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**THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS**

# A New Subscribers' Intercommunicating Table Telephone Set

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U.D.C. 621.395.331

The authors describe a new bell set and associated telephone which give intercommunication facilities between a main station and one or two extension instruments. The new telephone has several marked advantages over previous equipment of this type.

## Introduction.

ONE of the most popular extension telephone arrangements is that known officially as "Plan No. 7" whereby two telephones, "main" and "extension," can use an exchange line, either with or without secrecy against each other, and can also intercommunicate, with the exchange line held or free, as required. From the year 1925 until recently the necessary switching conditions at the main station for such an installation were obtained by the use of a Bell Set No. 20. This consists of a 4-position rotary type switch and a flag indicator mounted in a wooden box together with a magneto bell and generator. It is suitable only for wall mounting, and since the subscriber usually needs to operate the switch quite frequently, this is a serious drawback in certain situations, such as offices where desks are at a distance from the walls.

With the introduction of the moulded table instrument and the increasing popularity of table telephones generally, attention was directed towards the design of a table set incorporating the switching arrangements required for Plan No. 7. It was also desired to cater for Plans Nos. 5A and 5, which are similar arrangements providing for two extensions, with and without secrecy against the main station respectively, but limited to internal extensions.

The recently introduced Bell Set No. 39 and Telephone No. 248 (Fig. 1) meet these requirements for C.B. and automatic areas. It was decided not to design similar equipment for use on C.B.S. and magneto exchange lines in view of the obsolescent

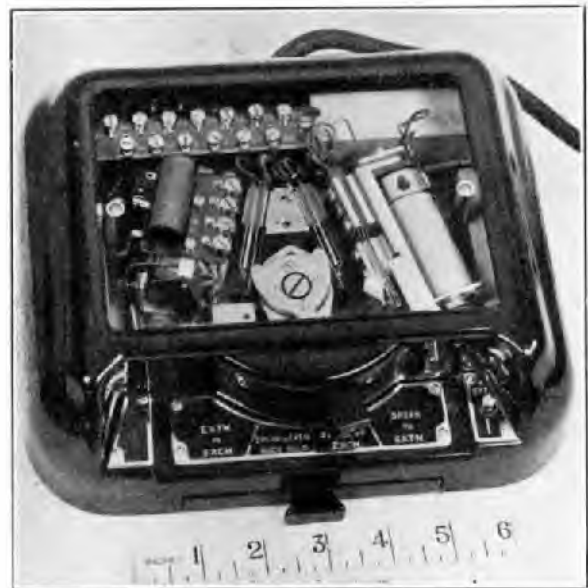


FIG. 2.—BELL SET NO. 39.

nature of these exchanges. At the extension standard instruments are used either incorporating a bell push or with this item mounted separately at internal extensions and with a separate hand generator at external extensions.

## Facilities Provided.

The bell set is fitted at the main instrument where exchange calls are normally received, and four switching positions set up conditions so that :

- (1) A conversation can be carried on between the main instrument and an extension, the main calling internal extensions by operating the appropriate press button on the bell set.
- (2) The main station can make calls to, or receive calls from, another subscriber via the public exchange, this being the normal position of the switch.
- (3) The main station can speak to an extension while holding an exchange call without the distant subscriber overhearing.
- (4) The extension can call the exchange direct (subject to the discretion of the main station) in which event a visual indicator on the bell set at the main instrument shows that the exchange line is in use.



FIG. 1.—TELEPHONE NO. 248 WITH BELL SET NO. 39.

### General Design.

The basis of design of the new instrument is the familiar two-piece combined table telephone set, the bell set (Fig. 2) being mounted underneath the telephone (supplied "minus base").

A large number of components is required at the main station, and it is clearly impracticable to mount all of them in a table set of reasonable dimensions. The magneto bell or bells are therefore mounted externally in the form of standard bell sets (Bell Sets No. 26). A separate hand generator when an

An extension of the switch arm is fitted with a moulded knob and moves in a horizontal arc in the front of the instrument, an engraved label showing the four switching conditions:—Speak to Extension; Speak to Exchange; Speak to Extension, Exchange Held; Extension to Exchange.

The contact springs are mounted in a vertical plane in four sets, the third set being underneath the first. Access to the lower springs for cleaning purposes is gained through three slots in the metal base plate, the directory tray slide having first been removed. Twin contacts are fitted, and the switch is designed to give a contact pressure of about 150 grammes. Faults on the switch should be comparatively rare, and it is not intended that the local staff should carry out maintenance adjustments.

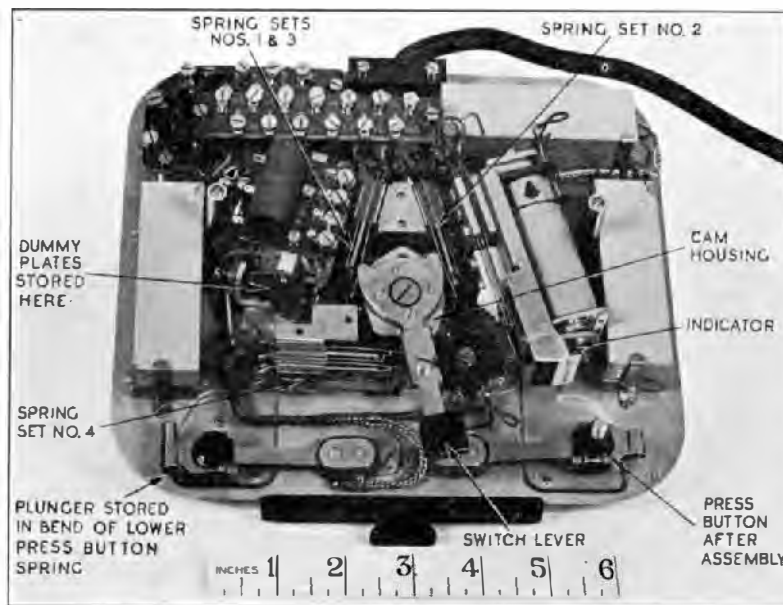


FIG. 3.—BELL SET CHASSIS.

external extension is concerned, and a three-cell Leclanche battery are also provided. The cradle switch, induction coil and dial are accommodated in the usual way in the telephone, while the remaining apparatus, described in some detail in the following paragraphs and shown in Fig. 3, is mounted on the metal baseplate which forms the chassis of the bell set. A sliding tray to accommodate a subscriber's personal directory is provided underneath the bell set.

### Switch Unit.

The switch unit is of very robust construction. Fig. 4 shows the principle of the construction adopted. A machined block of metal forms the body of the mechanism and is fixed to the baseplate by four screws. It houses a solid brass cam and is drilled to take 4 steel ball bearings (only 3 are shown in Fig. 4) which are pressed against the cam by flat steel springs. The cam is rotated by the switch lever, and in each of the four positions one or more of the ball bearings is pressed into cavities in the cam. The corresponding movement of the steel springs allows the appropriate contact springs to operate.

A pleasing snap action is thus obtained, and there is little chance of the switch lever being left in an intermediate position.

### Press Buttons.

Two press buttons, each operating a single "make" spring set, are provided, one on each side of the switch label, for ringing the extension (Plan No. 7 or 7A internal) or extensions (Plan Nos. 5 and 5A). Either or both the press buttons may be blanked out when not required (i.e., on a Plan 7 or 7A installation) by dummy plates, the plungers being stored in the bends of the lower springs of the spring sets. Alternatively, the dummy plates can be stored by fixing to the filter bracket with the small screw provided for this purpose.

The lower spring is bent up to form a carrier for a moulded saddle which takes the plunger, the complete assembly being self-centring in a conical hole in the bell-set cover.

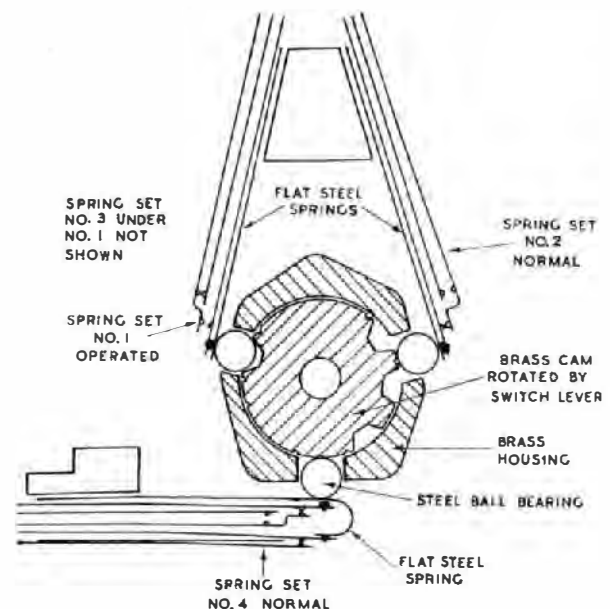
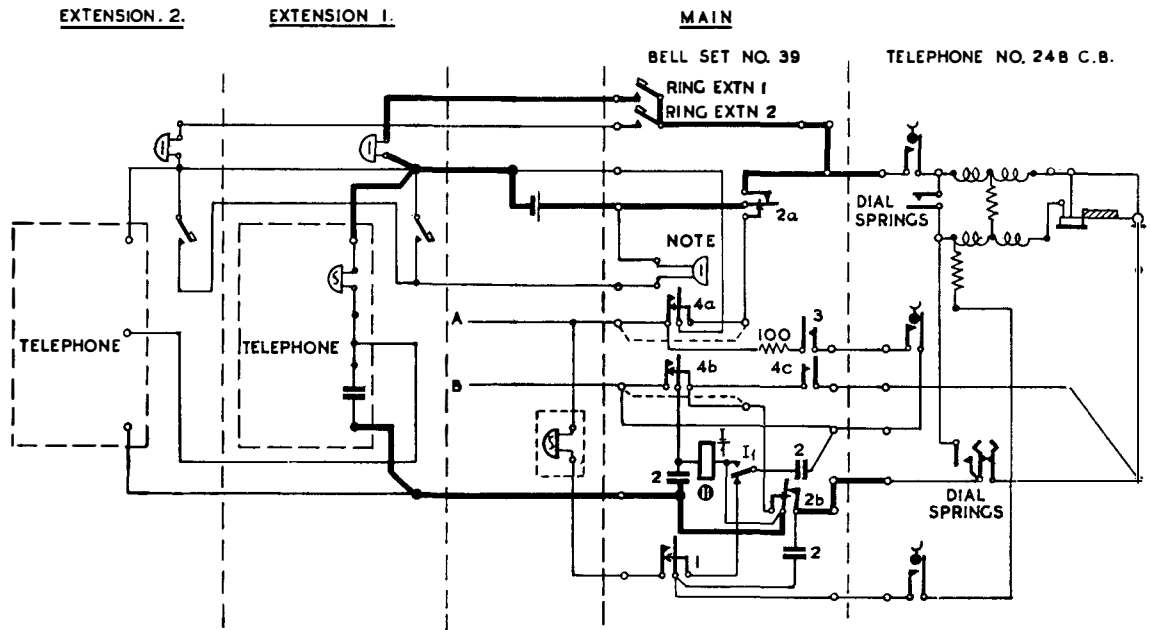


FIG. 4.—SWITCH UNIT (PART SECTION), SWITCH IN "SPEAK TO EXCHANGE" POSITION.



NOTE: BUZZER WITH SUPPRESSOR UNIT.  
 FIG. 5.—DIAGRAM OF BELL SET AND TELEPHONE SHOWING "SPEAK TO EXTENSION" CONDITION.

*Indicator.*

The indicator is provided to show when the extension is using the exchange line and consists of a 3,000-type relay having one change-over spring set and a flag attachment which shows the word "ENGAGED" through a small glass window in the bell-set cover when the relay is operated.

The indicator is designed to operate on a current of 30 mA and to hold during dialling on a current of 50 mA interrupted for  $66\frac{2}{3}$  mS ten times a second. The total resistance during dialling is therefore limited on this account to 1,000 ohms on a 50-volt exchange. With a feeding bridge of  $200 + 200$  ohms the limit of total line resistance is thus about 600 ohms, which is somewhat higher than that on transmission considerations. The resistance of the winding is 50 ohms and the transmission loss introduced by the indicator is less than 1 db.

*Other Components of Bell Set.*

The remaining components are standard items. A buzzer (Buzzer No. 24A) is provided to enable internal extensions to call the main, a filter unit being fitted to prevent radio interference. The exchange line "holding" loop consists of a 100 ohm resistor and a number of standard condensers is also included.

Connections to the bell set are made via two connection strips carrying a total of 25 terminals.

*Telephone.*

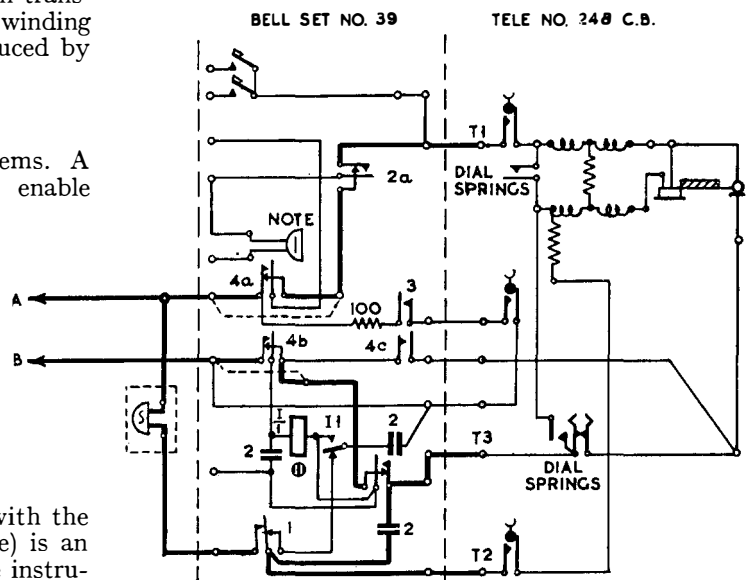
The special telephone introduced for use with the bell set (Telephone No. 248 C.B. minus base) is an ordinary C.B. anti-sidetone hand microphone instrument, but with an additional pair of cradle switch contacts to control the "hold" facility.

*Circuit Description.*

Fig. 5 is an explanatory diagram of the new bell set and telephone with the necessary wiring for connection to two internal extensions (i.e., Plan No. 5 or 5A). The contact springs operated under the various switching conditions are as follows:—

Position of Switch	Springs Operated
Speak to Exchange .. ..	1
Speak to Extension .. ..	2
Speak to Extension, Exch. held	2 & 3
Extension to Exchange ..	4

The "speak to exchange" condition is shown in Fig. 6. The exchange ringing circuit is from the



NOTE: BUZZER WITH SUPPRESSOR UNIT.  
 FIG. 6.—"SPEAK TO EXCHANGE" CONDITION.

A line, through the magneto bell in the external bell set, switch springs 1 operated,  $2\ \mu\text{F}$  condenser in the Bell Set No. 39, switch springs 2b and 4b normal to the B line. The exchange speaking circuit is from A wire, through switch springs 4a and 2a normal to telephone terminal T1, from B wire through switch springs 4b and 2b normal to telephone terminal T3, and from the junction of the magneto bell and  $2\ \mu\text{F}$  condenser to telephone terminal T2. The connections of the telephone from T1, T2 and T3 are those of a standard C.B. anti-

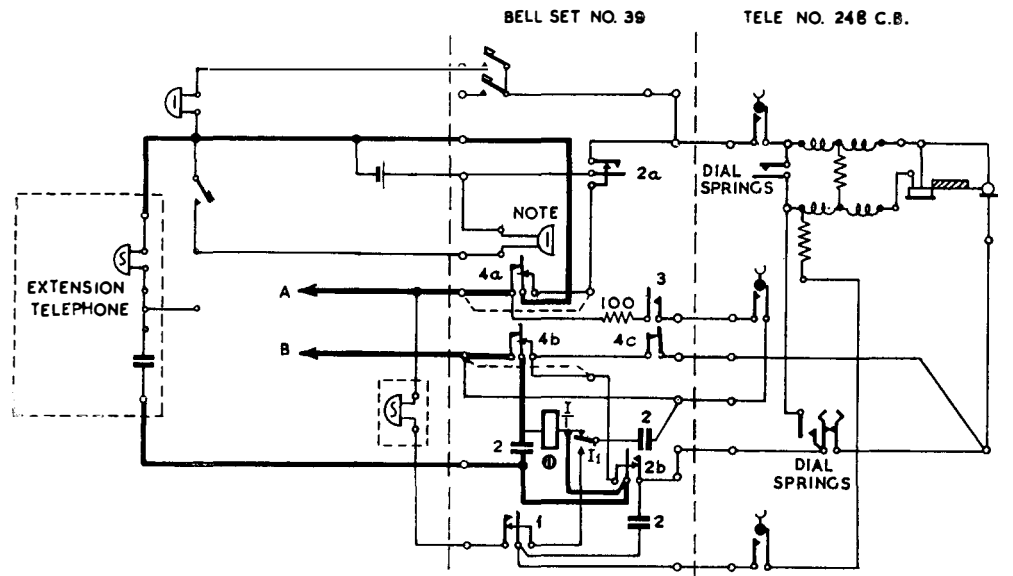
sidetone telephone. The exchange "hold" circuit is disconnected at switch springs 3 normal.

The main station cannot ring the extensions with the switch in this position, since the press buttons are disconnected from the local battery at contacts 2a normal. Depression of either of the press buttons at the extensions, however, operates the buzzer at the main station by application of the local battery.

In the "speak to extension" position of the switch (Fig. 5) switch springs 2a and 2b disconnect the main telephone from the exchange line and connect it to the extension speaking wires in series with the local battery. The magneto bell is left across the exchange line via the indicator contact I1 (normal) and a different  $2\ \mu\text{F}$  condenser. The first condenser remains in the telephone circuit to complete the anti-sidetone balance. Switch springs 2a also prepare the main to extension press-button calling circuit.

In the "speak to extension, exchange held" position of the switch the conditions are similar, but switch springs 3 are operated in addition, placing a 100 ohm loop across the exchange pair in series with the extra cradle switch springs. Thus the exchange line is not engaged if the switch is inadvertently left in this position with the telephone on its cradle.

In the position, "extension to exchange" (Fig. 7), switch springs 4a, b and c are operated. The exchange A wire is connected direct to the extension via the switch springs 4a, and the B wire is connected through the indicator, which is shunted by a  $2\ \mu\text{F}$  condenser. The magneto bell at the main instrument remains across the line in series with a  $2\ \mu\text{F}$  condenser until the receiver is lifted at the extension, when the operation of the indicator disconnects this bell, and places an additional  $2\ \mu\text{F}$  condenser across the indicator. The disconnection of the bell is required to prevent it tinkling when the extension dials.



NOTE: BUZZER WITH SUPPRESSOR UNIT.

FIG. 7.—"EXTENSION TO EXCHANGE" CONDITION.

If secrecy against the main station on extension to exchange calls is not required, springs 4a and 4b are strapped, and the main instrument is not then disconnected. Switch springs 4c short-circuit the dial-impulsing springs of the main telephone, preventing this station from dialling and thus tinkling the bells at the extensions. This also prevents the distortion of impulses by the bells and condensers since a caller from the main station must place the switch in the correct position (speak to exchange) in order to dial out.

When the bell set is used with an external extension the battery calling circuits are disconnected and condensed generators are provided at each end of the extension pair while an additional condensed magneto bell is connected at the main station.

#### Conclusion.

The new instrument is a considerable improvement on the previous equipment, and should meet a long-felt want.

It overcomes two serious circuit difficulties which existed on its predecessor—the "hold" cannot be accidentally left on the exchange line, since it is disconnected by the cradle switch. Also, the impulse springs of the dial at the main station are short-circuited while the switch is in the "Exch. to Extn." position, thus preventing wrong number trouble due to distorted impulses caused by the extension's bell and condenser being connected across the line.

The combined set is more convenient to use and of more pleasing appearance than the old pattern equipment, and its robust construction and easy accessibility should ensure that there will be little trouble from faults.

The instrument has been developed in collaboration with Messrs. General Electric Company, Ltd., of Coventry.