DIAGRAM NOTES (ISSUE 1)

concerning

GBW.13690

titled

U.A.X. N.Z. 13R

RINGING, TONES & ALARMS, PULSE DISTRIBUTION & RINGING CODES

GENERAL

The diagram shows the circuit arrangement of the common equipment, which includes Ringing, Tones, Time and Meter Pulses, Alarm and Test Number circuits, as installed in U.A.X. N.Z. 13R Multi-party line units.

The diagram should be considered in conjunction with the following diagrams or their equivalents:-

GBW 13640	Subscribers Line Circuit.
GBW 13650	Discriminating Selector, Linefinder & Allotter.
GBW 13660	Final Selector for multi-party lines.
GBW 13670	Bothway Junction Relay Set.
GBW 13680	Incoming Junction Relay Set.
GBW 13700	Common Services Rack Wiring

FACILITY SCHEDULE

Provision is made for:-

1. The generation of time pulses for forced release purposes.
2. The generation of "S" & "Z" time pulses for metering purposes.
3. The generation of ten different "groups" of ringing code pulses.
4. The generation, by a vibrator circuit, of alternating current suitable for operating a polarised ringer.
5. The generation, by valve oscillators, of tones suitable for use by the New Zealand Post Office.
6. The "pulsing" of the tone supplies.
7. An alarm to denote the failure of the battery charging system.
8. Transmission of inverted ringing and ring tone to the test number to indicate that neither of the following faults exist:-
   (a) Fuse blown.
   (b) Failure of battery charging supply.
9. Transmission of N.U. tone to the test number when one of the above faults exist.

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10. Transmission of N.U. tone to the caller when a ceased, unallotted or temporarily out-of-service number is dialled.

CIRCUIT DESCRIPTION

Outline

The equipment incorporates a vibrator circuit to generate ringing current, and valve oscillators to generate 400 c.p.s. and 900 c.p.s. tones.

A time pulse circuit divides these currents and tones into pulses for their separate applications, and also measures the time allowance for the various alarms.

The time base used for the above timing circuits is a mutually-interacting chain of relays.

A test number circuit is provided, which when called indicates to the calling operator whether or not a serious fault condition exists at the 13R unit.

Detail

1. Machine Start

Relay ST operates when either (a) the machine start wire is earthed by the exchange apparatus.

or (b) the test number is dialled (contact TN2 makes).

or (b) an unallotted number is dialled (contact TA1 makes due to the selector connexion).

ST1 starts the ring tone and overflow tone valve oscillators.
ST2 prepares the time pulse circuits.
ST3 starts the X, Y, Z relay timing chain.
ST4 starts the dial tone, busy and N.U. tone valve oscillators.
ST5 & ST6 start the ringing vibrator.

The various units will now be considered separately.

2. Relay Timing Chain

In order to obtain a time-base for the variety of pulses and delays required, relays X, Y and Z are connected so as to be mutually interrupting.

The relays have comparable characteristics and are connected so that:-

Relay X releases to operate relay Z at contact X1.

Relay Z operates to release relay Y at contact Z1.

Relay Y releases to operate relay X at contact Y1.

Relay X operates to release relay Z at contact X1.

Relay Z releases to operate relay Y at contact Z1.

Relay Y operates to release relay X at contact Y1.

When contact ST3 makes to start the chain, all the relays attempt to operate. Since the three relays are not completely identical one of them operates first and by the second step the above sequence is operating. The relays are timed so that the complete cycle repeats every 250 milliseconds (mS) (see also the inset diagram).

The inductive windings of the relays are shunted by non-inductive windings in order to render the relays slow releasing (see inset diagram) and also to act as spark quenches in order to guard the contacts.

Each relay carries two extra contact units which are connected as follows:-

(a) X2 and Z2 cause the Ringing Code switch RC to step once every 250 mS.

(b) Y2 and Z3 cause the Pulse Distribution switch PD to step once every 250mS.

(c) X3 and Y3 in conjunction with wiper PD2 and bank contact No.24 cause the time pulse switch TP to step once every 6 seconds.

3. Ringing Codes

The Ringing Code switch RC steps once every 250mS.

Every time the wipers are in position 1 earth is connected to the Ring Code Start (A) wire for 250mS by wiper RC1, in order to energise relay PM in the final selector(s).

Wiper RC2 then connects earth to the Ring Code Hold (A) wire for the next 10 contacts (i.e. for 2.5 secs.) in order to hold relay(s) PM.

During this period earth is connected to Ring Code Leads A,D,K,S & U by wipers RC1, 5, 6, 7 & 8 in accordance with the respective codes as determined by the bank wiring.

When wiper RC3 reaches bank contact No.11 earth is connected to the Ring Code Start (B) wire for 250mS.

When bank contact No.12 is reached earth is disconnected from the Ring Code Hold (A) wire and wiper RC3 connects earth to the Ring Code Hold (B) wire for the next 14 steps (i.e. 3.5 secs). During this period earth is connected to Ring Code Leads J,M,R,W & X by wipers RC4, 1, 5, 7 and 8, in accordance with their respective codes as determined by the bank wiring.

A diagram showing the codes used and the duration of the (A) and (B) "Start" and "Hold" pulses is inset on the diagram.

It will be seen that the ringing pulses are spread evenly over the whole cycle, in order to even out the load on the ringing vibrator. The ringing codes are also split into two pairs of five in order to facilitate the use of ten party lines when required.

4. Pulse Distribution Circuit

The operations caused by the stepping (one step every 250mS) of the PD switch wipers will now be considered.

(a) PD1 wiper operates relay RE on bank contacts Nos. 1 & 2, 4 & 5, 13 & 14, 16 & 17 only.

Relay RE operating.

RE1 disconnects ringing current from the test number circuit.
RE2 connects ring tone to the ring tone lead and the test number circuit.

Relay RE releasing.

RE1 disconnects ring tone from the test number circuit and connects ringing current to it instead.
RE2 disconnects ring tone from the tone feed circuit.

The timing will therefore be RE 0.5 sec. operated 0.250 sec. unoperated.

0.5 sec. operated 1.75 sec. unoperated.

(b) PD2 wiper

As the wiper moves over the first two bank contacts relay XB is operated. The relay is released for the next two bank contacts and then re-operated for the following two.

This cycle repeats until bank contact No.22 is reached and relay XB is released. On bank contact No.24 earth is extended to energise magnet TP causing it to take one step with the aid of X3 and Y3. On bank contact No.25, earth is extended by PD2 wiper to the PD magnet via the PDdm springs causing the switch to step quickly to bank contact No.1 again, and the cycle repeats.

Relay XB operating.

XB1 connects overflow tone to the overflow tone feed lead.
XB2 connects busy tone to the busy tone feed lead.
XB3 energises relay PB on its d-e winding via resistor R6 and on its a-b winding via capacitors C7.
XB4 connects N.U. tone to the N.U. tone feed lead via contact PB1.

Relay PB is connected in a circuit so that when XB3 makes, its two windings are in magnetic opposition. The d-e winding is weakened by the resistor R6 and the a-b winding gets the full effect of the capacitor charging currents.

This causes the relay to be slightly slow operating.

Relay PB operates.

PB1 disconnects N.U. tone from the N.U. tone lead.
PB2 disconnects relay PB.

Relay PB releases slowly owing to the charge on the capacitors.

PB1 connects N.U. tone to the N.U. tone lead.
PB2 reconnects relay PB, as long as contact XB3 is operated.

The values of the resistor R6 and the capacitors C7 are adjusted so that four short "pips" of N.U. tone (65mS on, 80 mS off) are given during the period when contact XB3 is operated (0.5 secs). N.U. tone is not connected when contact XB3 is unoperated (0.5 secs).

(c) PD4 wiper

S pulse: On bank contacts Nos. 1 and 13, battery is connected to the S lead (i.e. for 250mS every 3 seconds).

Z pulse: On bank contacts Nos.4 to 10 and 16 to 22, battery is connected to the Z lead (i.e. for 1.75 secs. every 3 secs.).

Bank contacts Nos.2 and 3, 11 and 12, 14 and 15, 23 and 24 are left blank so as to produce a gap of 500mS between successive S and Z pulses.

5. Time Pulse Release Circuit

The operations caused by the stepping (one step every 6 secs) of the TP switch wipers will now be considered.

Single ended wipers are used so that the switch has effectively 50 contacts. Bank contacts Nos. 34 to 50 are however strapped via the TPdm springs to TP magnet so that only 33 contacts are effective. The switch makes one sweep every 198 seconds (approximately).

When earth through a relay TM of a selector or relay set (see paragraphs on "Forced Release") is applied to the time-pulse start lead, relay TA is energised in series with relay TM. This occurs regardless of the position of the switch wipers (excepting of course during the brief "self-drive" period). If wiper TP1 is not on bank contact No.3, then relay TA only operates, the resistance of the 10,000 ohm d-e winding being too great to allow relay TM to operate. Contact TA1 then makes and operates (or maintains) the start relay ST. When wiper TP1 rests on bank contact No.3, the 400 ohm a-b winding of relay TA is connected in parallel with the other winding, allowing relay(s) TM in the selector circuit(s) to operate and hold. When wiper TP1 moves on relay(s) TM which has (have) operated hold directly to the a-b winding of relay TA via the time pulse hold lead.

60 seconds after this has occurred (i.e. ten 6 second steps), wiper TP3 applies earth to the "Time Pulse Release (A)" lead, causing the release of any selectors whose TM relays have operated. After a further 60 seconds have elapsed (i.e. twenty 6 second steps after the start pulse), wiper TP4 applies earth to the "Time Pulse Release (B)" lead, causing the release of any relay sets whose TM relays have operated.

When a selector (or relay set) has released, relays TM and TA are also released, unless a forced release condition has been initiated by another circuit, causing relay TA to remain operated.

6. Ringing Current

Ringing current is produced by the battery driven vibrator VB.

When contacts ST5 and ST6 make, earth is extended to energise the coil VB. The spring-loaded armature VB1 is attracted, and in moving it breaks the circuit of the coil VB (i.e. springs 2 and 3 break) causing it to be released. The armature VB1 therefore vibrates continuously with a periodicity of about 23 c.p.s. as determined by its weight and the spring tension.

As the armature vibrates the two contacts VB1 (i.e. springs 2 and 4, and 2 and 1) make alternately and pulses of direct current flow alternately in each half of the primary winding of the transformer, inducing an alternating current in the secondary winding.

The mid-point of the primary winding is connected to battery via a choke L1 which prevents high-frequency ripple from passing into the main battery feeds.

One side of the secondary winding is earthed, and the other side is connected to the continuous ringing current feed circuit. The capacitor C14 is used to reduce the harmonic content of the ringing current.

7. Ring Tone

Ring Tone is a 400 c.p.s. tone modulated by the ringing current, and is interrupted by contact RE2 as already mentioned above (0.5 sec. on, 0.250 sec. off).

A valve oscillator (V3) is used to generate the 400 c.p.s. tone which is fed to one winding of the ring tone transformer TR4. Capacitor C17 bleeds a small proportion of the ringing current and feeds it into the second winding, and, from a third winding, a lead is taken to the tone feed leads to carry the modulated 400 c.p.s. tone to the exchange apparatus.

8. Dial Tone

Dial Tone is a continuous 400 c.p.s. tone generated by a valve oscillator (V1) and fed to the apparatus via the dial tone transformer TR3.

A third winding of the transformer is used to feed the busy and N.U. tone amplifier valves.

9.

Busy Tone is a 400 c.p.s. tone obtained by amplification of the small amplitude signal obtained from the third winding of the dial tone transformer. The transformer TR1 in the anode circuit of the amplifier valve (V2) is used to feed the tone to the exchange apparatus.

Contact XB2 interrupts the busy tone as already mentioned (0.5 sec. off, 0.5 sec. on) and earths the feed lead during the "off" intervals.

10. N.U. Tone

N.U. tone is a 400 c.p.s. tone obtained from the secondary of a second transformer TR2 in the anode circuit of valve V2.

As already mentioned the feed is interrupted by contacts XB4 and PB1 to give the following timing.

65mS on,	80mS off.
65mS on,	80mS off.
65mS on,	80mS off.
65mS on,	500mS off.

The tone feed lead is earthed during the "off" periods by contacts PB1 and XB4.

11. Overflow Tone

Overflow tone is a 900 c.p.s. tone obtained from the secondary winding of transformer TR5 in the anode circuit of a third oscillator valve (V4).

The feed to the exchange apparatus is interrupted by contact XB1 as already mentioned (0.5 sec. on, 0.5 sec. off), which earths the tone feed lead during the off periods.

12. Test Number Circuit

As the unit is intended for use in unattended locations provision is made for a sample check of conditions by equipping a test circuit which is connected to the final selector bank multiple.

By dialling any tens digit and "flashing" the ring key, an operator can tell whether or not a serious fault condition exists.

(a) When no fault exists, the operator hears ring tone with ringing current returning a low frequency ripple during the "off" periods of the ring tone (see para. 4(a)).

(b) When a fault exists, N.U. tone is returned.

When the test number is dialled, relay TN operates to earth on the P wiper of the final selector.

Relay TN operating,

TN1 connects the tone feed to the a-b winding of retard TT.
TN2 operates or maintains the start relay ST.

For fault free conditions, ring tone is returned by contacts RE1 and RE2 (operated) and ringing current by contact RE1 (unoperated) via contacts MFA1 and CF1 (unoperated).

Under fault conditions the following will occur:

(i) Fuse Alarm

When a fuse blows in any part of the apparatus, relay MFA operates to earth extended by contact FA2 (operated) in the rack common services circuit.

Relay MFA operating,

MFA1 switches the N.U. tone feed via contact CF1 to retard TT so that N.U. tone is returned to the calling operator.

(ii) Charge Fail

Should the battery charging supply fail, relay CF operates.

Relay CF operating,

CF1 switches the N.U. tone feed to retard TT, so that N.U. tone is returned to the calling operator.
CF2 extends earth to the rack common services circuit, preparing the circuit for the operation of the charge fail lamp by the maintenance engineer pressing the push button.

13. Lines Ceased, Unallotted or Temporarily out-of-service

The line wires of these lines are returned to an NUA retard, and the P wire is returned to a winding of relay TS. This is achieved by jumpering from the appropriate line circuit to a "T.O.S." jack (see common services circuit) or to a set of N.U. tags (see Subscriber's Line Circuit).

A subscriber dialling one of these numbers is switched to an NUA retard and relay TS operates to earth extended on the P wire by the final selector.

Relay TS operating.

TS1 connects N.U. tone to the NUA retards and thence to the caller.

CIRCUIT NOTES

(a) Networks RSC (Fig.1), RSA & RSB (Fig.3)

The networks of chokes (RFC), capacitors and resistors (RSB only) are fitted to prevent the generation of radio interference.

(b) Contacts ST5 & ST6 (Fig.1)

Contacts ST5 & ST6 in series prevent arcing at either contact when the highly inductive vibrator circuit is broken. Wear on the contacts is thereby much reduced.

(c) Retards NUA1, NUA2, NUA3, & TT (Fig.2) IA,IB & IC (Fig.4)

These retards are made high impedance at speech frequencies to prevent leakage of tones to the battery.

E N D.