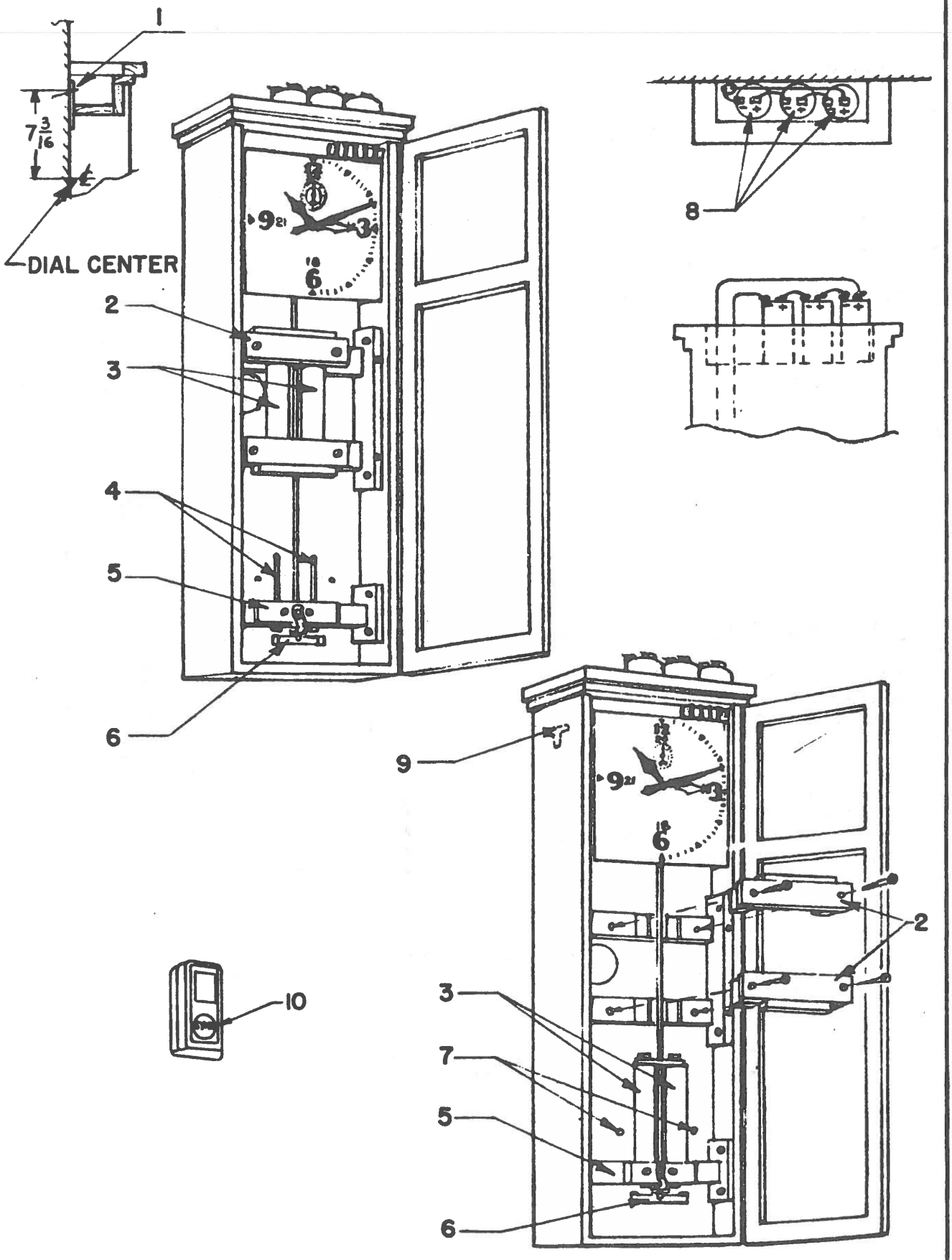
MAGNET (8) PULLS UP ARMATURE (2) WHICH IN TURN PULLS LEVER (5) AND (IN CLOCKS WITH SECOND HANDS) LEVER (9) INTO SYNCHRONIZING POSITION.



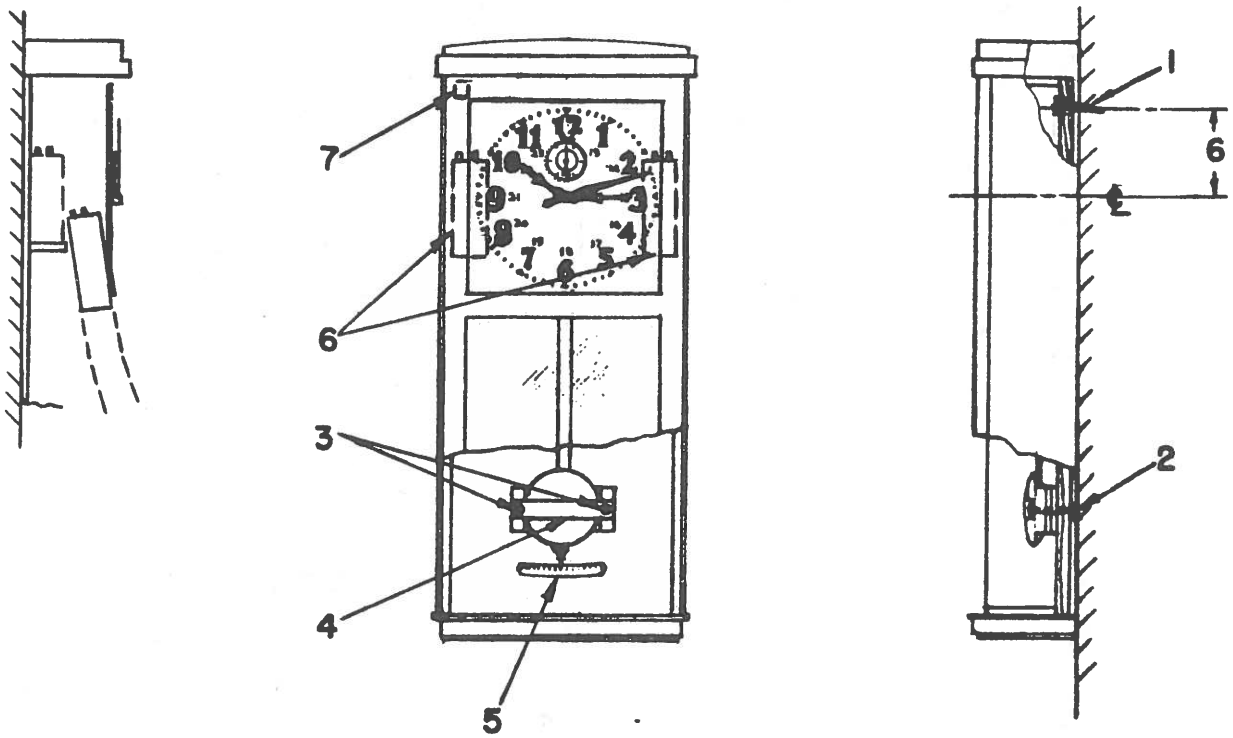
LEVER (5) SYNCHRONIZES MINUTE HAND, PRESSING ON "EARS" (10)
LEVER (9) SYNCHRONIZES SECOND HAND, TURNING "HEART-SHAPED CAM" (11) TO ZERO POSITION.

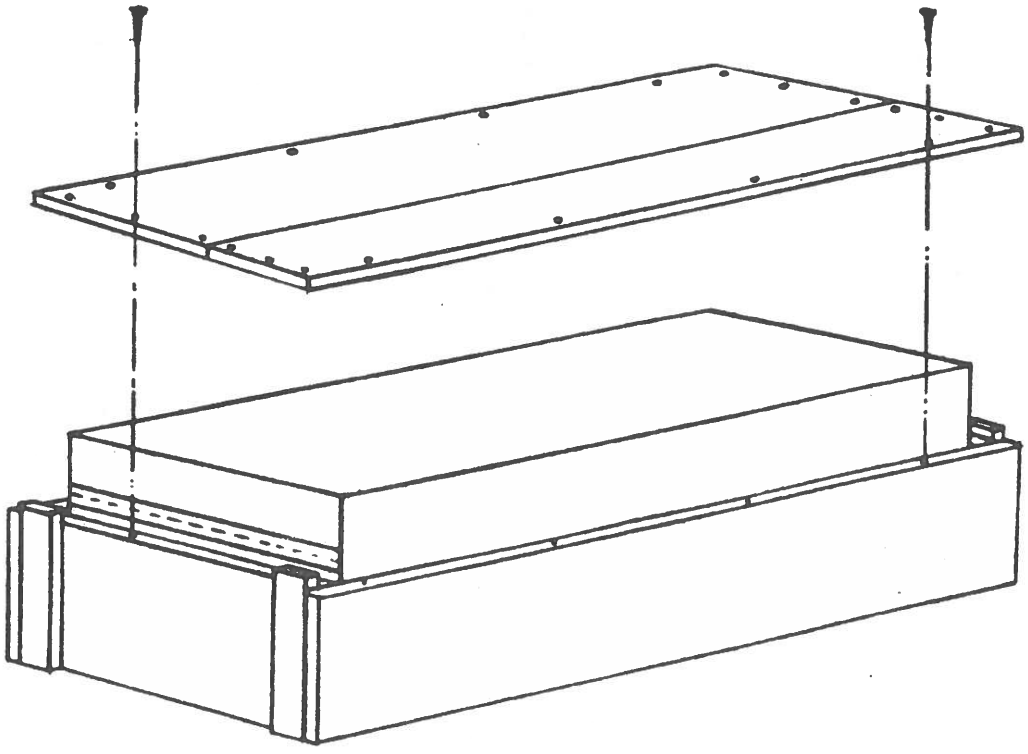
NOTE: .010 IN. CLEARANCE BELOW REAR MAGNET AT B
PLUS, MINUS HALF SECOND CLEARANCE AT C

INSTALLATION OF MASTER CLOCKS FIG. 5-6

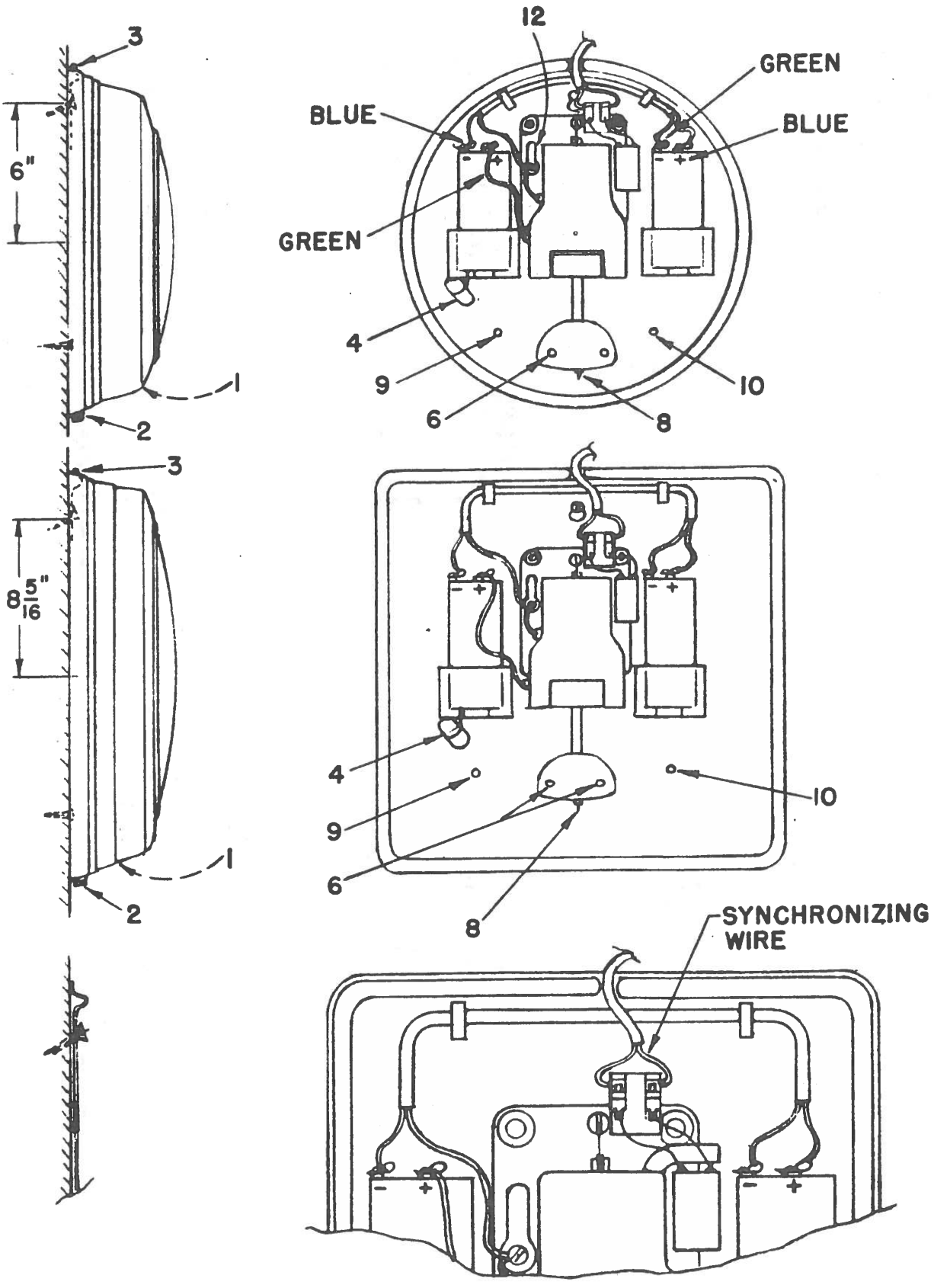


INSTALLATION OF SUB-MASTER CLOCKS FIG. 5-7

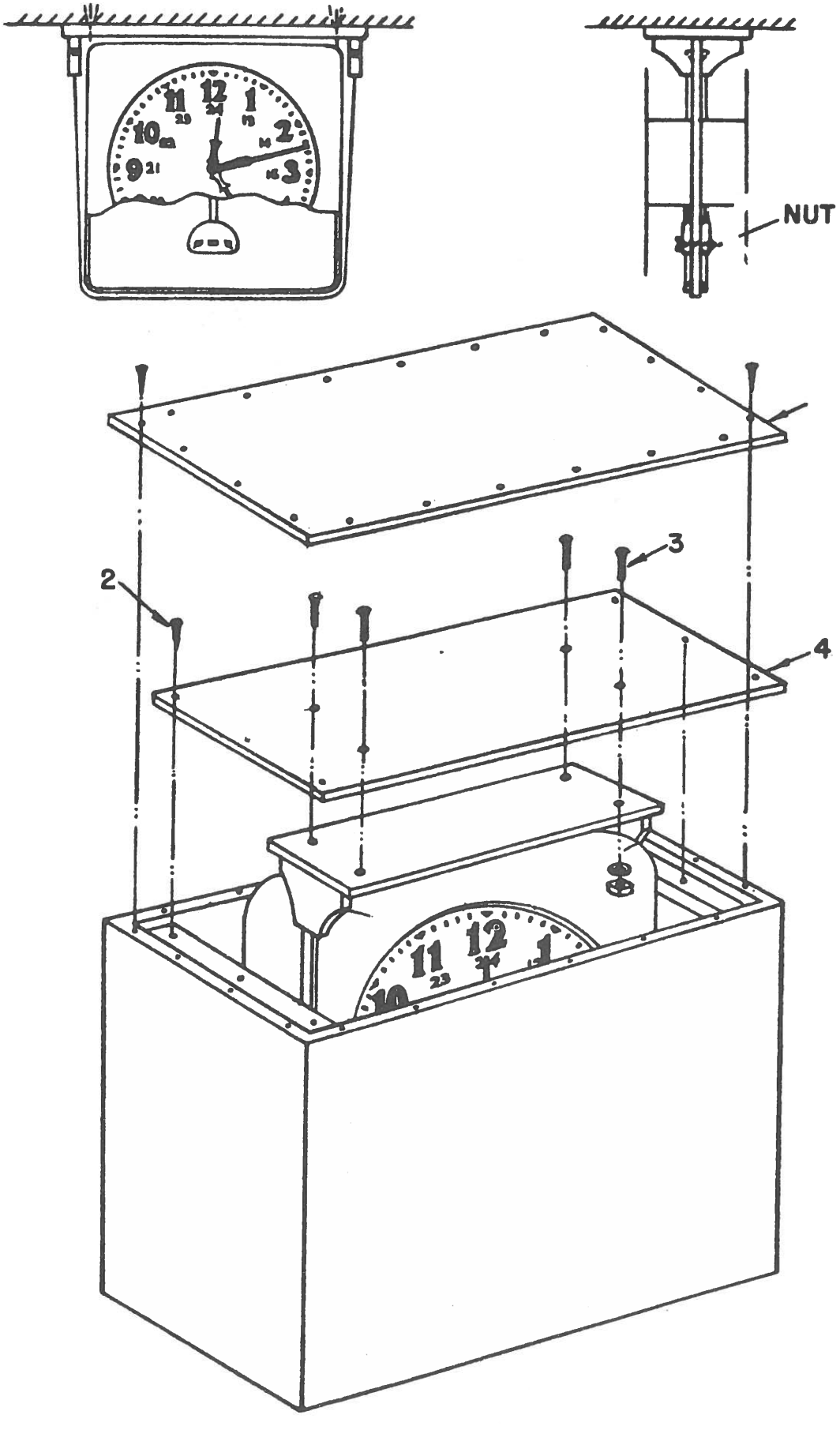




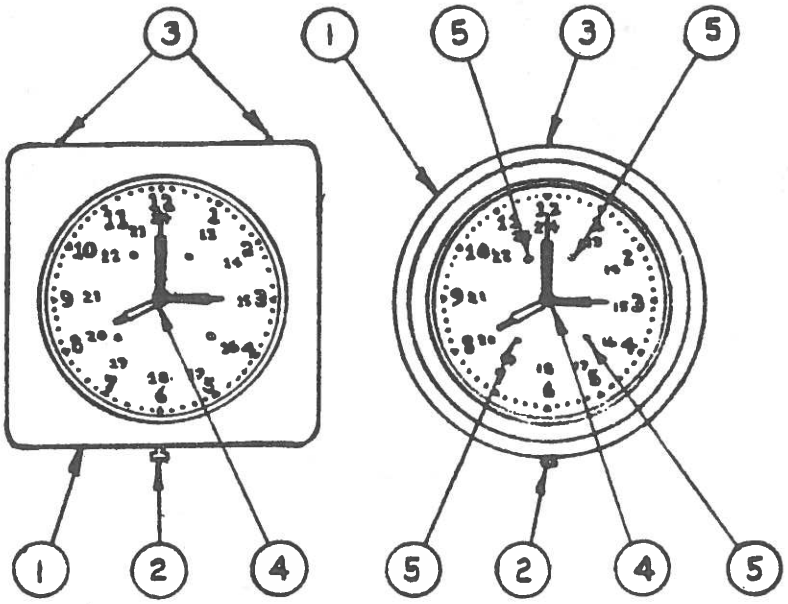
INSTALLATION OF WALL CLOCKS FIG. 5-8

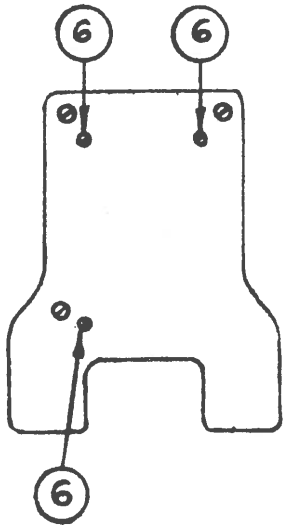


INSTALLATION OF CEILING MOUNTED DOUBLE CLOCKS FIG. 5-9



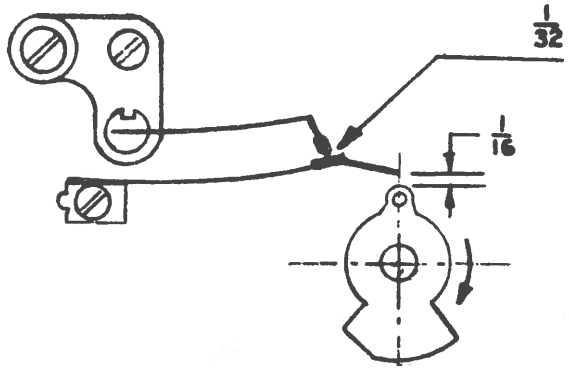
EXCHANGE OF MOVEMENTS FIG. 5-10





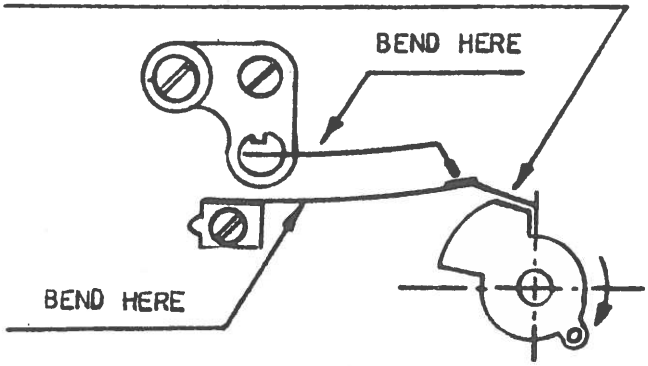
ADJUSTMENT OF HOURLY WINDING CONTACT FIG. 5-11

OPEN
(MAINSPRING UNWINDING)



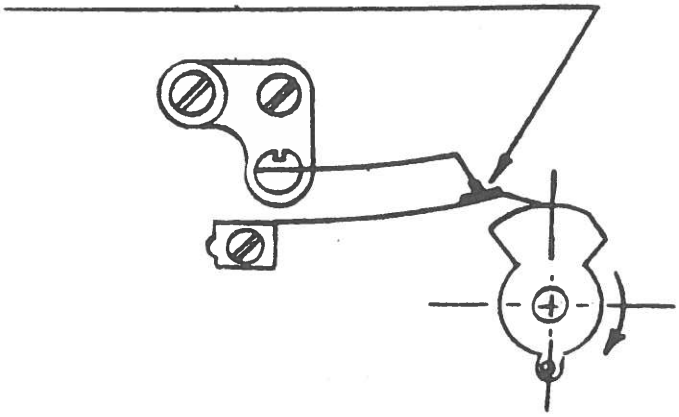
CONTACT - FINGER - TIP EVEN WITH EDGE

CLOSING
(MAINSPRING NEEDS WINDING)

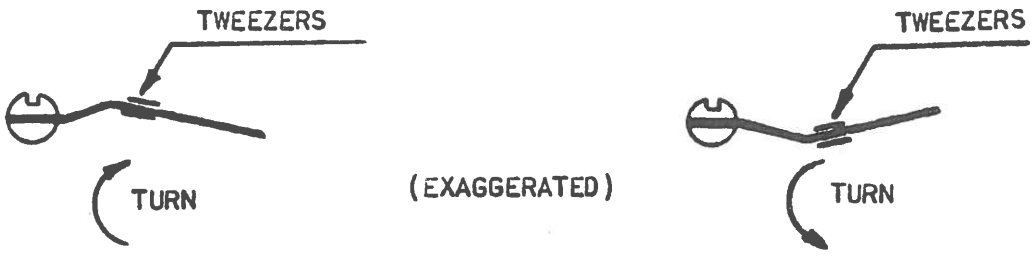


EDGE RESTS SQUARELY ON CONTACT

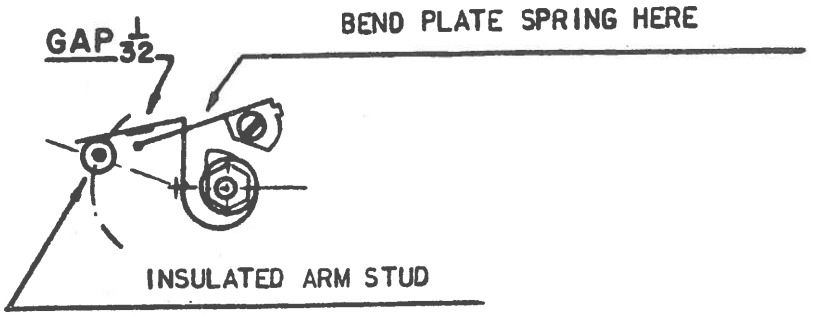
CLOSED
(MAINSPRING BEING WOUND)

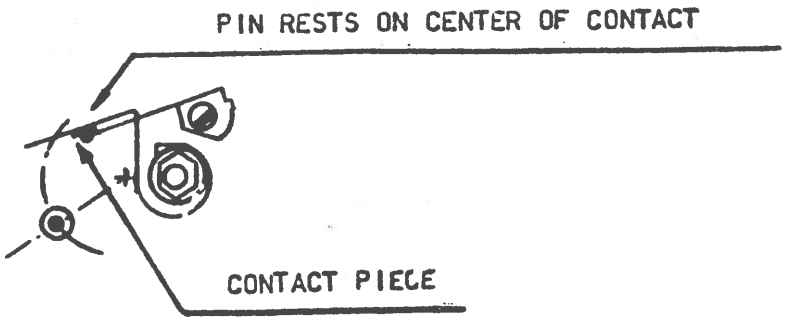


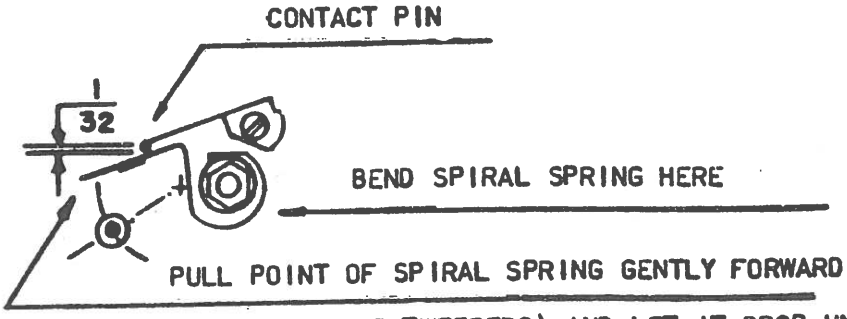
IF ADJUSTMENT IS REQUIRED BEND AS SHOWN



ADJUSTMENT OF WINDING MOTOR CONTACT FIG. 5-12



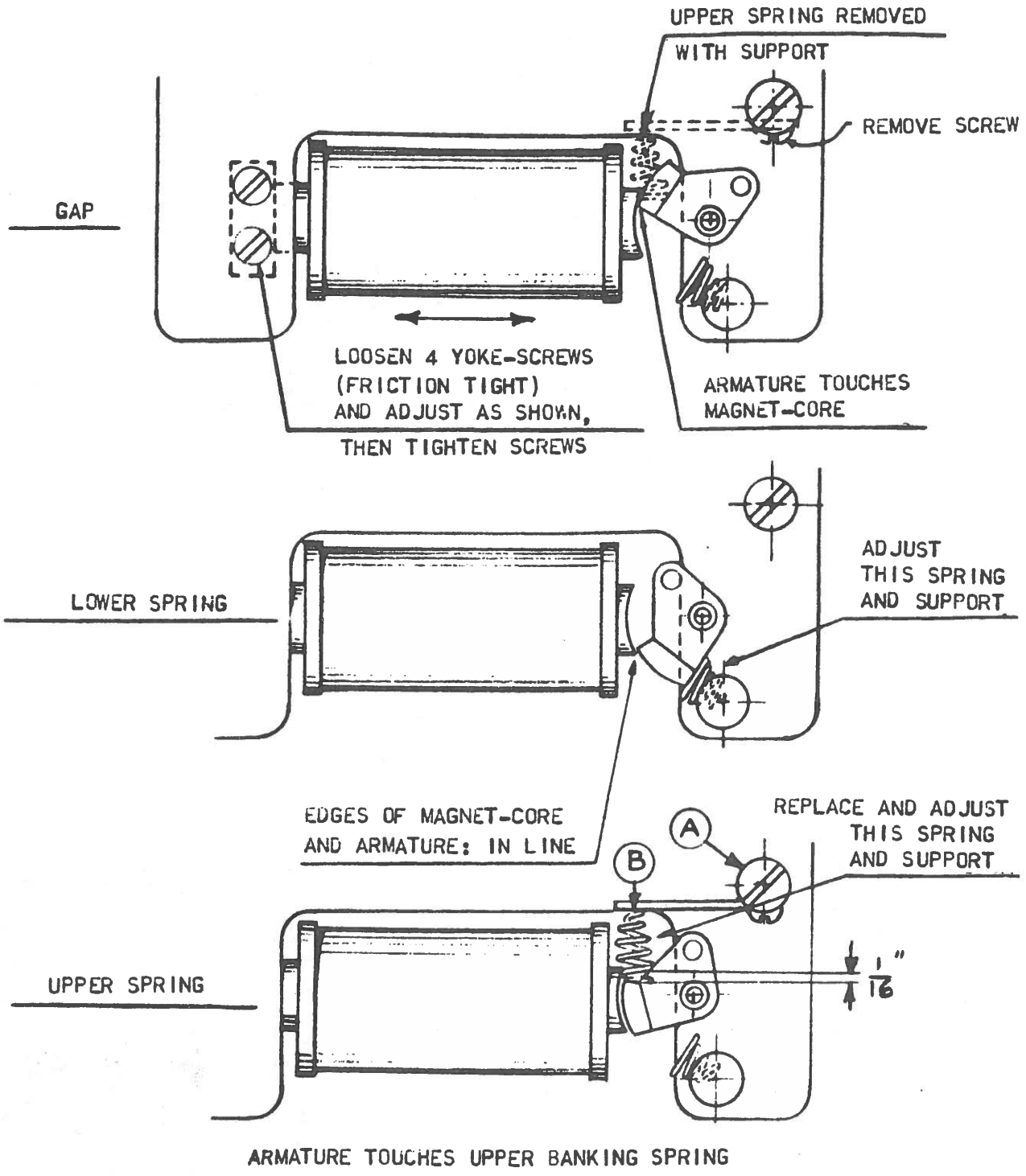




(USING LIGHT PAIR OF TWEEZERS) AND LET IT DROP UNDER CONTACT PIN - ADJUST - AND RESTORE SPRING TO ORIGINAL POSITION.

CHECK SPRINGS ON BOTH SIDES OF CONTACT OVER FULL WIDTH AND FOR APPR. SIMULTANEOUS "BREAK" AND "MAKE".

ADJUSTMENT OF WINDING MOTOR ARMATURE FIG. 5-13



ARMATURE TOUCHES UPPER BANKING SPRING

NOTE:

TO ADJUST UPPER SPRING, LOOSEN SCREWS "A" (FRICTION TIGHT), FRONT AND REAR PLATES AND SET SUPPORT UP OR DOWN. TIGHTEN SCREWS "A" FRONT AND REAR. LOOSEN SCREW "B" AND TURN SPRING SO FLUSH END IS FLAT AGAINST ARMATURE.

TO ADJUST LOWER SPRING, REMOVE AND COMPRESS WITH PLIERS IF TOO LONG. IF TOO SHORT, GRIP LAST TURN WITH PLIERS AND PULL OUT.

Why the Secticon clock marks a definite forward step in the search for accuracy

By F. Marti

The appearance on the market of a new electric clock, known as the Secticon, must be drawn to the attention of watchmakers throughout the world. It is, in fact, a battery-driven electric clock of a degree of accuracy never achieved before.

The development of the Escap movement, with which the Secticon clock is equipped, raised various problems which were somewhat difficult to solve. It is an absolute necessity that a movement which will run without attention for months, or even years, should be of a remarkably high degree of accuracy. The reason for this requirement is as follows : if one is obliged to wind one's wrist-watch or alarm clock every day, one will at the same time note whether it is right, and if necessary make a correction ; in this way the error is corrected daily. For an eight-day clock, and therefore to a much greater degree for a clock such as the Secticon, which will run for more than a year before its battery is exhausted, the error accumulates day by day and may assume proportions sufficient to be troublesome. The problem therefore consisted of developing a movement of such accuracy that it was to all intents and purposes unnecessary to correct the time indication.

To obtain this result, it was necessary to evolve an electrically driven timekeeping mechanism involving no maintaining contacts (which are a prime menace) and to eliminate the effects of the effort necessary to drive the counting train, the size of the hands, friction in the escapement, temperature, and finally variations of battery voltage. This implies the development of :

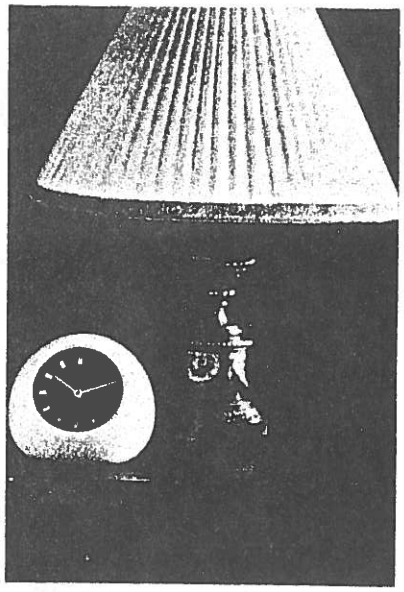


Table model T2

a) a new escapement

b) a miniature transistorised electric motor of high efficiency

c) a special form of regulator of great sensitivity, enabling corrections to rate of fractions of a second to be made

d) a coupling mechanism allowing the count train to be driven at the necessary low speed.

The assembly of the movement consists of three functional units, namely :

— a square plate carrying the wheel train needed to drive the hands and set them to time (Fig. a).

— the motor assembly containing all the electrical parts, the magnetised rotor, the coil, transistor, resistance and central arbor with pinion (Fig. b).

— An escapement unit consisting of an original form of constant force escapement, a balance with Breguet spring, a highly accurate regulator, and a device allowing the impulse arm of the escapement to be re-cocked periodically by the motor unit (Fig. c).

These three units can be assembled without the aid of special tools, and are interchangeable. They thus form separate units which can be obtained readily and changed when repair is required. Fig. d shows the base-plate and escapement units assembled, while Fig. e shows the complete movement as built up from the three units in question ; they are held together by small lever latches.

Repair Service

The unit construction described above simplifies repair and maintenance to a large extent. In fact, small transparent containers have been evolved for the transit of the escapement and motor units, which permits of an easy ex-

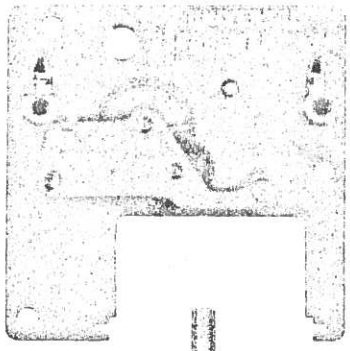


Fig. a.

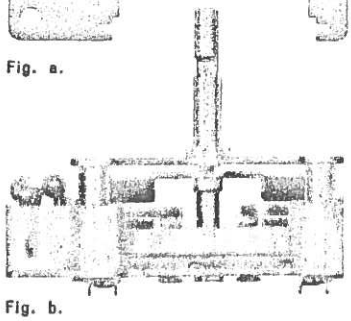


Fig. b.

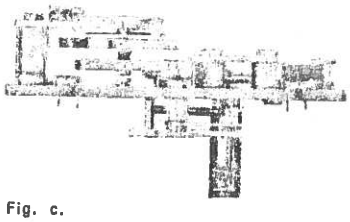


Fig. c.

The Escap movement of the Secticon clock consists of three units. Assembly is effected by small lever latches without need of any tools.

Fig. a) Base plate carrying the wheel train.

Fig. b) Motor assembly containing all the electrical parts, as well as the central arbor with pinion.

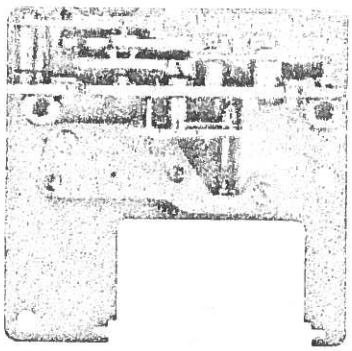


Fig. d.

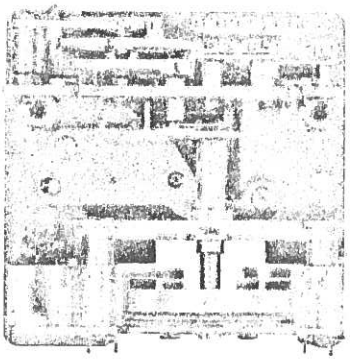
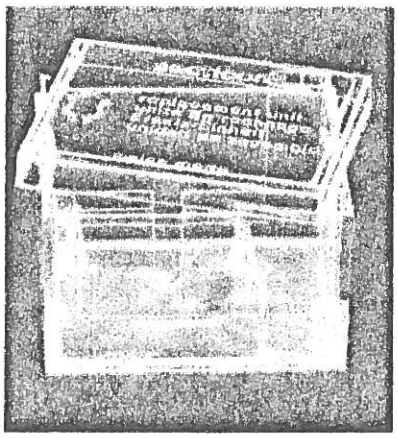


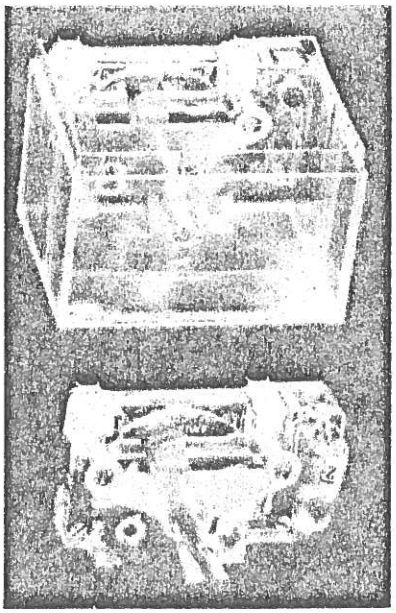
Fig. e.

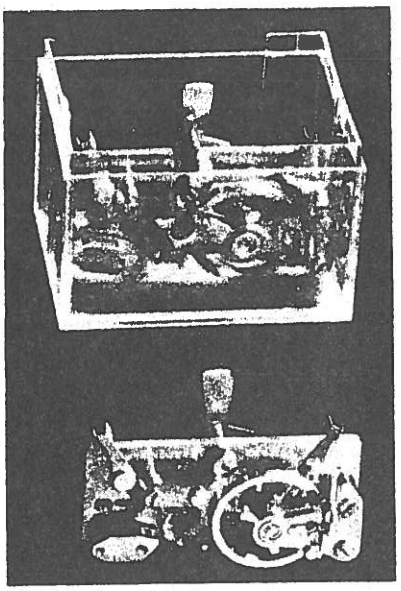
Fig. c) Escapement unit consisting of an original form of constant force escapement, a spring balance, a highly accurate regulator, and a device allowing the impulse arm of the escapement to be re-cocked periodically by the motor unit.

Fig. d) Base plate and escapement unit assembled.

Fig. e) Complete movement.







Special protective containers have been designed to hold either motor or escapement units of the Escap movement, and are used for shipping spares. Repairers find this very helpful.

change of any defective parts between the retailer and the wholesaler. It should be noted that the third element, namely the plate which carries the wheel train, is a mechanism entirely familiar to all watchmakers. A repairer having a certain stock of containers available will thus be able to overhaul a Secticon clock, restoring it to proper order in a minimum of time, so that he will be able to study the technique of repairing this movement at leisure.

Action of the Mechanism

a) maintenance of the oscillations of the balance.

When the clock is stopped, the movement, and in particular the motor, are disconnected from the battery. The motor is not self-starting ; the transistor which controls the delivery of driving impulse is in its non-conducting state. The motor must be set spinning for the transistor to be able to commence its switching action and a starting lever is provided for this purpose ; this is fitted to the escapement unit. When this lever is actuated the motor will be set spinning and the balance is caused to start oscillating at the same time. The motor will continue to rotate at a speed which is determined by the battery voltage, approximately 1,000 revolutions per minute for 1.5 volts. It revolves continuously until the battery is run down. The motor arbor extends vertically and enters the escapement unit.

The oscillations of the balance and spring are maintained by the periodical release of an impulsing or remontoir spring acting directly on a lever with a special fork. This is not a conventional lever escapement, but a device of complete originality. When the fork has transmitted the impulse of the remontoir spring to the balance it is quickly returned to its initial position by a re-cocking wheel (a kind of escape wheel). This action may be briefly explained as follows :

Periodically, that is to say once per oscillation (and not once per half-cycle), the specially shaped re-cocking wheel is engaged with the motor for a very short time, just sufficient for the wheel to return the lever to its starting position in which the remontoir spring has been re-cocked. The time taken for re-cocking increases as the battery runs down. During this action the balance is completely disconnected from the impulsing mechanism, so that its motion is in no way affected by the decrease of battery voltage.

b) motion of the hands

The arbor of the re-cocking wheel carries a worm which drives a wheel bearing the seconds hand. The motion of this wheel is transmitted to the counting train and motion work, i.e. to the minute and hour hands.

The wheel carrying the seconds hand turns through a certain angle every time the re-cocking wheel rotates to set up the remontoir spring, i.e. once per oscillation (not half-cycle) as in the case of the chronometer escapement. We have observed that this motion takes place while the balance and spring are completely disconnected from the escapement : power is supplied by the miniature motor. The duration of the forward motion of the hands depends only on the speed of the motor and therefore on the battery voltage. This has no effect on time indication, since the seconds, minutes and hours are counted out from the oscillations of the balance and spring. As the latter is not interfered with and receives constant impulse, this movement is fundamentally able to have a high accuracy of performance.

Properties of the Movement

The principles of construction of the Escap movement have enabled remarkable time-keeping performances to be achieved. This accuracy is due to the following necessary conditions being fulfilled in this design :

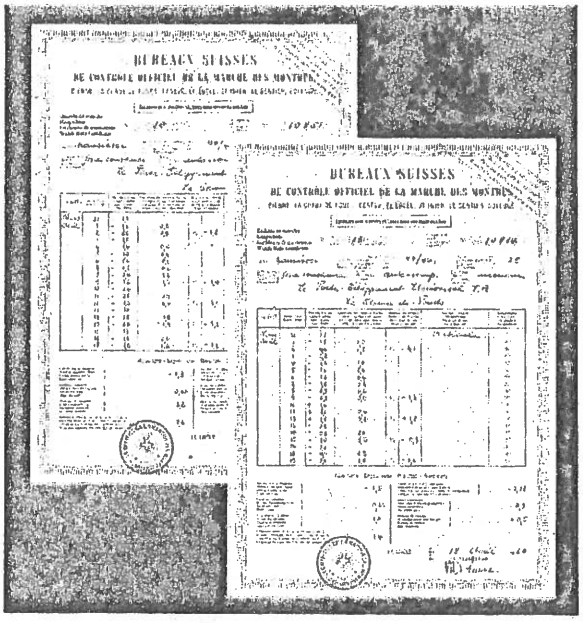
a) great freedom of the balance
b) constant amplitude of oscillation, independent of the battery voltage, imperfections of the wheel train or the escapement
c) elimination of maintaining contacts by the use of a switching transistor
d) possibility of very close adjustment of the period of oscillation of the balance and spring, thanks to the provision of a special regulator enabling corrections of rate of fractions of a second per day to be made.

Time-keeping Performance

All watchmakers know that the results obtained from a measuring instrument do not only depend on the principles of construction, but also to a considerable extent on the excellence of manufacture of the various components, and the adjustment of their functions.

Only observation of the actual rate of the clock will indicate whether its design is soundly based, and whether the standard of manufacture and adjustment is up to the requirements of competent and conscientious watchmakers.

For this reason, the manufacturers of Secticon clocks have submitted production movements, chosen at random, to the Swiss Institute for official watch timekeeping tests. It is most interesting to compare the results obtained from two genuine production movements with the limits required for the award of a certificate, with mention.



The new transistorised Escap movement used in the Secticon allows of exceptionally fine adjustment. Thus, two production movements chosen at random were awarded a certificate with mention "Especially good results" by the Swiss Institute for official timekeeping tests.

Test	Results of Observations		Limits for Obtaining Certificate with Mention
	(seconds)		(seconds)
Mean daily rate	— 1,9	— 1,5	— 2,0 to 6,0
Mean variation	0,66	0,36	1,5
Greatest variation	2,2	1,0	2,5
Difference between 1st and 7th day at 20° C.	2,6	1,4	5,0
Variation per degree C.	+ 0,01	— 0,18	± 0,20
Middle temperature error	+ 0,4	— 0,9	± 3,0
Return to rate	+ 0,2	+ 0,5	± 2,5

Technical Characteristics

Design of movement :	Three interchangeable units (wheel train, motor and escapement) secured by lever latches.
Width of movement :	44 mm
Number of jewels :	7
Shock absorbers :	Incabloc
Balance :	Nickel silver, without screws.
Balance spring :	First quality Isoval, for precision time-keepers ; thermoelastic coefficient of system ± 0.2 sec/day/degree C.
Type of escapement :	Constant force, electrically driven.
Miniature motor :	Continuous rotation, transistor commutation.
Maximum length of hands :	
(without centre seconds hand)	180 mm (width : 6 mm)
(with centre seconds hand)	70 mm
Source of power :	Standard 1.5 volt battery
Annual power consumption :	1.8 ampere-hours.
Duration of run :	15 to 18 months with battery 32 × 60 mm.
Guarantee of quality :	The Secticon clock was developed by the manufacturers of the Incabloc shock absorber.

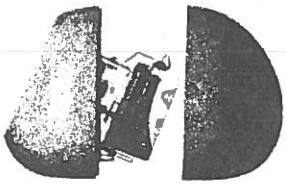
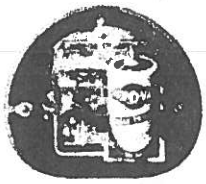
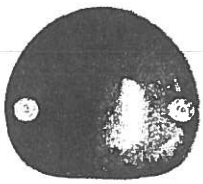


Table model T2 open : Side



Front



Back

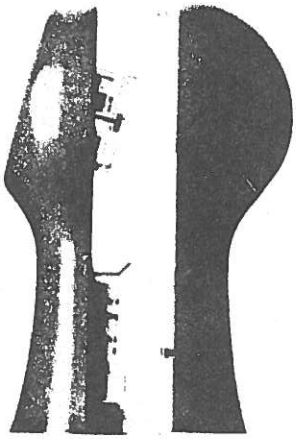
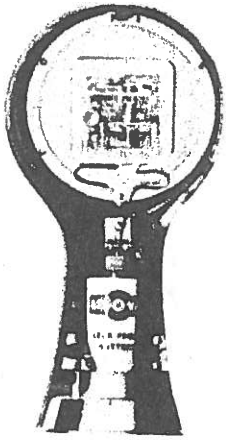
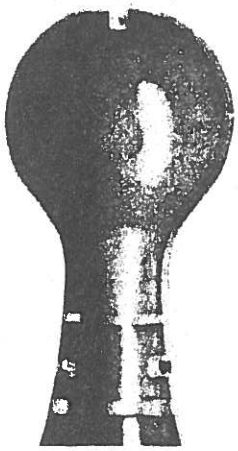


Table model T1 open : Side



Front



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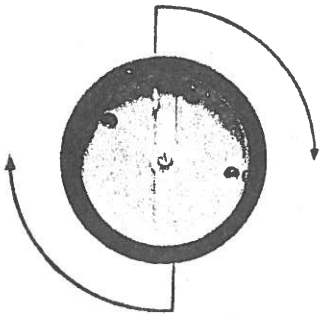
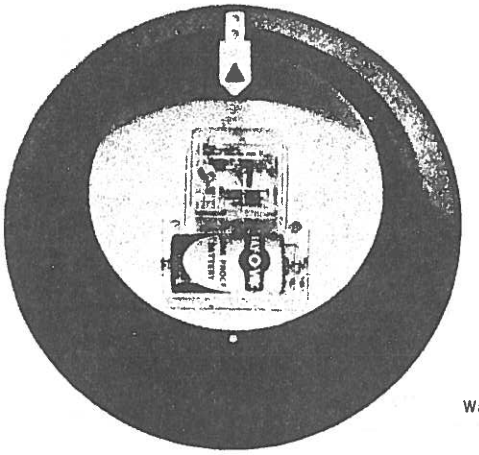


Closing device of the table model T1



Wall model M1 seen from the back

Conclusion

The Escap movement and the forms in which the Secticon clock are presented constitute a very real advance. However, this is not all ; new manufacturing techniques have been developed so that the cost of the finished clock is not excessive and within the range of a wide section of the public.
The Secticon clock thus fills a definite need at the present day : it makes available to everyone a time-keeper of a new order of accuracy, in a presentation that fits in with both classical and modern styles of room furnishing.

To be continued.

PAMPHLET III

ELECTRIC ATO CLOCKS

TIME DISTRIBUTION
BY MEANS OF
THE "ATO" REGULATORS
& RECEIVING CLOCKS

The high precision " ATO " Regulator has been specially studied in view of affording, in connection with clocks, the most interesting results for the distribution of time in Hotels, Offices, Workshops, etc.

Only one regulator, fed by a single battery, and fitted with a very simple special arrangement, regulates all the clocks, and makes them share the regularity of its working.

The setting up does not require any technical knowledge, and can be made by a non-specialised electrician.

It is cheaper than any other system, firstly because of the extremely low price of the clocks, and secondly because it does not require any accessories, costly branchings or supplementary expenses such as electric relays, shunts, connecting roses, a battery of accumulators, etc. It is therefore interesting, even for middle-sized and small premises.

It is evidently of a primary interest for an Hotel, for instance, to be able to fit each room with an elegant clock, matching the furniture, keeping the exact time, which needs no winding and can, by the position given to it, avoid being handled by the residents.

It presents the same interest for Offices, Workshops. etc.

The "ATO" models, include specially some absolutely TIGHT clocks, which are able to work regularly in places either dusty, damp or full of noxious vapours, such as cellars, sculleries, bath-rooms, stables, laboratories, etc...

Bankers, Stock-brokers, Exchange-brokers are able, with only one regulator working three or four clocks, to know the exact time from the principal exchanges...

At home , the " ATO " Regulator, placed, for instance, in the hall, regulates the receiving clocks distributed in the bed-rooms, dining-room, kitchen, etc... the mechanism of which may be decorated in the most various styles, or fitted in the bodies of old clocks.

All receiving clocks show the same accuracy as the master clock, give the same time, and work continuously without the inconveniences of other receiving clocks, the hands of which jerk noisily.

To sum up, the distribution of time by means of the " ATO " system shows the latest progress of science applied to everyday life. It is interesting to all those who, for some reason, like to have whether in business or at home, accurate time distributed in a great number of rooms.

DIRECTIONS FOR THE FIXING

1. SKETCH OF THE FIXING.

A sketch of an " ATO " installation for time distribution is given in fig. 1.

It includes a regulator with a pendulum beating the1/2 second, connected to the time receivers by means of a tube containing two conductors.

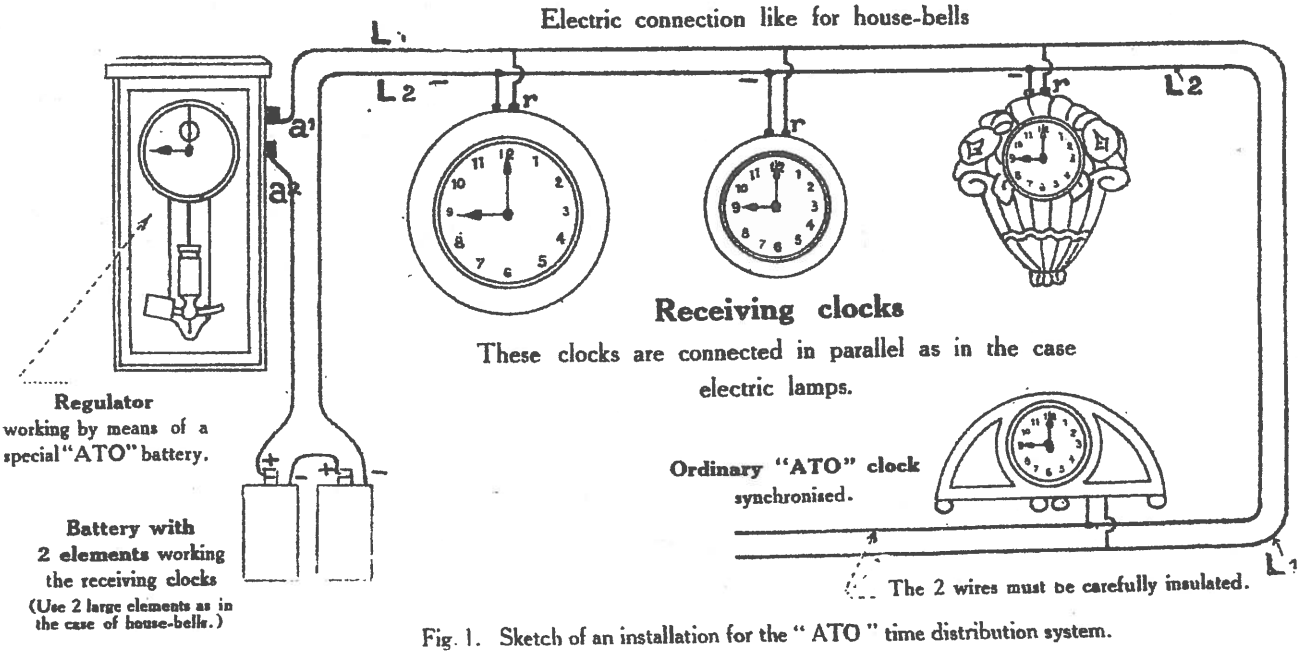


Fig. 1. Sketch of an installation for the " ATO " time distribution system.

2. "ATO" DISTRIBUTING.

The "ATO" regulator works by its own means, with the help of a small "ATO" battery provided with an air depolarizer, which is delivered with the regulator. (For the installation and the starting of the regulator, see directions in Pamphlet II).

The distributing Regulator is provided with two poles *a*1 and *a*2 which are connected with the receiving clocks as explained herein-after.

3. BATTERY WORKING THE TIME RECEIVERS.

All the time receivers are worked by means of a single battery, distinct from the special battery of the regulator. This battery, must give a voltage higher than 2 volts, which is obtained through 2 ordinary elements coupled in series.

For the battery the elements usually employed in the installations of house bells can be used ; these can be easily bought anywhere.

For example two dry elements of good quality measuring about 6 1/4 × 2 3/4 × 2 1/2 inches, (16×7×6 centimetres), are sufficient to work about 10 receiving clocks for two years.

If our customers wish it, we can supply them with very good quality batteries specially suitable for controlling the " ATO " time receivers.

4. BRANCHING OF THE RECEIVING CLOCKS.

This branching is to be made as for a house bell or telephone installation. One of the wires L2 is connected with the negative pole of the battery, the other wire L1 is connected with one of the terminals a1 of the regulator. The other terminal *a*2 is connected with the positive terminal of the battery.

Whatever the distance between the time receivers may be, the 7/10$^{m/m}$ electric insulating wire for bells can be used, but the two wires must be insulated from one another.

Lead covered wire is recommended so as to avoid any trouble which may be caused by dampness.

5. FIXING OF THE TIME RECEIVERS.

The time receivers of the "ATO" system, are provided with two terminals, one of which is painted in red. Before fixing the time receivers, the pendulum must be set free. According to sketch (fig. 1), the red terminal R is to be connected with the wire L1 ; the other terminal is to be connected to the wire L2 connected itself with the negative pole of the battery (Zinc). It is recommended to

take care of the splices so as to have a good electric connection, and avoid all risks of the metal part of the wires L1 and L2 coming into contact, by carefully insulating the bare parts of the wires.

Fig. 1 shows that all the time receivers of the "ATO", system are connected in parallel as lamps in a circuit. One clock can be taken out or added without preventing the remainder from working.

6. SETTING FAST AND SLOW.

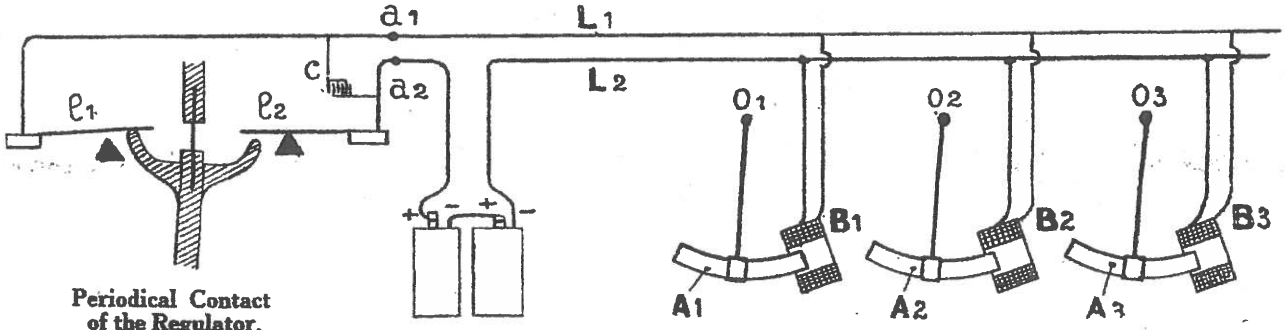
By suitably regulating the Regulator, it is no more necessary to put the time receivers right separately, by acting on the hands.

As it is explained in the Directions relating to the Regulator, the regulation of the speed of the Regulator is obtained by turning a milled part R of the pendulum. This pendulum can easily be regulated so as to slightly advance (for example by 10 to 15 seconds monthly). When after some time the time receivers of the installation advance by more than 1/2 a minute, it is sufficient to cut the current for a moment and to let it flow again when the receivers show the right time.

TECHNICAL DESCRIPTION AND ADVANTAGES SHOWN BY THE "ATO" DISTRIBUTING SYSTEM OVER OTHER SYSTEMS

7. PRINCIPLE.

The sketch fig. 2 shows the principle of the time distribution.



Periodical Contact of the Regulator. Closes every 1/2 second each time the pendulum becomes vertical in both directions.

BATTERY

B1, B2, B3. Coils of the receiving clocks, receiving the current impulses every 1/2 second.

Fig. 2. Principle of the distribution.

The pendulum of the Regulator operates periodically an electric switch connected with the terminals a1 and a2 which can be provided on the side of the Regulator. This switch sends into wires L1 and L2 successive impulses of current supplied by the battery operating the time receivers. The keeping up of the oscillations of the Regulator pendulum is ensured by a special small battery contained in the Regulator.

The contact of the Regulator closes each time the pendulum becomes vertical in its movement towards right and left. Accordingly the current impulses are sent every 1/2 second as the duration of one beat of the Regulator pendulum (to and fro) is one second.

The main mechanism of each receiving clock is constituted by a small pendulum the oscillation of which (to and fro) lasts 1/2 a second. This pendulum is fitted with a special permanent magnet A moving near coil B, which periodically receives the current impulses sent by the Regulator. During each current impulse, all the magnets of the time receivers simultaneously receive the driving impulsions, whereby all the pendulums beat in perfect synchronism.

8. ADVANTAGES OF THE "ATO" SYSTEM.

The "ATO", system shows great advantages over the old arrangements with electro-magnets controlling every minute or 1/2 minute the movement of the hands.

The pendulums of the receiving clocks work like alternativing magneto-electric motors, with a high electric efficiency.

The keeping up of the beat of the pendulums requires a very small mechanical power and the consumption of electricity is much lower than with the system of electros, as the important losses of energy caused by the inertia of the pieces to be displaced and the magnetic

contacts are avoided. The working of the hands is done continuously, without any shock. The working is very safe, as the pendulum remains sufficiently fed for producing beats even in the case of a lowering of 50 0/0 in the voltage of the battery, and of an important increase of the mechanical contacts.

The mechanism of the " ATO " receivers can hardly wear out as all the pieces and gears are only submitted to very small efforts, and they would be able to work even exposed to dust and without oiling. The mechanism is therefore much less delicate then that of some systems with ironwork submitted to strong magnetic attractions, the working of which may be prevented by the smallest piece of metallic dust.

The clockwork of the "ATO " receiving clocks is of small size, and does not require any delicate level fitting.

An intensity of 0.0002 amp. is sufficient to work the " ATO " receivers. Owing to this very small consumption, ordinary batteries are able to feed big installations, thus avoiding the trouble of branching on the general system, with all the complications attached to this branching (emergency batteries of accumulators, make and break arrangements, etc.).

The receiving pendulums being sensitive only at intermittent periods very near their proper period of oscillation, there cannot be any miss or abnormal advances caused by induction current in the wires. The branching can be made very economically by reason of the very much reduced voltage between wires (a maximum of 3 volts) and the very small section of wire necessary. The drop of tension is always to be neglected, the current being extremely low. Owing to this low current, the contact of the master-clock cannot be deteriorated.

In large installations, the use of relays and complicated and delicate apparatus are avoided, the keeping up of which requires frequent and costly visits of specialists;

The hands of the time receivers move continuously, and the working is practically silent. This advantage is specially appreciated at home and in offices, hotels, hospitals, etc.

Owing to their parallel laying down, it is very easy to alter and extend the time distribution without requiring the distribution to be stopped.

9. TRANSFORMATION OF " ATO " ORDINARY CLOCKS INTO RECEIVING CLOCKS.

Instead of working the " ATO " ordinary clocks, with short pendulums, with the small batteries with which they are provided, they can be used as synchronised receiving clocks by means of a distributing " ATO " regulator, of high precision.

The mechanism requires no alteration as the independent " ATO " clocks possess all the parts necessary for their working as receiving clocks, according to the above described principle.

However, when working as receiving clocks, the battery and periodical switch become useless.

Therefore the electric current sent by the Regulator passes directly into the clock coil. But, the two ends of the clock coil are made to be connected on one side with the clock body, and on the other with the large contact blade R1. It is therefore sufficient to

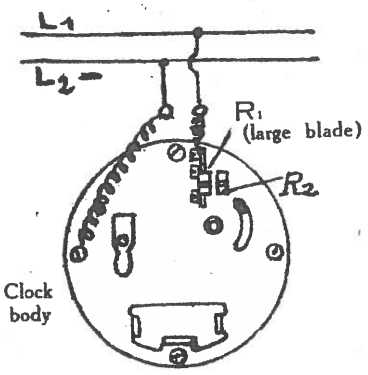


Fig. 3. Connections to be made in order to synchronise an ordinary "ATO " clock.

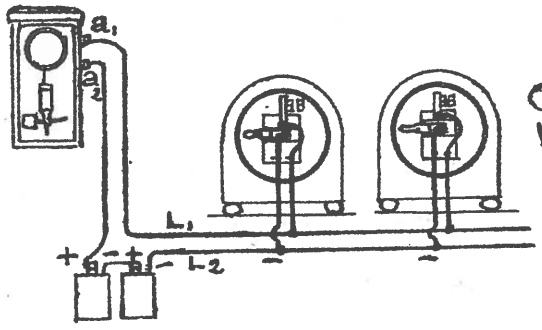


Fig. 4. Sketch of an installation of ordinary " ATO " clocks synchronised by means of a Regulator.

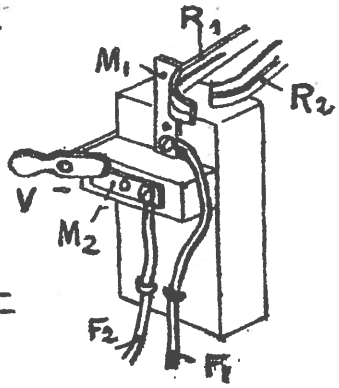


Fig. 5. Switches to substitute for the battery in view of synchronisation.

connect the wire L1 with the large blade R1 and the wire L2 to the clock body, at some point in the metal part of the clock, for instance through one of the fixing screws. The connections can be made as shown on fig. 3. Under these conditions, the pendulum of the clock oscillates according to the rythm imposed by the current impulses sent every 1/2 second by the Regulator.

We also supply our customers with special switches to be used instead of the battery in view of making immediately the connections allowing an independent clock to be transformed into a synchronised clock. (See figs. 4 and 5).

REMARKS RELATING TO THE DISTRIBUTION OF THE TIME THROUGH THE "ATO" SYSTEM

The following directions are intended for those of our clients who are not thoroughly acquainted with electrical matters.

In the installations for time distribution care should be taken against risks of stoppage caused by the carelessness of those using the apparatus. We strongly recommend our clients to follow closely the indications given hereunder which will allow the easy fixing of the apparatus with the minimum risk of stoppage, as the result of either disconnections or short-circuiting.

BRANCHING.—Our installations, even when carried out on a large scale, are made with only one type of electric cable of uniform section. Only few accessories are required for the fixing, and these are easily found in the trade (and we may in any case provide).

We advise to use small lead covered electric cable, with two copper conductors, having each a diameter of about 6/10 to 7/10 millimetre (Wires of 9/10 millimetre can also be used as they are mechanically stronger, but from an electrical standpoint 6/10 millimetre wire is sufficient). This cable, frequently used in telephony is shown on fig. 1. It offers the advantage of better resisting humidity, and is less exposed to mechanical damages than ordinary wires. This cable is fixed by means of clamps P.

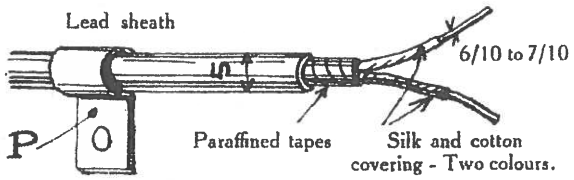


fig. 6.

I.—FOR SMALL INSTALLATIONS OF THE "ATO" SYSTEM

We will take as an example (fig. 2) the case of an installation consisting of a regulator Reg and 4 Receivers P1 R1, P2 R2, P3 R3, P4 R4. The regulator works by its own means, owing to the special battery which is provided at the back of the cabinet.

1° **BATTERY REGULATING THE DISTRIBUTION OF THE TIME.**—The receivers will be actuated by one only battery consisting of 2 elements E1 and E2 branched in series.

Although elements of small dimensions are sufficient, we advise the use of large batteries, similar to those used for ordinary house bells ; the increase in price caused by the installation is very small, and large batteries last always longer. Dry or wet batteries can be used indifferently. The latter offers the advantage of being able to be recharged indefinitely, but care should be taken to add water in the vessels, from time to time, to compensate for evaporation, and further, to see that the salts by creeping, do not corrode the wires connected with the terminals. To avoid this in small and medium installations we recommend to use our special dry batteries of large capacity, particularly suitable for time distribution. If wet batteries are chosen, we recommend the Fery batteries, which are depolarised by air.

Battery E1 E2 should be placed with advantage on the top of a cupboard, and not on the ground, as it is necessary to avoid touching the wires when sweeping or dusting the walls.

2° **LAYING DOWN THE CABLES.**—The lead covered electric cable shown in fig. 7 should be laid down without taking any notice, at first, of the connections of the clocks with this cable. This work can be done by any ordinary electrician.

Fig. 7 shows diagrammatically the branchings to be laid down. A first lead of cable C1 connects the regulator to the battery E1 E2. A second lead C2 connects the regulator Reg to the nearest receiver P1 R1. The leads C3 and C4 interconnect the receivers. In some cases, so as to economise the cable, it may pay to feed the receiver by means of a derivation connected to an intermediate point on the branching connecting two receivers. This is shown on the sketch as the receptor P4 R4 is fed by the cable C5 going from this receptor to point D on cable C3, selected so as to reduce the length of cable required to a minimum.

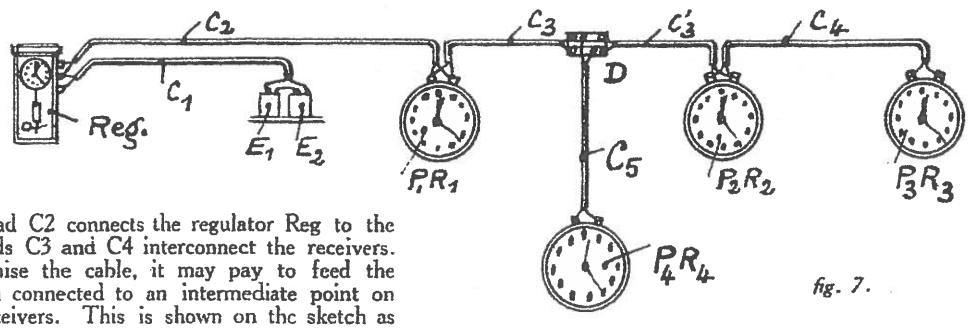


fig. 7.

In the preparatory work for the laying down of the cable, extra length of cable should be allowed at the points where the cable is to be connected to the clocks.

We shall now explain in detail the best method of making the connections which have been described in Pamphlet III fig. 1 and 2.

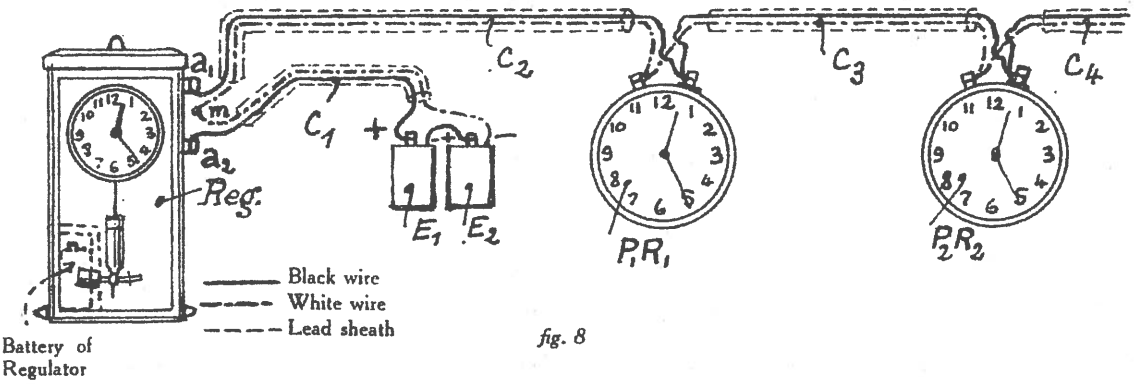


fig. 8

In order to utilise only one cable with two conductors and thus reduce the number of joints, we recommend to fit the apparatus as shown on fig. 8. which is theoretically the same as fig. 2 in Pamphlet III.

3º **CONNECTING THE REGULATOR.**—The regulator should be first fixed up and set to work by means of its special battery. (according to directions on page 12). It is essential that the regulator should be well set.

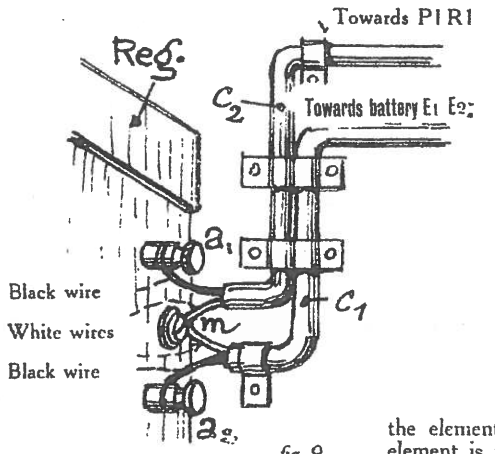


fig. 9.

The cables C1 and C2 connecting the regulator with the battery P for distribution of the time, and with the first receptor, should be connected as shown on fig. 9. The regulator is provided with terminals A1 and A2, which end, in the interior of the apparatus, at the contacts for distribution of the time, as shown on fig. 2, Pamphlet III.

Each cable C1 and C2 contains a white and a black wire. The black wire of the cable C2 is to be connected to the terminal a1. The white wires of both cables are to be interconnected. To make this connection easier a terminal is provided on the cabinet of the regulator, under which it is sufficient to tighten the ends of the white wires. It is advisable to protect by means of an insulating tube the black and white wires coming out of the lead sheath, as the cotton coverings are not sufficient protection.

Cable C1 ends at the casing containing battery P composed of the two elements E1 and E2 branched in series. The black wire of cable C1 is to be connected to the positive pole (carbon) of the element E1 ; the negative terminal of this element is to be connected to the white wire of the cable C1.

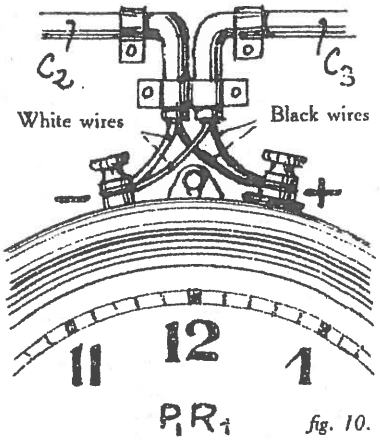


fig. 10.

4º **CONNECTING THE RECEIVERS.**—This connection can be made as shown on fig. 10. (This arrangement prevents the occurrence of soldered derivations, or the use of a rose of derivation). The sketch shows cable C2 connecting the regulator to the first receiver P1 R1, and cable 3 connecting this receiver to the second receiver P2 R2.

The black wires of both these cables are united and tightened under the positive terminal of the receiver (insulated terminal). The white wires are tightened under the negative terminal (connected with earth). We recommend to protect either by means of insulating tube or of ribbon the part of the wires which is not lead coated.

The receiver P2 R2 should be connected in the same way.

This mode of connecting is of special advantage when several receivers almost in a straight line can be interconnected.

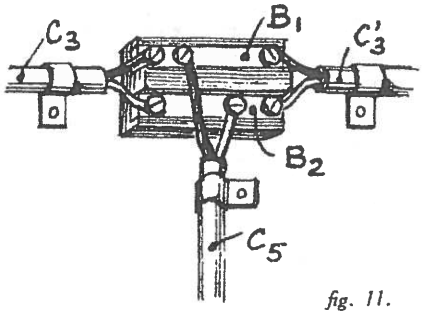


fig. 11.

5º **DERIVATIONS.**—In the case shown, where receptor P4 R4 is fed by cable C5, the connection of cables C3 and C5 can be made as shown on fig. 11.

Use can also be made of roses of deriviation frequently utilised in the branchings for light.

In the arrangement fig. 11, one of our parts for derivation, composed of two brass plates B1 and B2, is fixed on an insulating support, Each plate is provided with three screws to which the ends of the cables are connected as shown on the figure. When fixing, care should be taken that the white wire of the cable C5 should be insulated from plate B2 on top of which it passes. To that purpose protect it by means of insulating tube or ribbon.

To be continued.

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