B4

AIRWAYS ENGINEERING BULLETIN

AIR TRAFFIC CONTROL ENGINEERING SECTION

ACTC BULLETIN NO. 2

# TIME PRESENTATION SYSTEMS

B4

FORWARD

It is intended that this and other bulletins will introduce to regional staff and others concerned, a brief outline of new equipment about to be put into service. Regional staff are not always informed at the innovations which arise from Head Office planning and development, and frequently find their first contact with new equipment is its appearance on a facility schedule or its mention in the AEWCC lists.

The general background information included in these bulletins, should afford clearer understanding of the role of new equipment, together with appreciation of the engineering effort involved in its installation and maintenance.

# TIME PRESENTATION SYSTEMS

## INTRODUCTION:

The original clocks used by operations staff for air traffic control and communication purposes were of several types. Those used in communication centres were generally of the twenty-four hour spring driven wall type with a sweep seconds hand. Smaller clocks with similar appearance were used for mounting in ATC consoles.

2. As the number of positions where time was to be presented increased, it became clear that, rather than employ an increasing number of independent time pieces each indicating perhaps a different time, a common system with all displays locked to a single source, should be introduced. A master clock controlling the required number of slaves for each centre was the obvious choice for a system to be generally adopted. Master clocks and slaves were installed at several main centres and their use provided the background for the subsequent specifying of what has become a standard clock system.

3. It is the intention of this bulletin to convey information relating to the whole range of units incorporated in a master clock time system. Items which have been used for some time, and those which are at present being employed are described here along with those which are at this stage something of an innovation to be introduced in the future.

4. The units described in this bulletin are set out below :-

1. Master Clocks
2. Master Clock Monitor and Distribution Panels
3. Synchronising Panels
4. Slave Clocks
5. Time and Date Stamps
6. Time Injection Units
7. SARTIME Reminder Systems
8. Dual Master Clock with automatic changeover facilities (one only installed in Sydney)

5. The Wagner Master Clock has become the standard time keeping unit for departmental operations. Several "IBM" clocks are in service, but it is intended that these be replaced as convenience permits and replacement Wagner clocks came to hand.

6. The introduction of a satisfactory master clock monitor and distribution panel, has made system installation and setting up much more convenient; it removes the need to open clock cabinets to effect relay adjustments or other minor service acts. As indicated later on, clock movements are to be maintained by means of replacement at fixed intervals. A Master Clock once correctly set up and regulated, should not be touched except when the movement is removed for maintenance.

7. At some centres, it is proposed that two master clocks be installed. Each of these will be connected to a separate slave system with slave clocks so positioned that at least one clock connected to each master clock will be in view from any operator's position. By this means, it is intended that continuity of time keeping will be greatly enhanced.

8. Slave Clocks

Slave clocks are of various types, some for wall mounting and others for console mounting. A number of ornamental twelve hour dial slave clocks have been provided for use in passenger terminals.

9. Time Injection Units

Time Injection Units are used to record time signals on aerodrome tape recorders, and so relate any portion of a tape recording with the instant of its being recorded for the purpose of analysing the events surrounding an air incident or air accident.

10. The types of Time Injection Units in service at present, generate time signals in morse code at minute intervals; those in process of being purchased, provide time signals in spoken tones and thereby make recognition on play-back much easier.

11. Reminder System for Search and Rescue

The SARTIME reminder system referred to makes use of the progressive minute by minute switching functions included in the Voice Operated Time Injection Unit. These switching functions may be exploited by providing externally connected digital thumb wheels on which may be pre-set a series of "SAR" reporting times in twenty-four hour display form. As time progresses, coincidence with each SARTIME will cause the ringing of a warning bell to advise A.T. Controllers that the appropriate SARTIME has been reached.

General identifications and descriptions of the various time system units are included in the following chapters.

## 2. GENERAL

### 1. Master Clock, Wagner

While the basic clock movement of the master clocks has remained unchanged, several variations have arisen over a period of years. These have been evolved for the purpose of making easier the tasks of Installation, synchronising, and maintenance. Master clocks now fit into three types (1) Those of serial numbers 1 to 24 AC wound clocks with all slave operating relays and distribution terminals contained in a single clock case.

(2) Those of serial numbers 25 to 36 which are also AC wound, but include the slave operating relays and distribution terminals in a separate box connected by cable and plug to the main master clock cabinet.

(3) Those of serial numbers 37 and above are designed to be used with a Monitor and Distribution Unit described further on. The monitor and distribution unit contains all the slave operating relays and the distribution line terminations to which are connected small monitoring slave clocks. This unit also contains a built in master clock monitor with associated alarm circuits and a series of distribution line control switches which may be used for stepping slave clocks independently from master clock control pulses so that correct synchronising of all slave clocks may be readily effected. Master clocks above SN 37 are D.C. wound and require no A.C. connection of any sort for their operation.

2. Monitor and Distribution Panels

Type I monitor and distribution panels are essential adjuncts to master clocks SN 37 and above, and these clocks cannot be operated without the addition of one of these panels.

Types 2 and 3 monitors are designed to serve as additions to master clocks already in service (SN8 1-34). These master clocks are capable of independent operation irrespective of whether a monitor panel is connected or not.

3. Monitor and distribution panels have been ordered for all clocks of all types purchased to date. When these came to hand, it will be possible by the use of the different types of monitor and distribution panels for each type of master clock, to bring all master clock systems up to a standard of uniformity, both in operation and appearance. Minor differences exist in each type of monitor to match those of the particular type of clock with which they are to be associated. These differences are small and relate mainly to wiring connections. The three types of monitor and distribution panels are separately identified to enable the correct unit to be chosen for the master clock for which it is required.

3. Technical Descriptions:

1. Master Clock (Wagner)

The Wagner master clock is of pendulum type, which is fully described in the Master Clock Handbook. The pendulum is actuated by an escapement driven by a chain and weight. Seconds pulses are generated by means of the pendulum operating a set of contacts as it moves from side to side. Minute pulses are derived from a cam system driven under control of the escapement in such a way that the position of the drive weight is restored each sixtieth second. This is achieved by means of a wind-up motor. The action of the wind-up motor on a cam produces minute pulses. The hour hand of the master clock is driven from the minute hand shaft by gears in the normal fashion of clocks. For purposes of operating slave clocks, seconds and minute signals are all that are required as hours are produced in slave clocks by normal progressive counts of minutes. While all Wagner master clocks in service have the same basic pendulum movement, weight wind-up is effected in earlier clocks by an AC motor (SNs 1 - 36), and in later clocks by means of a special DC wind-up motor similar to the typical drive of a slave clock. (SNs 37 and above).

2. A feature of AC clocks is their ability to restore lost minute pulses into the slave system after a loss of AC power for any period up to twelve hours. This feature is described in the clock handbook. As the DC clock relies solely on DC for operation, an interruption to the DC supply will result in loss of time display on all slaves which must be advanced to correct time manually from the master clock time-advance switch. The DC master clock will in the same way as the AC clock, continue operating for up to twelve hours after a power failure. After twelve hours, it would be necessary to restore the drive weight to its original position by hand. This is equally necessary after short duration power interruptions, as the DC motor rewind returns the weight only that distance which it fails in one minute. As the rewind operates only at minute intervals, it is obvious that the drive weight cannot be returned to its optimum position without manual assistance.

3. The accuracy of a properly adjusted master clock is extremely good, and no difficulty is experienced in keeping time to within a few seconds if a time check is made at regular intervals.

4. While it is the responsibility of operations staff to advise technical staff of inaccuracies of time keeping in accordance with the requirements of AOI Gen. 2., it is also necessary for technical staff to keep the accuracy of clocks under frequent surveillance. (This they should do by reference to the standard time signal nominated by operations). Corrections should be made to well regulated clocks by means of the Electro-magnetic control, and the better the pendulum is adjusted, the finer the EMR regulating voltage may be set. The time displayed on a master clock system must not vary from standard time by more than ten seconds.

5. Duplication of Master Clock Systems

Because time-keeping is so operationally important, continuity of service is imperative. It is for this reason, that the duplication of master clock systems has been initiated for various locations. Where duplication is effected, two entirely separate systems are in operation - one master clock serves one group of operational slaves, and the second master clock serves a second group of slaves so arranged that a system "A" and a system "B" slave is visible from each operating position. A failure of either clock system leaves the second system available for immediate use with the minimum of inconvenience. Such is the philosophy of the A and B master clock systems. Unfortunately the benefits arising bring with them certain disadvantages, the worst of which is the sight of two operational clocks flipping over without synchronisation. The remarks in the paragraph on monitor and distribution units indicate how the synchronising difficulty is overcome.

6. Monitor and Distribution Units

Monitor and Distribution Panels perform two important functions.

(1) Monitoring of m/c movement operation is effected by means of a comparator device which rotates a cam wheel when activated by seconds pulses generated from the pendulum. Minute pulses are also fed into the comparator, and the coincidence of the sixtieth second pulse and a minute pulse is detected.

Absence of coincidence produces a "fail" indication, which permits recognition of any m/c clock fault which could effect good time-keeping. Such fault indications may be displayed at any required position remote from the m/c.

(2) The distribution arrangement of the slave clock circuits permits adequate line overload protection by means of circuit breakers fitted with alarm contacts. Each distribution line, minutes and seconds, is connected to a small monitoring slave clock which is used to synchronise slave displays on that line to the m/c. There are two separate distribution lines on each panel - a distribution line meaning a pair to operate both minutes and seconds, that is, four wires.

7. The development and production of the Monitor and Distribution Panel made possible the removal of all master clock slave relays from the main cabinet. This arrangement leaves the m/c movement in a clear uncluttered mounting position in its case, and permits any required relay adjustment to be carried out without opening the m/c clock case or disturbing the movement in any way. The absence of equipment other than the movement in the m/c case, also allows ready removal of the complete clock movement for the purpose of inspection and maintenance. A m/c movement is designed to be removed from its case without upsetting or removing the pendulum.

8. These features make possible the introduction of a regular maintenance contract as described below.

9. While all Wagner master clocks are basically similar, three distinct types are described earlier in this bulletin. It has been necessary to purchase three distinct types of Monitor and Distribution Panels to conform with the m/c's in service.

(1) Panel type I for use with all clocks SHS 37 and above, and are simply mounted alongside the m/c and plugged in.

(2) Panel type 2 designed for m/c SHS 25 to 36. In this clock the existing separate distribution panel is unplugged and the type 2 panel is plugged in to replace it. In accordance with the purchase arrangements (T/S C64/198) the replaced distribution panel is to be returned to the manufacturer, E.S. Rubin and Co., through the stores organisation. This return must be expedited to ensure a constant flow of delivery of panels type 2. The manufacturer recovers items from the replaced panel to produce the new panel, and his price has been negotiated on this basis.

(3) Panel type 3, is intended for use with the earlier A/C master clocks SHS 1 to 24. When panels are attached to these m/cs it is necessary to attach cables by direct termination. No plug is provided. It is also necessary to disconnect the m/c internal relays which should be left in position but no longer used. Details of the method of connection will be found in the appropriate drawing. All relevant drawings for time systems are listed at the end of this bulletin.

10. Synchronising Panel:

(1) In the previous section, mention was made of the drawback of non-synchronised pendulums in a duplicated master clock system. While the device designed to remove this disadvantage is not included in the monitor and distribution panel and is still under test, it may be discussed along with that unit. The circuit employed is shown on the drawing HR 57037 sheets 7-8 now being prepared. The operation of the synchronising panel exploits the use of the EMR for automatic control of the "B" system. Once m/c A is set up and regulated, m/c B should be brought by pendulum adjustment to close regulation with A. When this has been done, the connection to the synchronising panel should be made. The synchronising panel contains two bi-stable relays which are driven independently from minute pulses from each of the two m/cs. Any non-coincidence of minute pulses is detected in the unit and depending upon whether clock B is lagging or leading clock A, so a corrective voltage is applied to the EMR of clock B. This has the effect of gradually bringing clock B to synchronisation with clock A. After fine adjustment the regulation achievable is such that the two pendulums operate with less than a second of time separation. Any variation from standard time by clock A may be corrected in the normal way by manually operating the A clock EMR as necessary. Clock B will continue to follow clock A and will remain in step. To facilitate setting-up adjustments, two electro-magnetic counters with a zero re-set are connected in the automatic EMR correction lines. These by numerical count, clearly indicate the direction of correction being applied and if this rises by more than a few counts, it suggests that further pendulum correction is required before refined control is attempted.

(2) Slave clocks connected to the A and B systems will now display similar time within less than one second. If master clock A were to fail, B would continue operating but automatic EMR would be removed. The effect of this is that B could deviate steadily from standard time by a rate depending upon the accuracy to which it has been regulated without EMR control. At the worst, this could mean a change of perhaps three seconds in twenty-four hours. Once the master clock A is restored to service, master clock B would be brought back to correct synchronisation, in the manner described above. This arrangement presents a very reliable and accurate time keeping system, and will be employed at locations where two clocks are required. However the system, because of supply delay in the provision of synchronising panels, must of necessity be introduced into service gradually. Tullamarine will be the first location to emploit this system, and the Tullamarine clock using an A and B system will be extended to exercise surveillance over the Essendon master clock so that there is no significant discrepancy between time displays on the same operational network.

4. Installation and Maintenance

1. Installation of master clocks should be effected by careful adherence to the details in the master clock handbook which describes the pendulum and clock movement and the care which must be taken in setting up such clocks.

2. A maintenance contract has recently been established with the supplier of the master clocks, E.S. Rubin and Co., Sydney in such form that the contractor will hold a reserve of master clocks movements with a list of location priorities, with airfreight to each location at three yearly intervals, a fully overhauled and tested movement contained in a special carrying case manufactured for the purpose.

3. Upon receipt of a serviced movement, it will be the duty of the receiving station to changeover the movements and return the replaced one to the contractor. Obviously the master clock will be out of service for a short time which this procedure is effected.

4. Full details of the maintenance priority list have not been completed as yet, and therefore cannot be included in this bulletin. The maintenance contract is effected under O/N H.21033.

5. Installation Programme

The installation programme for master clock systems will be established from time to time through the normal documents of AEWCC.

6. Additional Details

| | Stores Descriptions | Ident. Nos. | Nominal Costs |
|---|---|---|---|
| 1. | Master Clocks (Wagner) (E.S. Rubin) | V9/209 | £505 $1000 |
| 2. | Master Clock Monitor and Distribution Panels. Type 1. for clocks SNs 37 and above. | V9/252 | £174 $350 |
| | Type 2. for clocks SNs 25 to 36 | V9/253 | £154 |
| | Type 3. for clocks SNs 1 to 25. (E.S. Rubin) | V9/254 | £174 |
| 3. | Clocks Slave Miniature Minutes only. for use in Master Clock Monitor and Distribution Panels. | V9/242 | £18 |
| | As above. Seconds only. (E.S. Rubins). | V9/243 | £18 |
| 4. | Clocks, Spring Reserve AC wound - Wall Digital (CSA) | V9/236 | £70 |
| 5. | Clocks, Slave Wall Dial with seconds. | V9/210 | £31 |
| 6. | Clocks, Slave Wall Digital with seconds dial (CSA) | V9/237 | £70 |
| 7. | Clocks, Slave Wall ornamental for passenger terminals. 12 hr. dials. (E.S. Rubin) | V9/247 | £20 |

| Stores Descriptions | Ident. No. | Nominal Costs |
|---|---|---|
| 8. Clocks, Slave Console Mounting, Digital with dial seconds. (E.S. Rubin) | V9/197 | £40 |
| 9. Time and Date Stamps Jack-knife, Manual. IBM (CSA) | V9/196 | £59 |
| 10. Time Injection Unit Morse Code Signals (Assman) (Jacoby Mitchell) | Y17/15 | £280 |
| 11. Voice Time Injection Unit. Voice announced time (to be purchased) | - | - |
| 12. Timer, manual set for "RCC" times 0-60 seconds. (E.S. Rubin) | V9/248 | £2 |
| 13. Master Clock (Mechanical Movement Only) for replacement maintenance (Held by E.S. Rubin) | V9/209 | - |
| 14. Case, transporting for above. (Held by E.S. Rubin) | V9/250 | - |

Relevant Drawings.

Master Clock Handbooks
DCA drawings HR 57037

M/C SNs 1-24 - Sheet 1
SNs 25-36 - Sheet 2
SNs 37 above - Sheet 3
Master Clock.
Monitor and Distribution
Units. type I - Sheet 6
(clocks, SNs 37 and above)
type 2 -
(clocks, SNs 25-36) Sheet 5
type 3
(clocks, SNs 1-24) Sheet 4
Synchronising Panel Sheets 7-8.
for Duplicated Systems.
Other Details Sheets - as required.

Date:.....  .....

BLOCK DIAGRAM OF DUPLICATED MASTER CLOCK SYSTEM