DIAGRAM NOTES

RELATING TO

GBW.13723 ISSUE 4
AND
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U.A.X. N.Z.13

COMMON EQUIPMENT RINGING, TONES AND PULSES USING

ELECTRONIC GENERATORS

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COMMON EQUIPMENT RINGING, TONES AND PULSES

USING ELECTRONIC GENERATORS

1.0 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.13 Multi-Party line units.

The diagram should be considered in conjunction with the following diagram or its equivalent:

GBW.13730 Rack Alarm Circuits.

2.0 FACILITY SCHEDULE

Provision is made for:

2.1 The generation of time pulses for forced release of selectors.

2.2 The generation of "S" and "Z" pulses for metering purposes; and the connexion of up to 6 metering pulses as required.

2.3 The generation of "S" and "Z" pulses for the Linefinder Control relay sets.

2.4 The generation, by transistor circuit, of alternating current suitable for operating polarised ringers.

2.5 The generation, by transistor circuit of tones suitable for use by the New Zealand Post Office.

2.6 The "pulsing" of tone supplies.

2.7 Battery charging fail alarm.

2.8 Fuse alarm.

2.9 Release alarm.

2.10 Linefinder control alarm.

2.11 The connexion of N.U. tone to the test number circuit when faults causing any of the above-mentioned alarms exist.

2.12 The connexion of a "no fault" tone (inverted ringing tone) to the test number circuit when none of the above-mentioned faults exist.

2.13 Meter routine testing.

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

3.0 CIRCUIT DESCRIPTION

3.1 OUTLINE

The equipment incorporates a transistor circuit to generate ringing current, and electronic units to generate 400c/s, 400+33c/s, and 900c/s tones.

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

The time pulse circuit divides the ringing current and tones into pulses for their separate application and also measures 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.

3.2 DETAIL

3.2.1 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 (TM2 makes).

MS operating

MS1 applies earth to the electronic ringing generator.
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; connects earth to the 400c/s, 33c/s and Overflow Busy Tone generators.
MS5 connects earth to the Busy Tone and Dial Tone Generators.

RC operating

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

3.2.2 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 200mS (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 two extra contact units which are connected as follows:-

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

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

3.2.3 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:

400mS	-	operated
200mS	-	released
400mS	-	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 connexion of an S pulse and the succeeding Z pulse.

RE operating

RE1 connects 400+33c/s tone to the Int. Ring Tone Eth wire.

RE2 disconnects ring tone from contact TM4 (for the test number circuit).

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

RE releasing

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

RE2 substitutes ring tone for earth (test number).

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

RO operating

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

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 200mS duration and the Z pulse of 4 seconds duration. An interval of 800mS elapses between the connexion 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 200mS battery pulses to the meter routine test circuit via ST1 (operated) resistor R2 and relay A.

(b) Connect metering pulse 4 (four 200mS 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:

600mS - operated
400mS - released.

PA operating

PA1 operates relay PB.

PA2 substitutes tone (from retard BT 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.

PB operating
PB1 disconnects relay PB.
PB2 substitutes earth for 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.

PB releasing
PB1 re-connects the operate circuit of relay PB.
PB2 substitutes tone for earth on the N.U. Tone Earth wire.

This self-interrupt circuit to relay PB is maintained during the 600mS operate period of relay PA. Relay PA is disconnected by wiper MP9 (MP10).

PA releasing
PA1 disconnects relay PB self-interrupt circuit.
PA2 earths the N.U. Tone Earth wire.

Thus N.U. tone consists of four "pips"of tone (65mS on, 80mS off) connected by PB2 during the period that PA2 is operated. N.U. tone is not connected while PA2 is normal.

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

400mS - operated
200mS - release

XB operating
XB1 disconnects the Rev. Pulse wire.
XB2 connects 400c/s tone to the Busy Tone wire.
XB3 connects 900c/s tone to the Overflow Busy Tone wire.

XB 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.

3.2.4 Uniselector TP (Time Pulse Release)

The wipers of uniselector TP step once every 10 seconds except on contacts 21-25, via which wiper TP1 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 lead relay TA operates. TA1 operates, or holds, the start relay MS. TM in the selector or relay set does not operate due to the 10,000 ohm resistance of relay TA.

When the TP uniselector is switched to position 3, full 50 volt potential is applied to the TP START lead, via TP2/3. This also causes relay TA to start to fall back, however TA is made slow to release by D5. TM in the selector or relay set operates or holds over the TP HOLD lead. When TM operates, battery behind the H relay (or equivalent) in the selector or relay set is fed via the TP release lead to switch on transistor TR1. The emitter earth from TR1 is fed to energise relay TA. Relay H (or equivalent) in the selector or relay set does not operate, due to its circuit impedance.

The application of full 50 volt potential to the TP hold lead enables a large number of TM relays to be held. Should the current loading be exceeded the meter pulse fuse blows, disabling the metering facility, but allowing subscriber service to continue.

Should the relay set be idle, with the TP uniselector resting on bank position 3 relay TA is started, using TR1 in the same manner as above.

The selector/relay set release function occurs by the application of the TP1 earth to the appropriate release lead, in the TP uniselector cycle following the application of 50 volt full potential at TP2/3, and the subsequent operation of TM in the selector or relay set. Thus a minimum time will occur if a release function is initiated when the TP uniselector is on bank position 3 and a maximum if it is on position 4.

Junctions are released by bank position TP1/1 with a 190 seconds minimum - 390 seconds maximum release time. Revertive relay sets are released by bank position TP1/2 with a 200 second minimum - 400 seconds maximum release time. Selectors are released by bank position TP1/10 with a 60 seconds minimum - 260 seconds maximum.

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.

3.2.5 Ringing Current

The four transistors are arranged to operate in pairs, and the circuit is so designed that when one pair is switched on, the other pair is biassed off.

Transformer T1 possesses the characteristics of high initial permeability and of saturation at a well defined point of magnetisation, and the rapid cut off of currents in the secondary windings resulting from this causes the transistors to switch, thus reversing the current in the primary winding and repeating the sequence in the opposite direction.

The circuit operation commences when the start earth is applied. Resistors R5 and R6 provide a forward drive current for transistors VT1 and VT4, and collector current flows via SCA5, VT4(e-c), T1(9-10), VT1(e-c), L1(a-b).

The current through winding T1(9-10) is induced into windings T1(3-4)(7-8) to increase the forward drive currents of VT4 and VT1 respectively, while the voltage induced into windings T1(1-2) (5-6) biasses transistors VT3 and VT2 off.

The flux builds up, and then when saturation point is reached, the magnetic field becomes static, and the induced currents cease to flow in the various secondary windings. The forward drive currents having ceased in windings T1(3-4)(7-8) transistors VT1 and VT4 now tend to switch off and in so doing reduce the current through primary winding T1(9-10). As a result of this the magnetic

field decays slightly, and currents are again induced into the secondary windings, this time in the opposite direction, causing transistors VT2 and VT3 to switch on, and biassing transistors VT1 and VT4 off. Current through the primary winding is now in the opposite direction, and the magnetic field is reversed, the flux building up to saturation and eventually causing transistors VT2 and VT3 to switch off and transistors VT1 and VT4 to switch on again. One complete cycle of operation has now taken place, and the sequence is repeated at a frequency of 25 c.p.s.

The alternating voltage on the bridge inverter is supplied to transformer T2 and this provides an output at a level suitable for ringing subscribers telephone bells.

3.2.6 Interrupted Ringing

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

400mS	-	ringing
200mS	-	earth
400mS	-	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 the battery on the R.R. Batt. wires provide an operate circuit for selector ringing control relays.

3.2.7 Ring Tone

Ring tone is a 400c/s tone modulated by 33c/s tone and interrupted by contact RE1 in the same sequence as interrupted ringing.

3.2.8 Dial Tone

Dial tone is a 400c/s continuous tone.

3.2.9 Busy Tone

Busy tone is a 400c/s tone fed to the exchange apparatus via the interrupting contact XB2 to give the following tone sequence:

400mS	-	tone
600mS	-	earth

3.2.10 N.U. Tone

N.U. tone is a 400c/s tone interrupted by contacts PB2 and PA2 to give the following sequence:

65mS tone, 80mS earth
65mS tone, 80mS earth
65mS tone, 80mS earth
65mS tone, 500mS earth

3.2.11 Overflow Tone

Overflow tone is a 900c/s tone interrupted by contact XB3 to the O/F B.T. wire in the following sequence:

400mS tone
600mS earth

3.2.12 Test Number

Access to the test number circuit is gained by dialling the appropriate number. The final selector switches to battery at resistor R6 on the P wire. Winding a-b of relay TN provides an answering loop for the final selector.

TN operating

TN1	connects the tone feed to the tone winding.
TN2	operates relay RB.
TN3	operates (or holds) relay MS.
TN4	prepares an alternative tone path via RB1, against the momentary operation of RA1.

RB operating

RB1	prepares an alternative tone path via TN1, 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 ring tone.

(b) Fault Condition
N.U. tone via the appropriate operated contact TM4, RA1 or FA1.

(c) Fault Condition
Overflow Busy Tone via contact CF1 only.

(d) Fault Condition
Busy Tone via contacts CF1 and LO1 in series.

3.2.13 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.

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.

MFA operating

MFA1	extends earth to the Fuse Alarm lamp.
MFA2	operates relay FA.

Relay FA operates direct when other circuit fuses blow.

FA operating

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

3.2.14 Release Alarm

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

RA operating

RA1	prepares the test number circuit for the connexion 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 relay TN via TN4 and RA1.

3.2.15 Charge Fail Alarm

Should the battery charging supply fail, relay CF operates.

CF operating

CF1 connects overflow Busy Tone to the test number circuit.
CF2 connects earth to the charge fail alarm lamp.

3.2.16 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.

TS operating

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

Should a fault condition operate relay NUA:

NUA operating

NUA1 earths the P wire to preclude switching of final selectors to the faulty circuit.
NUA2 connects earth to the N.U. tone alarm lamp.
NUA3 spare.

3.2.17 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 TM is extended from U52 to the line circuit P wire. When the line circuit is free, this earth busies the line circuit and relay TM operates.

TM operating

TM1 prepares a circuit for the meter routine test relay via the test keys.
TM2 operates relay MS.
TM3 connects earth via U56 to light the meter test lamp.
TM4 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 connexion 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 TM1 and A1. The cam-operated contact on the routine test relay closes, extending earth from U54 to operate relay ST.

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.

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.

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 TM releases. N.U. tone is disconnected from the test number circuit at TM4. Contact TM3 extinguishes the meter test lamp. Should the plug be withdrawn before the test key is restored, TM3 maintains the meter test lamp circuit via U52 and the key contacts.

3.3 CIRCUIT NOTES

3.3.1 Relays 1NUA, 2NUA, 3NUA, 4NUA, TN

These relays are made high impedance to improve their efficiency as transformers.

3.3.2 Suppressor Unit RSC

The suppressor unit is fitted to prevent the radiation of energy at radio frequencies.

END OF DIAGRAM NOTES