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A Switching Unit for Use with 700-Type Telephones—Plan Set N625

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A switching unit has been developed to permit the use of 700-type telephones on extension plans with intercommunication (Plans 5 and 7). The unit, designated Plan Set N 625, and the associated apparatus are described and the advantages over existing apparatus are pointed out.

INTRODUCTION

EXTENSION plans consisting of one exchange line and two or three telephones with intercommunication have been popular with customers for over 50 years. An installation with one main and one extension telephone is known as a Plan 7: an installation with one main and two extension telephones is called a Plan 5. Such installations require a switching unit, and this was originally incorporated in a wall-mounting bell set used at the main station. The introduction of handset telephones was followed by the development of the Bell Set No. 39¹, which formed the basis of the improved Bell Set No. 44. These were switching units intended to stand on a desk and have a special handset telephone, Telephone No. 248, mounted on top of them. Although the title "bell set" was retained, these items did not contain bells.

Because Bell Sets No. 39 and 44 are intended for use only with Telephones No. 248, it is not possible to fit 700-type telephones at the main stations of Plan 5 and 7 installations. Pending the development of a replacement for these bell sets the use of the Telephone No. 706 was permitted at extensions only.

The desirability of using the Telephone No. 706 to meet as many requirements as possible has been discussed elsewhere.² A new switching unit has therefore been developed as a plinth on which a Telephone No. 706 can be mounted. The objectives in designing the switching unit were that it should:

- (a) be of modern appearance and in harmony with Telephone No. 706,
- (b) provide all the facilities given by existing Plans 5 and 7 and, in addition, enable external extensions to be used with Plan 5, as well as with Plan 7,
- (c) operate with extension-to-exchange lines of 1,000 ohms resistance,
- (d) have press-buttons instead of the rotary switch used in the Bell Set No. 44,
- (e) have a lamp to indicate when an extension-to-exchange call is in progress instead of the 3,000-type relay indicator used in the Bell Set No. 44,
- (f) dispense with hand generators, and
- (g) operate from a.c. mains or batteries.

PLAN SET N 625

The new switching unit has been designated Plan Set N 625 and meets the requirements listed above. The title was chosen to indicate an association with extension plans and to avoid the misleading term "bell set" as well as the very general term "switching unit." N 625 is the number of the circuit diagram of the plan set.

The plan set, the appearance of which has been approved by the Council of Industrial Design, is shown

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FIG. 1—PLAN SET N 625 AND TELEPHONE NO. 706

in Fig. 1 together with a Telephone No. 706. The moulding material, polymethyl methacrylate, is that used for the Telephone No. 706 and is suitable for production in the full colour range used for that telephone, although at present it is intended to produce plan sets in elephant grey only. The plan set is supplied with an 18-way cord and a terminal block and also with a short 13-way cord which connects the plan set to the telephone through a knock-out hole in the base of the telephone.

Three of the small keys (Fig. 1), marked SPK TO EXCH, SPK EXTN EXCH HELD, and EXTN TO EXCH, are locking keys, and are pressed to establish three of the circuit conditions provided on Plans 5 and 7. Depression of the fourth small (non-locking) key, marked RELEASE, restores any of the locking keys and establishes a fourth circuit condition—"main to extension." The two large unmarked keys are used to call the extensions. A white lamp behind the EXTN TO EXCH key acts as an engaged signal and lights if this key is depressed when the handset at an extension is off its rest. A red lamp is fitted behind the SPK EXTN EXCH HELD key and lights if this key is depressed when the handset at the main station is off its rest, thereby indicating that the exchange line is being held.

Facilities

Plan 7 with a main station and one internal extension will be discussed first. Incoming calls may be received at the main or the extension and, if received at the latter, the bells ring simultaneously at both. The main and extension call each other with press-buttons, which operate buzzers. The main can hold an exchange call and speak to the extension without being heard on the exchange line. Exchange calls from the main cannot be heard at the extension. The main can intervene on calls between the exchange and the extension.

The facilities of Plan 7A are similar to those of Plan 7, except that calls between the exchange and the extension are secret from the main. Plans 5 and 5A are similar to Plans 7 and 7A, respectively, but have two

extensions. Incoming calls may be received at the main or either extension, the bells being rung simultaneously at the main and both extensions in the latter case. Calling between the main and either extension is by means of buzzers operated by press-buttons. The extension calls are not secret from one another. A second press-button can be provided at each extension telephone to enable them to call each other without the assistance of the main.

Because only two wires are normally provided between the main and external extensions, a 20 c/s ringing convertor is used to ring the magneto bells at the extension telephones. The buzzer at the main is operated by a relay when an earth is applied at either extension. Push-button calling is therefore possible from all telephones. The facilities are the same as with internal extensions except that on Plan 5 the extensions cannot call each other. Intercommunication between external extensions is, however, possible if calls are established through the main.

CIRCUIT DESCRIPTION

The circuit arrangements for Plan 5 and Plan 7 are similar, but, because more facilities are provided by Plan 5, the circuit description will deal with this extension plan.

Installations with Internal Extensions

Fig. 2 is a simplified diagram of a Plan 5 with internal extensions. A brief description follows of the circuit

operation for each of the four conditions provided by Plan 5.

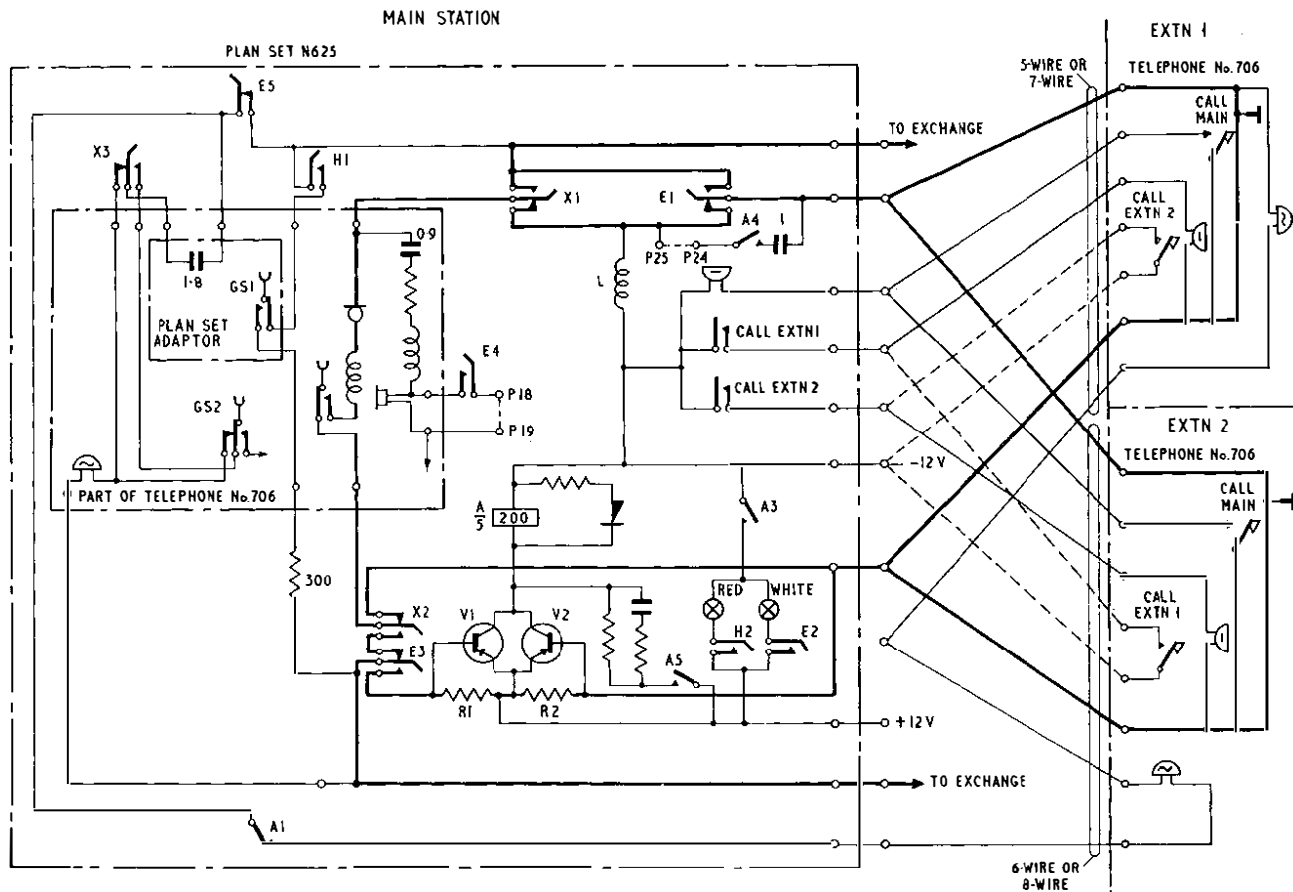
Speak to Extension (all keys normal). Lifting the handset at the main or either extension telephone connects the telephone to the common speech path between stations via E1, X1, and X2. The negative pole of the 12-volt supply is connected to the circuit through the inductor, L, and the positive pole is connected through R2. Calling between main and extension is by buzzers which are operated over separate signalling wires.

Incoming calls from the exchange will ring the bell at the main via E5 and X3.

Speak to Exchange (key X operated). The telephone at the main is connected to the exchange via X1, X2 and E3. An incoming call from the exchange will ring the bell at the main via E5, X3 and GS2.

Speak to Extension, Exchange Held (key H operated). A 300-ohm resistor is connected to the exchange line via GS1 and H1. The main telephone is connected to the common speech path and the extensions may be called by operating the appropriate calling key. The voltage developed across R2, when a handset is lifted, is applied to V2, which becomes conducting and allows relay A to operate. The red lamp on the plan set will light via A3 and H2.

Extension to Exchange (key E operated). The exchange line is connected to the common speech path via E3, R1, R2 and E1. According to the polarity of the exchange



The keys operated for each circuit condition are: speak to extension—none; speak to exchange—X; speak to extension, exchange held—H; extension to exchange—E

FIG. 2—SIMPLIFIED DIAGRAM OF PLAN 5 WITH INTERNAL EXTENSIONS

line either V1 or V2 will become conducting and allow relay A to operate. The use of the transistor switch enables a standard 600-type relay to be used in this circuit. The relay is operated from the 12-volt supply and is controlled by the transistor switch, which is in turn controlled by the line current, which would be too low in value to operate the relay directly. The white lamp lights via E2 and A3. The end of the call is indicated at the main station by the release of relay A, which extinguishes the white lamp.

Extension to exchange calls are secret from the main if plan-set terminals P18 and P19 are strapped. If this strap is removed and P24 strapped to P25, the main station may intervene on such calls.

Incoming calls from the exchange will ring the bells at the main and extensions in series via E1, A1 and X3.

Either of the extensions can make an outgoing call. The operation of relay A will disconnect the bell circuit at A1, and A5 connects a resistance-capacitance network to relay A, to prevent its release during dialling.

Installations with External Extensions

Fig. 3 is a simplified outline diagram of a Plan 7, with an external extension. The circuit differs from that of Fig. 2 only in the signalling arrangements. Three signalling conditions are considered.

Main Call Extensions. The operation of the call-extension key starts the 20 c/s ringing convertor and connects the ringing current to the extension line to ring the earth-connected bell at the extension.

Extension Calls Main. The push-button key on the extension telephone is operated and earth is applied to the negative line. Except when key E is operated, the +12 volts terminal is earthed via E2. The earth at the extension operates relay B and B1 operates the buzzer. When key E is operated the earth connexion will be removed from the power supply by E2. It is essential, therefore, that the negative wire of the exchange line should be correctly connected so that in this condition, with the EXTN TO EXCH key operated, relay B will operate to the exchange battery, which has its positive pole earthed.

Incoming Calls. Except when key E is operated, ringing current operates the bell at the main via E5 and X3 to earth. When key E is operated, the bell at the extension is rung via E1, relay B and the call extension key contacts to earth. Relay B operates in synchronism with the incoming ringing cadences, and B1 operates the buzzer at the main.

For Plan 5 the speech paths of the two extensions are connected in parallel and the bells are connected via thermistors to earth, the bell connexion being to the positive line at one extension and to the negative line at the other. The thermistors prevent bell-tinkling when the other extension dials.

ASSOCIATED APPARATUS

Extension Telephones

At the majority of installations the instrument at the extension will be a Telephone No. 706 with one press-button, which is used to call the main station. On installations with internal extensions additional buttons are sometimes required, for example, to call the exchange on a shared-service installation, to call the other extension on a Plan 5, or to recall the private branch exchange (P.B.X.) operator. On such installations a Telephone No. 710³ must be used.

Ringing Convertor

An interior view of the ringing convertor (Convertor, Ringing, No. 9A), which is intended for wall mounting, is shown in Fig. 4. The circuit and method of connexion are shown in Fig. 3. The ringing convertor also contains relay B, which is a 3,000-type relay shunted with a germanium diode.

Power Unit

The power unit (Power Unit No. 53A) has been designed specially for use with the plan set, and is intended for wall mounting.

To avoid damage to the transistors associated with relay A, the output of the power unit does not exceed 12 volts with the lightest load applied by the plan set. The full-load output is 0.25 amp at 10 volts. The inter-

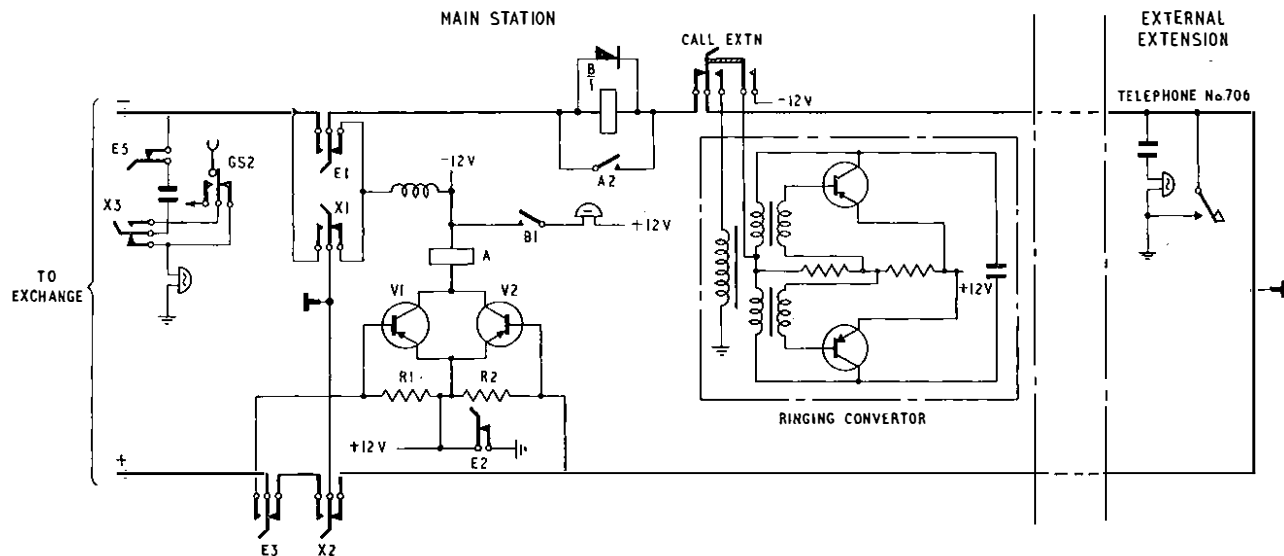


FIG. 3—OUTLINE DIAGRAM OF PLAN 7 WITH EXTERNAL EXTENSION

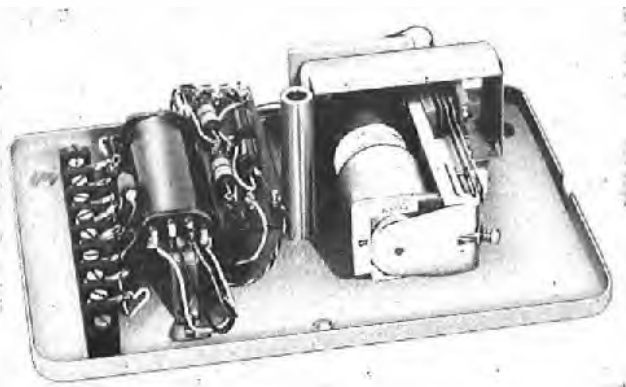


FIG. 4—RINGING CONVERTOR

nationally-agreed upper limit for noise on power supplies is 2 mV (weighted), which is satisfactory when the supply is fed through a transmission bridge. On the plan set, however, where the supply is connected directly to the speech circuit through an inductor, 2 mV of hum was clearly audible and a limit of 0.75 mV was therefore specified. An interior view of the power unit is shown in Fig. 5.

Plan-Set Adaptor for Telephone No. 706

In addition to the change-over and make spring-sets included in all Telephones No. 706 (the term "make" indicating that the contacts are made when the receiver is off the rest), another make spring-set is required in the exchange-hold circuit. A further break spring-set will be required if the plan set is used on P.B.X.s with 4-wire extensions.⁴

A capacitor (Capacitor, Paper, No. 7719) used in Telephone No. 706 consists of 0.9 μ F and 1.8 μ F capacitors in the same case. Coupling between the two capacitors led to distant subscribers overhearing conversations between main and extension with the SPK EXTN EXCH HELD key depressed. The best way of

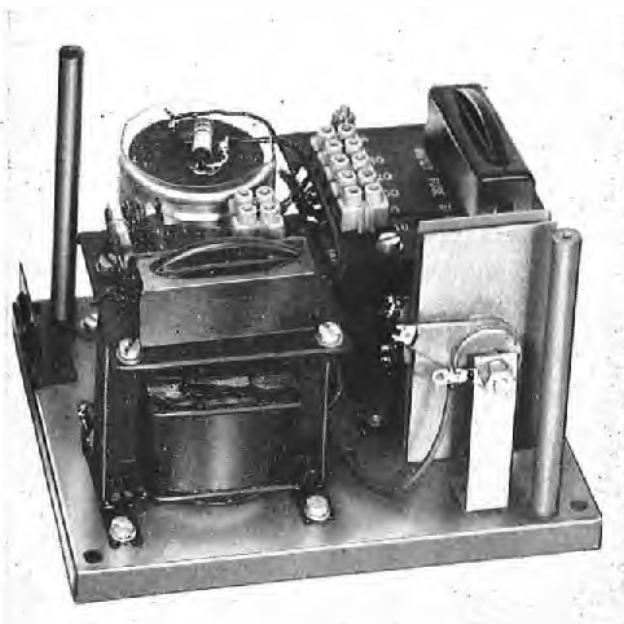


FIG. 5—POWER UNIT

overcoming this overhearing is to use a separate capacitor in place of the 1.8 μ F capacitor in the Capacitor, Paper, No. 7719. Owing to the limited space in the plan set this capacitor was combined with the additional spring-sets previously described to form the Adaptor, Plan Set, No. 1, which is fitted on the side of the gravity-switch bracket opposite to the normal spring-set.

Buzzer

The buzzer (Buzzer No. 32A-1) has a 55-ohm coil and operates from a 12-volt d.c. supply. It is attached, together with its suppression unit, to a bracket which is held under one of the bell-gong fixing screws.



(a) Apparatus required at main station using Plan Set N 625



(b) Apparatus required at main station when Bell Set No. 44 is used

FIG. 6—NEW-STYLE AND OLD-STYLE APPARATUS FOR MAIN STATIONS

CONCLUSION

The design of the plan set was undertaken to provide a switching unit of modern design which would permit the use of Telephone No. 706 at the main station of Plan 5 and 7 installations. The plan set is equally suitable for use by a secretary or an executive who prefers to have the main station on his desk. Increased facilities and extended transmission limits have been attained and it has been possible to reduce the number of items required in addition to the switching unit, especially on installations with external extensions. Fig. 6(a) shows the apparatus required at the main station when a Plan Set N 625 is used and Fig. 6(b) shows the apparatus necessary with a Bell Set No. 44.

ACKNOWLEDGEMENTS

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article was carried out for the Post Office by the General Electric Co., Ltd., under the British Telephone Technical Development Committee Procedure. The author wishes to thank colleagues in the Subscribers' Apparatus and Miscellaneous Services Branch, especially Mr. F. J. Harvey, who suggested improvements which have been incorporated in the design.

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