DIAGRAM NOTES (ISSUE 1)

concerning

DIAGRAM GBW.13720

U.A.X. N.Z. 13

COMMON EQUIPMENT RINGING, TONES AND PULSES

USING ELECTRONIC GENERATORS

1. 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. 13C units.

The diagram should be considered in conjunction with the following diagram:-

GBW.13730 Rack Alarm Circuits

2. FACILITY SCHEDULE.

Provision is made for :-

(1) The generation of time pulses for forced release of selectors.

(2) The generation of "S" and "Z" pulses for metering purposes; and the connection of up to 6 metering pulses as required.

(3) The generation of "S" and "Z" pulses for the linefinder control relay sets.

(4) The generation, by vibrator circuit, of alternating current suitable for operating polarised ringers.

(5) The generation, by valve oscillators, of 400 c.p.s. and 900 c.p.s. tones.

(6) The "pulsing" of tone supplies.

(7) Battery charging fail alarm.

(8) Fuse alarm.

(9) Release alarm.

(10) Linefinder control alarm.

(11) The connection of N.U. tone to the test number circuit when faults causing any of the above mentioned alarms exist.

(12) The connection of a "no fault" tone (inverted ringing and ringing tone) to the test number circuit when none of the above mentioned faults exists.

(13) Meter routine testing.

(14) The transmission of N.U. tone to the caller when a ceased, unallotted, or temporarily-out-of-service number is dialled.

3. OUTLINE.

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

A meter pulse uniselector generates the pulses required for multi-metering and pulses to step the time pulse uniselector.

The circuits divide the ringing current and tones into pulses for their separate applications and also measure the time allowance for the various alarms.

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

Reprinted by N.Z.P.O. October, 1957.

4. CIRCUIT DESCRIPTION.

4.1 Machine start.

Relay MS operates when

(a) The time pulse Start wire is earthed by the exchange apparatus (TA1 makes).

(b) The Ring M/C Start Batt. wire is earthed.

(c) The test number is dialled (TN3 makes).

(d) The meter routine test circuit is taken into use (T2 makes).

Relay MS operating,

MS1 applies earth to operate vibrator VB.

MS2 removes earth from test jack MPtj; operates relay RC; connects earth to wipers MP1, MP2, MP9 and MP10:

MS3 starts the X, Y, Z relay chain:

MS4 removes earth from test jack TPtj; completes the cathode circuit of valves V3 and V4:

MS5 short circuits resistor R3 to apply full earth to the cathode circuit of valves V1 and V2:

Relay RC operating,

RC1 connects battery to wipers MP3, MP4, MP5, MP6, MP7 and MP8.

4.2 Relay Timing Chain.

In order to obtain a time base for the various 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 X2.

Relay Z operates to release relay Y at contact Z2.

Relay Y releases to operate relay X at contact Y1.

Relay X operates to release relay Z at contact X2.

Relay Z releases to operate relay Y at contact Z2.

Relay Y operates to release relay X at contact Y1.

When contact MS3 makes to start the chain, all the relays attempt to operate. Since the three relays are not 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 is repeated every 200 mS (see also the diagram inset).

The inductive windings of the relays are shunted by non-inductive windings in order to render the relay slow-to-release, and to provide spark-quenching at the interrupting contacts.

Each relay carries an extra contact unit, connected as follows :-

(a) X1 causes uniselector MP to step once every 200 mS.

(b) Y2 and Z1 in conjunction with wiper MP1 and bank contact 3 cause uniselector TP to step once every 10 seconds.

4.3 Uniselector MP (Ringing and Meter Pulses).

The various functions performed by the wipers of uniselector MP stepping over the bank contacts are as follows :-

Wipers MP1 and MP2

(a) Pulse relays RE and RO (out of phase) in the following sequence:-

400 mS	-	operated
200 mS	-	released
400 mS	-	operated
2 seconds (approximately)	-	released

(b) Connect S and Z pulses to the linefinder control relay set via bank contacts 13 and 9 respectively, providing a 9.2 seconds interval between the connection of an S pulse and the succeeding Z pulse.

Relay RE operating.

RE1 connects 400 c/s tone to the Int. Ring Tone Eth wire;

RE2 extends ring tone via RE1 to contact T4 (for the test number circuit);

RE3 connects ringing current to the Int. Ring (Even) wire.

Relay RE releasing.

RE1 substitutes earth for tone on the Int. Ring Tone wire;

RE2 substitutes ringing current for ring tone at T4 (test number);

RE3 substitutes earth for ringing current on the Int. Ring (Even) wire.

Relay RO operating.

RO1 connects ringing current to the Int. Ring (Odd) wire.

Relay RO releasing.

RO1 substitutes earth for ringing current on the Int. Ring (Odd) wire.

Wipers MP3 and MP4

Connect S and Z pulses (battery) to the metering circuit. The S pulse is of 200 mS duration and the Z pulse of 4 seconds duration. An interval of 800 mS elapses between the connection of an S pulse and the succeeding Z pulse. During the Z pulse period the metering pulses are connected by wipers MP5, MP6, MP7 and MP8.

Wipers MP5 and MP6.

(a) Connect 200 mS battery pulses to the meter routine test circuit via ST1 (operated) resistor R2 and relay A.

(b) Connect metering pulse 4 (four 200 mS pulses of battery) to the metering circuit during the Z pulse period.

Wipers MP7 and MP8.

Connect metering pulses 1, 2, 3, 5 and 6 (each comprising the appropriate number of 200 mS pulses of battery) to the metering circuit during the Z pulse period.

Wipers MP9 and MP10.

(a) Pulse relay PA in the following sequence:-

600 mS	-	operated
400 mS	-	released

Relay PA operating.

PA1 operates relay PB

PA2 substitutes N.U. tone (from transformer TR2 via PB2) for earth on the N.U. Tone Earth wire.

Relay PB is slow-to-operate due to the charging current of capacitors C1A and C1B, the relay windings being energised in opposition.

Relay PB operating,

PB1 disconnects relay PB,

PB2 substitutes earth for N.U. tone on the N.U. Tone Earth wire.

Relay PB is slow-to-release due to the discharge current of capacitors C1A and C1B, which energises the relay windings in series assisting.

Relay PB releasing,

PB1 re-connects the operate circuit of relay PB,

PB2 substitutes N.U. tone for earth on the N.U. Tone Earth wire.

The self-interrupt circuit to relay PB is maintained during the 600 mS operate period of relay PA. Relay PA is disconnected by wiper MP9 (Mp10).

Relay PA releasing.

PA1 disconnects relay PB self-interrupt circuit,

PA2 earth the N.U. Tone Earth wire.

Thus N.U. tone consists of four "pips" of tone connected by PB2 during the period that PA2 is operated. N.U. tone is not connected while PA2 is normal.

(b) Pulse relay XB (slow release) in the following sequence :-

500 mS	-	operated	approximately
500 mS	-	release	

Relay XB operating,

XB1 disconnects the Rev. Pulse wire,

XB2 connects 400 c/s tone to the Busy Tone wire,

XB3 connects 900 c/s tone to the Overflow Busy Tone wire.

Relay XE releasing,

XB1 earths the Rev. Pulse wire,

XB2 substitutes earth for tone on the Busy Tone wire,

XB3 substitutes earth for tone on the Overflow Busy Tone wire.

4.4 Uniselector TP (Time Pulse Release)

The wipers of uniselector TP step once every 10 seconds except on contacts 21-25, via which wiper TP4 completes a self-drive circuit via TJ1/2 and interrupter springs TPdm. The wipers thus complete a revolution once every 200 seconds approximately.

When earth through relay TM of a selector or relay set is applied to the time pulse Start wire, relay TA (winding d-c) operates. Contact TA1 operates (or holds) the start relay MS. When wiper TP2 rests on contact 3 the two windings of relay TA and resistor R1 are connected in parallel, allowing relay TM in the selector to operate. When the wipers move on, relay TM holds via the time pulse. Hold wire to relay TA (winding a-b) and resistor R1 in parallel.

60 seconds after the connection of winding a-b (relay TA) to the Start wire, wiper TP1 applies earth to the Release wire, to complete the selector release sequence.

Similarly the release sequence for junction circuits is completed after 180 seconds approximately; and for the revertive call circuits after 190 seconds approximately, via contacts 1 and 2 of bank TP1.

When a selector or relay set circuit has released, relays TM and TA release unless a time pulse release sequence has been initiated by another circuit, causing relay TA to hold.

4.5 Ringing Current.

Ringing Current is generated by vibrator VB.

When contact MS1 closes, earth is extended to energise the coil VB. The spring-loaded armature VB1 is attracted and in moving breaks the coil circuit at springs 2/3. The armature therefore vibrates continuously at approximately 23 c/s.

As the armature vibrates, the two contacts, springs 2/4 and 2/1 make alternately and pulses of current flow alternately in the two halves of the primary of transformer TR6. An alternating current is thus induced into the transformer secondary winding.

The mid-point of the primary winding is connected to battery via choke L1, which prevents the leakage of ringing current to the battery.

One side of the secondary winding is earthed and the other side is connected to the continuous ringing current feed.

4.6 Interrupted Ringing.

Contacts RO1 and RE3 connect ringing current, respectively to the odd and even Int. Ring wires in the following sequence :-

400 mS	-	ringing
200 mS	-	earth
400 mS	-	ringing
2 seconds	-	earth

Earth is maintained on the Int. Ring Wires, during ringing periods via the transformer secondary, and during silent periods, via normal contacts RO1 and RE3. This earth, and battery on the R.R. Batt. wires provide an operate circuit for selector ringing control relays.

4.7 Ring Tone.

Ring tone is a 400 c/s tone modulated by ringing current and interrupted by contact RE1 in the same sequence as interrupted ringing.

Valve V3 generates the 400 c/s tone, which is fed to one winding of transformer TR4. Capacitor C5 feeds a small proportion of ringing current to a second winding of transformer TR4 and the modulated tone is taken from a third winding.

4.8 Dial Tone.

Dial tone is a 400 c/s tone generated by valve V1 and fed to the Dial Tone wire via transformer TR3. A third winding of transformer TR3 is used to feed 400 c/s tone to the Busy and N.U. Tone valve V3.

4.9 Busy Tone.

Busy tone is a 400 c/s tone obtained from valve V2, which amplifies the tone fed from the dial tone transformer. Transformer TR1 in the anode circuit of valve V2 feeds busy tone to the exchange apparatus via the interrupting contact XB2 to give the following tone sequence :-

500 mS - tone
500 mS - earth
} approximately

4.10 N.U. Tone.

N.U. tone is a 400 c/s tone obtained from transformer TR2 in the anode circuit of valve V2. Contacts PB2 and PA2 interrupt the tone to give 4 "pips".

4.11 Overflow Tone.

Overflow tone is a 900 c/s tone generated by valve V4 and fed via transformer TR5 to the 900 c.p.s. wire, and via XB3 to the O/F B.T. wire in the following sequence :-

500 mS - tone
500 mS - earth
} approximately

4.12 Test Number.

Access to the test number circuit is gained by dialling the appropriate number. The final selector switches to battery at relay TN and relay TN operates via the P wire. Winding a-b of relay TT provides an answering loop for the final selector.

Relay TN operating,

TN1 connects the tone feed to the tone winding of retard TT,

TN2 operates relay RB,

TN3 operates (or holds) relay MS,

TN4 prepares an alternative tone path via RB1, against the momentary operation of RA1.

Relay RB operating,

RB1 prepares an alternative tone path via TN4, against momentary operation of RA1 during the release of selectors.

The appropriate tone is returned to the caller via the windings of retard TT as follows :-

(a) No Faults,

Inverted ringing (23 c/s tone) with ring tone connected in the silent periods,

(b) Fault Condition,

N.U. tone via the appropriate operated contact CF1, RA1 or FA1.

4.13 Fuse Alarm and Linefinder Control Alarm.

Relay PFA operates to positive battery extended to U54; or to resistance battery at U52 returned to U54 when a positive battery fuse blows.

Relay PFA operating,

PFA1 operates relay MFA (winding d-e).

Relay MFA operates direct on winding d-e or on both windings in series when a common circuit fuse blows.

Relay MFA operating,

MFA1 extends earth to the Fuse Alarm lamp,

MFA2 operates relay FA.

Relay FA operates direct when other circuit fuses blow, or when a linefinder control alarm condition arises.

Relay FA operating,

FA1 connects N.U. tone to the test number circuit.

4.14 Release Alarm.

Relay RA operates to earth on the Rel (Rlse) wire whenever a selector releases.

Relay RA operating,

RA1 prepares the test number circuit for the connection of N.U. tone,

RA2 disconnects relay RB.

If the selector releases normally, relay RB holds (should the test number be in use) until RA2 restores. The no fault tone is maintained via RB1, TN4 and RA1 during the operate period of relay RA.

Should the selector fail to release, relay RA holds and relay RB releases, contact RB1 extending N.U. tone to retard TT via TN4 and RA1.

4.15 Charge Fail Alarm.

Should the battery charging supply fail, relay CF operates.

Relay CF operating,

CF1 connects N.U. tone to the test number circuit,

CF2 connects earth to the charge fail alarm lamp.

4.16 Lines Ceased, Unallotted, Temporarily Out-of-Service or Faulty.

The line wires of these lines are returned to a relay, NUA 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 or to a set of N.U. terminals (see common services circuit).

When one of these numbers is dialled, the final selector switches to battery via relay TS, which operates to earth on the P wire.

Relay TS operating,

TS1 returns N.U. tone to the caller via the windings of relay NUA.

Should a fault condition operate relay NUA:

Relay NUA operating,

NUA1 earths the P wire to preclude switching of final selectors to the faulty circuit (and operates TS),

NUA2 connects earth to the N.U. tone alarm lamp,

NUA3 operates relay FA,

Relay FA connects N.U. tone to the test number circuit.

4.17 Meter Routine Test Circuit.

When a test cord is connected between a meter routine test jack and a line circuit meter test jack (see common services and line circuits), earth via relay T is extended from U52 to the line circuit P wire. When the line circuit is free, this earth busies the line circuit and relay T operates.

Relay T operating,

T1 prepares a circuit for the meter routine test relay via the test keys,

T2 operates relay MS,

T3 connects earth via U56 to light the meter test lamp,

T4 connects N.U. tone to the test number circuit.

This provides a warning if the line circuit is not freed by the removal of the test connections at the conclusion of the test.

When the meter test lamp glows, the "operate" or "non-operate" test keys may be operated. Earth thus connected to U54 operates the meter routine test relay via T1 and A1. The cam-operated contact on the routine test relay closes, extending earth from U54 to operate relay ST.

Relay ST operating,

ST1 completes the meter pulse circuit to the subscriber's meter under test, via relay A.

Pulses of operate or non-operate current (depending on the exclusion or inclusion of resistor R4 by the test keys) are connected to the meter by wiper MP5. Relay A operates to each pulse.

Relay A pulsing,

A1 steps the meter routine test relay,

A2 flashes the meter test lamp.

At the release of relay A after the tenth meter pulse, the meter routine test relay operates for the eleventh time and the cam-operated contact opens, releasing relay ST.

Relay ST releasing,

ST1 disconnects the meter pulse circuit.

At the completion of the ten meter pulses, contact A2 causes the meter test lamp to glow continuously. The test key should now be restored.

The meter routine test relay is disconnected when the test key is restored. When the test cord plug is removed from the line circuit meter jack, the line circuit becomes free and relay T releases N.U. tone is disconnected from the test number circuit at T4. Contact T3 extinguishes the meter test lamp. Should the plug be withdrawn before the test key is restored, T3 maintains the meter test lamp circuit via U68 and the key contacts.

5. CIRCUIT NOTES.

5.1 Retards NUA1, NUA2, NUA3, NUA4, TT, IA, IB and IC

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

GBW.13720. END OF DIAGRAM NOTES