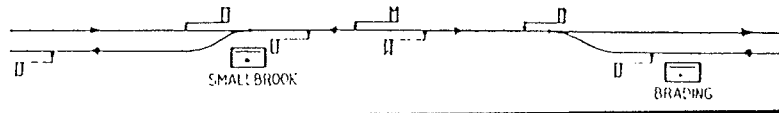
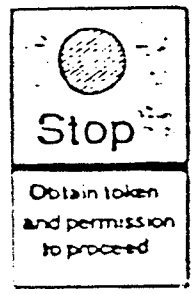
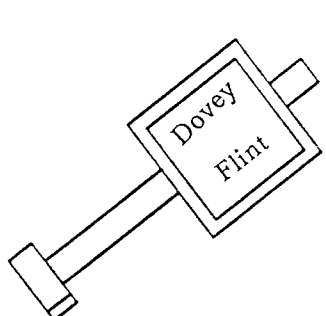


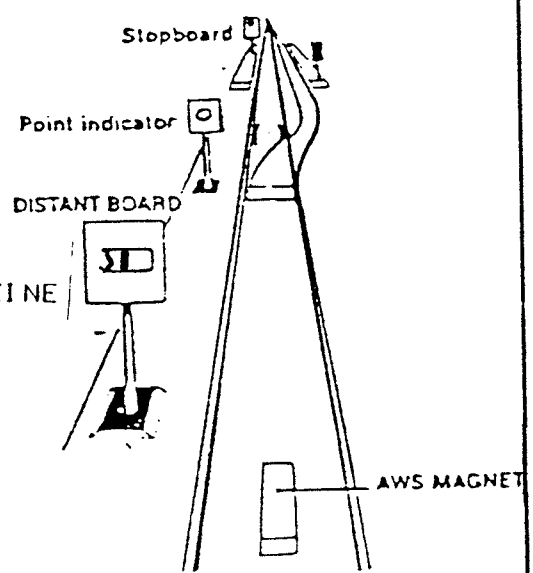
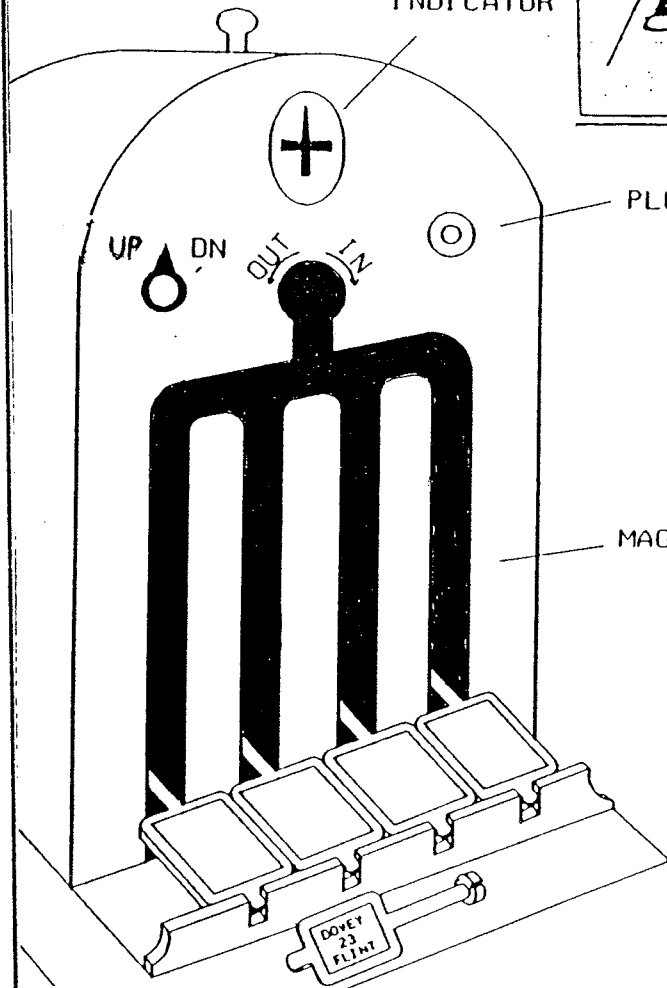
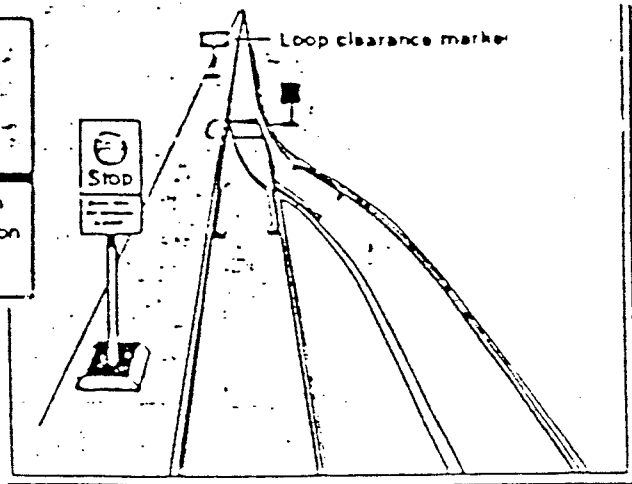
DIRECTOR OF S & T ENGINEERING.
WEST MIDLANDS PROJECTS GROUP.



OPERATION OF SINGLE LINES



GALVO INDICATOR



OPERATION OF SINGLE LINES

Extract from Railway Construction and Operation Requirements for Passenger Lines and recommendations for Goods Lines, section C - Operation of Single Lines (Department of Transport Requirements).

SECTION C

Operation of Single Lines

1. On single lines used for passenger traffic, arrangements must be made to prevent opposing movements, as well as to maintain a space interval between following trains. As a rule some form of token should be used to authorise movement in each single line section, as described under Methods I to IV below, with regulations to the effect that no engine or train may travel on the single line, beyond the protection of the signals at a crossing place, unless its driver is in possession of the appropriate token. Alternatively, a non-token method of operation, depending only on obedience to signals, as in Method V, may be adopted where specially approved.

In each case a formal undertaking must be sent to the Ministry of Transport, and Civil Aviation stating the method of operation which will be adopted.

NOTE: In the following paragraphs the term "section" signifies a length of single line between signalled crossing places. The term "train" includes light engines or rail motor vehicles running singly or coupled together.

2. **Method I. Train-staff and ticket.** With this system a train-staff and a set of train tickets, of paper or metal, are required as tokens for each section. No train may leave a crossing place unless the train-staff for the section through which it is about to travel is then at that crossing place, and no driver may proceed into a section, except for the purpose of shunting within the protection of signals, unless he has the train-staff in his possession, or has seen it.

So long as movement through a section takes place alternately in opposite directions, the driver of each train must carry the train-staff as his authority. But if two or more trains require to travel in succession through a section in the same direction, before any train passes through it in the reverse direction, the driver of each except the last must be shown the train-staff and be given a train ticket as his authority to proceed. The train-staff will then be carried through the section by the driver of the last train of the series.

3. The train-tickets to be kept in the signal box or booking office in a locked box can only be opened by a key forming part of the appropriate train-staff. Removal of the train-staff must re-lock the ticket box.

OPERATION OF SINGLE LINES

4. The absolute block system with suitable block instruments must be used to ensure a proper space interval between trains. A single line section may be divided into two or more block sections by intermediate block posts with the necessary signals, in order to increase its capacity for following movements.
5. **Method II. Divisible train-staff.** In this modification of Method I the train-staff has one or more detachable portions, each serving as a train-ticket and so labelled. The "tickets" must remain attached to the train-staff and travel with it, except when removed for issue to the drivers of the earlier trains of a series travelling through a section in the same direction, to whom the train-staff must be shown; also the direction of movement through a section must not be reversed unless the train-staff and all its "tickets" are at the crossing place from which the next train will start. In other respects the routine to be followed is the same as in Method I, and the absolute block system must be used to ensure a proper space interval between following trains.
6. **Method III. "One engine in steam."** With this system there must not be more than one train upon the single line or any section of it at one and the same time. The train-staff for the line or section must be carried on the train, and no train-tickets may be used. Block instruments are not necessary.
7. **Method IV. Electric token.** The instruments at opposite ends of a section in which the tokens (electric staff, tablet, or key-token) are kept must be so arranged that after withdrawal of a token from one of them a second token cannot be obtained from either instrument until the one already withdrawn has been transferred to the instrument at the far end of the section, or returned to the instrument from which it was taken. Separate block instruments are unnecessary, but if token instruments are provided at intermediate block posts between crossing places they should be interlocked to prevent the simultaneous issue of tokens for movement in opposite directions.
8. The line wire connecting token instruments should preferably have continuous insulation as a precaution against accidental contact with other wires; a continuous uninsulated return wire may be necessary to prevent interference with the instruments by earth currents.

OPERATION OF SINGLE LINES

9. Auxiliary token instruments, to be operated by station staff or enginemen and controlled by the main instruments for the section, may be used where necessary, to avoid delay in obtaining a token from a signal box, or surrendering it. Intermediate token instruments similarly controlled may be provided at outlying sidings in order that the main instruments may be restored to normal, and through running resumed, when a train working at the siding has been shunted clear of the running line and while the token carried by it is locked in the intermediate instrument.

A bank engine token may be used where specially approved, to enable an engine to return from an intermediate point in the section to the station from which it started, after assisting a train from the rear.

10. **Notes on the foregoing Methods.**

- (i) **Marking and custody of tokens.** Tokens and train-tickets must be clearly marked with the name of the section for which they are valid; those for adjoining sections must differ in colour or in shape, or both. Only the person authorised to do so may hand the token to a driver or receive it from him, or show the train-staff to him under Methods I and II.
- (ii) **Outlying sidings.** Points leading to sidings in a section must have some locking device which can be released by insertion of the token for the section, including the train-tickets used in Method I, if of metal; they must be left normal for through running before the token can be removed.
- (iii) **Long and short section tokens.** Special signalling arrangements may be made to enable crossing places to be closed when traffic is light. These must include some interlocking device to make the short section tokens unobtainable when the long section token is in use, and vice versa.
- (iv) **Motor trolley and Engineer's Occupation.** Where motor trolleys are used for track maintenance, arrangements are necessary to ensure that they are clear of the line at derailing points before the token for the section can be obtained. Similar arrangements for controlling the issue of tokens may be required to enable permanent way work to be carried out in the section without protection by flagmen.
- (v) **Starting signal release.** It is desirable to control the signal leading to a section so that it cannot be cleared unless the appropriate token has been obtained from the token instrument under Method IV or the staff is available for issue to the driver under Methods I and II.

OPERATION OF SINGLE LINES

11. **Method V. Direction lever and track circuit.** This non-token system requires continuous track circuits through the section. The signals for entering it to be so controlled that they cannot be cleared unless all track circuits in the section are unoccupied, and unless released by the signaller at its far end; his release must be repeated each time the signals are cleared and there must be a control to ensure that they are put to Danger behind each departing train.

Precautions against disregard of signals may be required in the form of detonator placers working with them or of facing trap points.

12. **Other methods.** Other methods of operation, or a combination of adaptation of the foregoing methods to meet special conditions, may be approved; full particulars of the arrangements to be adopted should be submitted before installation.

Since these requirements were written two other methods of "Single Line Working" have been used on British Rail that are worth noting namely:- "Tokenless Block System" and "Radio Electronic Token Block" (RETB).

TOKENLESS BLOCK

The objective of the Tokenless Block System is to provide a safe means of signalling trains over a single track without the necessity of their slowing down or stopping to exchange staffs or tokens.

The system obviates the need for continuous track circuiting throughout the section, the signaller being responsible for ensuring that trains have arrived complete with tail lamp.

The signaller is provided with visual indicators in the Signal Box.

RADIO ELECTRONIC TOKEN BLOCK

The communication link between Signal Boxes in rural areas is provided mainly by lineside poles carrying the necessary telegraph and telephone circuits.

Their vulnerability to extreme weather conditions and the consequent high cost of repairs led BR engineers to consider the use of radio as a replacement.

What has emerged from their studies carried out is the concept of the computer based electronic token block system using a radio link between the Signal Box and the trains. ie. the token is carried electronically on the train.

OPERATION OF SINGLE LINES

METHODS OF OPERATION

We will now look at some of the previously mentioned methods of operation, however mainly we will concentrate on the Electric Key Token method of single line operation to achieve a basic understanding of the principles of operating the single line safely.

“One engine in steam” or “One train working”

With this system there must not be more than one train upon the single line or any section of it at one and the same time. The train-staff for the line or section must be carried on the train. Block instruments are not necessary.

The system is usually limited to branch lines of which one end is a terminal and the traffic requirement is such that only one train need occupy the branch at a time. An engraved staff is provided as the driver's authority to occupy the section and he must be in possession of this before proceeding. Only one staff is provided and it may have attached to it a key which will unlock any of the ground frames in the section.

Refer to Fig. 1, Sketch “B”

“Train staff & ticket”

One engraved staff is provided for each section. If it is required that succeeding trains are to pass through the section, then the staff is shown to the driver of the first and subsequent trains. The drivers are respectively handed a written ticket authorising them to proceed through the section. The last train which is to pass through the section before a train is to pass in the opposite direction must carry the staff. This is because no train may enter the section from either end without seeing the staff.

The tickets may take the form of standard metal tabs of which a unique number are kept. The tickets must be kept in a locked box, which can only be opened by a key forming part of the appropriate train staff. Removal of the train-staff must re-lock the ticket box. Therefore, tickets may only be obtained at the sending end if the section staff is present.

The Absolute Block System with block instruments must be used to ensure a proper space interval between trains.

Refer to Fig. 1, Sketch “A”

OPERATION OF SINGLE LINES

“Divisible train staff”

This is similar to staff and ticket. The staff divides into several sections. The first train is shown the whole staff and then handed a portion of it. A succeeding train is shown the remainder of the staff and handed a portion of it. The last train to travel through the section must carry the whole of the remaining portion of the staff. The staff must be complete at the sending end after a change of direction.

The Absolute Block System with block instruments must be used to ensure a proper space interval between trains.

Refer to Fig. 1, Sketch “A”

“Electric Token”

Principles:-

The instrument at opposite ends of a section in which the tokens (key token, electric staff or tablet) are kept must be so arranged that after withdrawal of a token from one of them a second token cannot be obtained from either instrument until the one already withdrawn has been transferred to the instrument at the far end of the section, or returned to the instrument from which it was taken.

Refer to Fig. 1, Sketch “A”

Auxiliary token instruments, to be operated by station staff or enginemen and controlled by the main instruments for the section, may be used where necessary, to avoid delay in obtaining a token from a signal box, or surrendering it.

Refer to Fig. 2. Sketch “C”

Intermediate token instruments similarly controlled may be provided at outlying sidings in order that the main instruments may be restored to normal, and through running resumed, when a train working at the siding has been shunted clear of the running line and while the token carried by it is locked in the intermediate instrument.

Refer to Fig. 2, Sketch “D”

The instruments are provided to hold up to forty keys in a magazine. Each key is engraved with the name of the section and is allocated a unique number. The instruments at each end and also any auxiliary intermediate instruments are electrically interlocked so that only one key may be out at a time.

OPERATION OF SINGLE LINES

If two sections of single line are separated by a passing loop then the keys for the adjacent sections are of a separate configuration to prevent them being placed into the wrong instrument.

The keys will also unlock any ground frames that may be in the section.

“Key Token Instrument” (Refer to Fig. 3)

The instrument consists essentially of:-

A PLUNGER for transmitting bell signals to the distant token station, or for sending current for releasing a token.

A POINTER for indicating the state of the sections at any time. This is worked manually in some instruments and electrically in others.

AN INDICATOR for indicating all outgoing and incoming signals sent on the plunger at either end of the block section. Each instrument is provided with a bell.

A MAGAZINE for receiving TOKENS.

In order to understand the method of working adopted on the single line we will consider the wiring diagram “Llanfair, Standby token working.” (Fig. 04)

This diagram shows two “Tyers” key token instruments controlling the stretch of line between Menai Bridge and Llanfair itself.

For this exercise Llanfair will be known as Box “A” and Menai Bridge as Box “B”.

With the wiring diagram to refer to let us now consider the Key Token working itself.

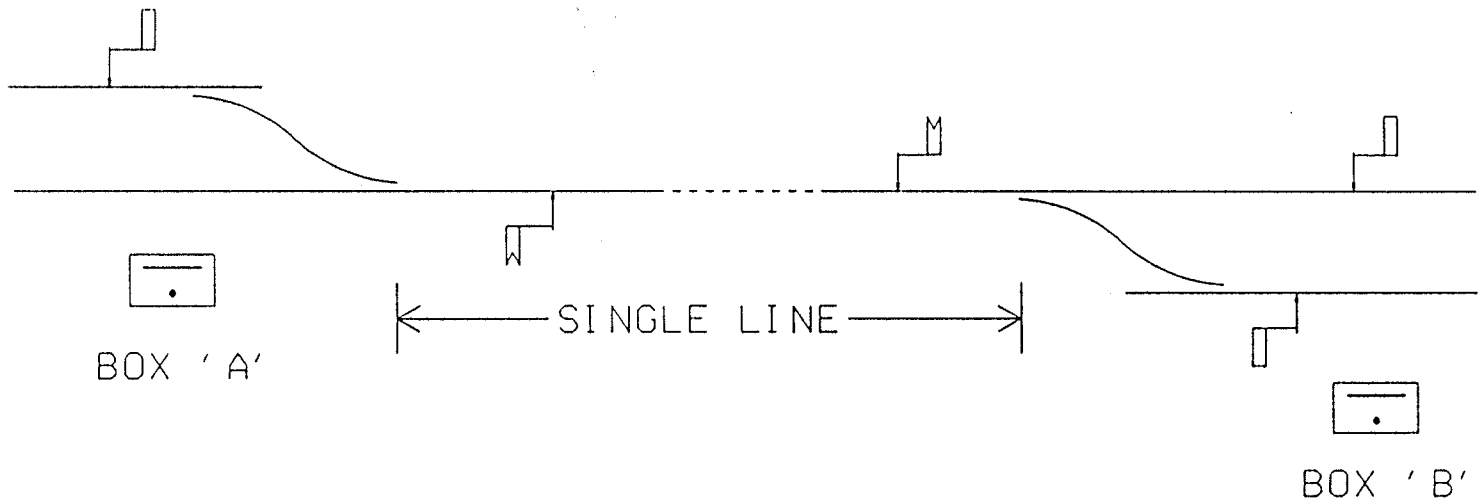
1. Assume a train wishes to travel along the single line from A —>B.
2. Both instruments are “IN PHASE” position 1 & 1 or position 3 & 3, assume both instruments are in position 1 & 1.
3. “A” sends “IS THE LINE CLEAR” on bell plunger to “B”. If “B” accepts, then at the end of the bell signal “B” holds down the plunger.
4. “A” turns the key to position 2, this is the lock face position that the signalman has to go through before the token can be withdrawn (positions 2 & 4 are both lock positions).

OPERATION OF SINGLE LINES

5. S/Man turning key to position 2 enables polar relay in the single line instrument to operate and close its contact, allowing the key to be withdrawn and the instrument to be in position 3.
 6. When "A" is in position 3 and "B" in position 1 the instruments are said to be "OUT OF PHASE" by holding down plunger at "B" to try to give a release to "A". You will prove that the polar relay is deflected in the opposite direction and the token cannot be withdrawn.
 7. When the train has passed through the section it arrives at box "B" and the token is handed to the s/man who places it into the instrument and turns the key token instrument from position 1 —>3 both instruments are back "IN PHASE" ready for withdrawal of a key from either instrument.
- NB. The key token for that section of line is the drivers permission to occupy that stretch of single line.

OPERATION OF SINGLE LINES

SKETCH A



SKETCH B

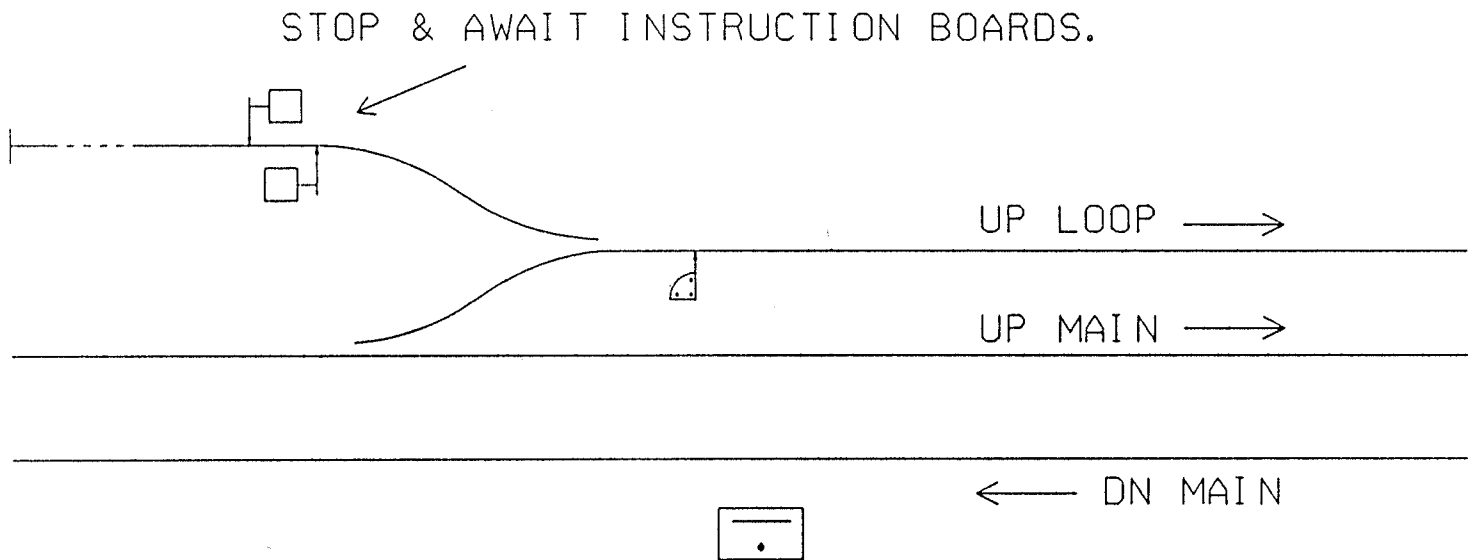
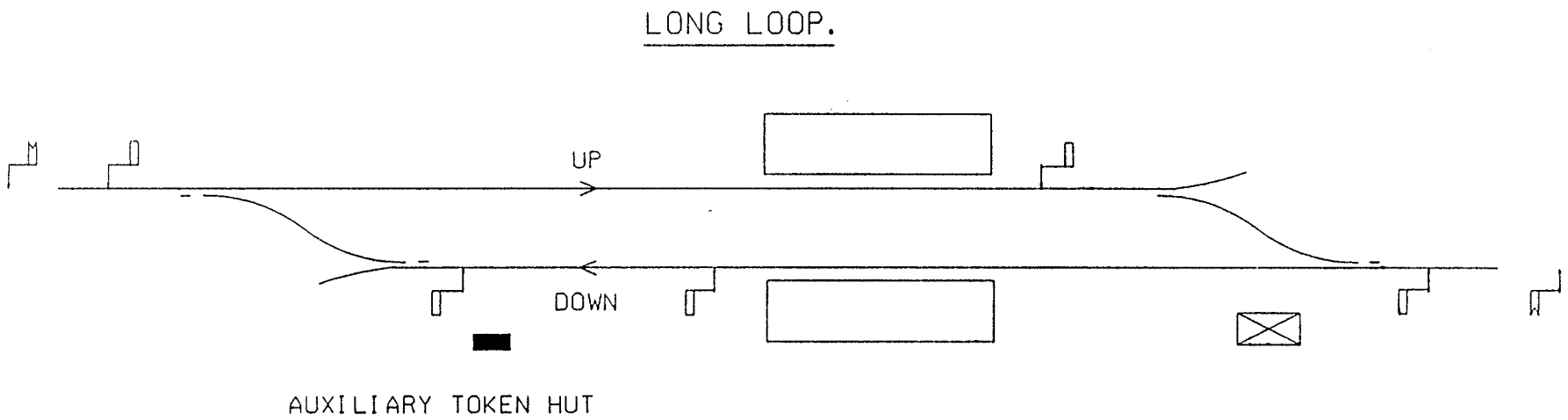


FIGURE 1.

continued

OPERATION OF SINGLE LINES

SKETCH C



SKETCH D

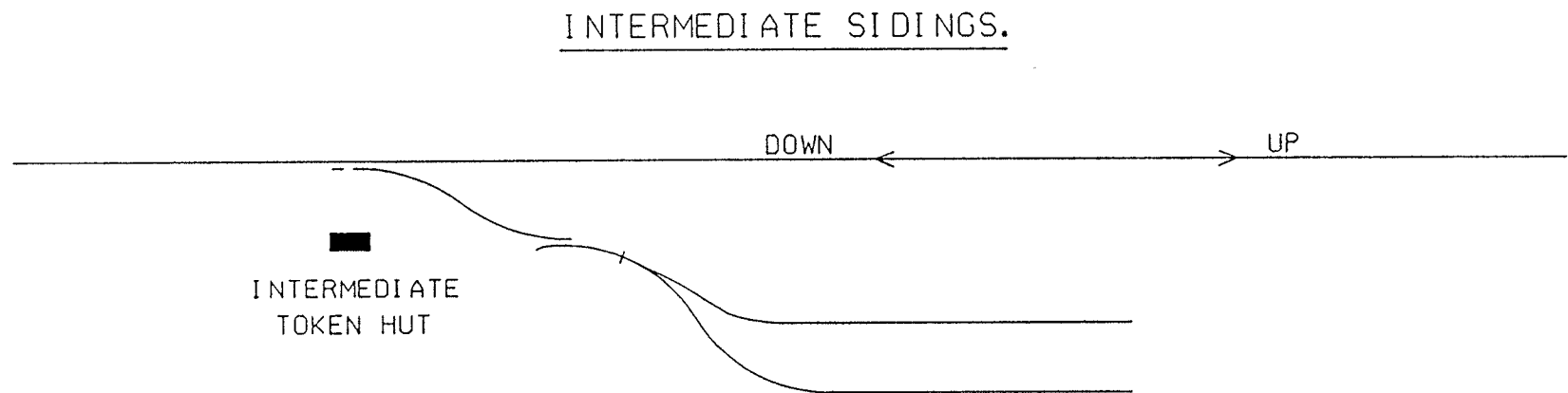
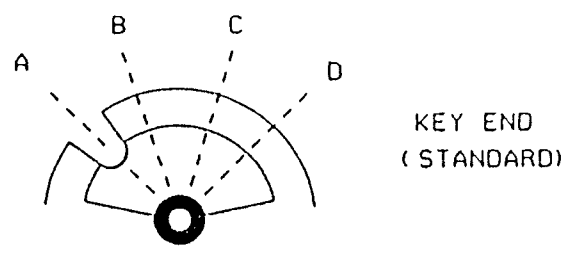
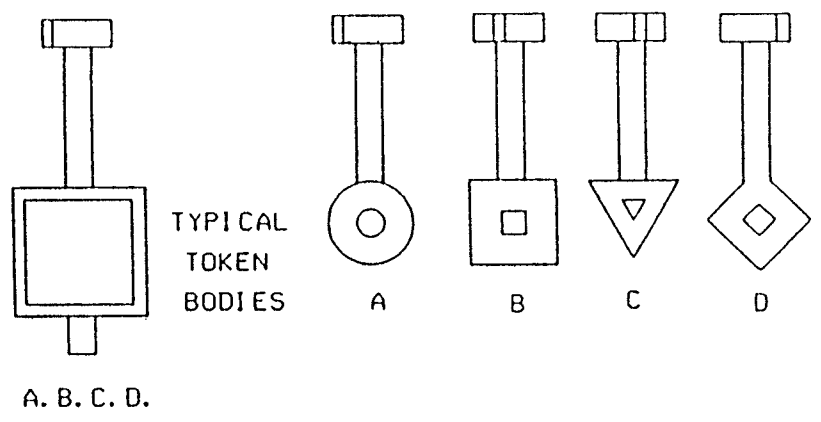


FIGURE 2.

continued

OPERATION OF SINGLE LINES

KEY TOKEN CONFIGURATIONS.



- TOKEN COLOURS (STANDARD) {
- A. RED
 - B. BLUE
 - C. GREEN
 - D. YELLOW

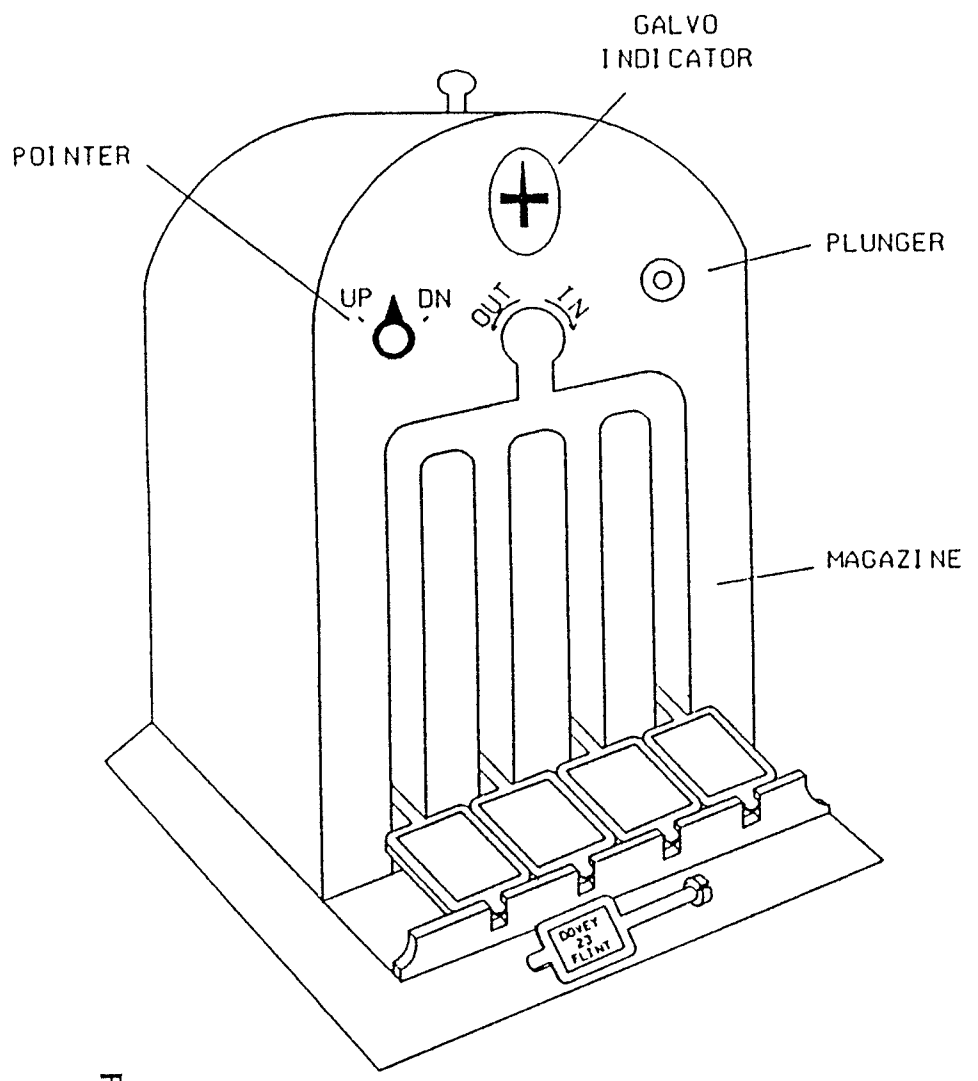


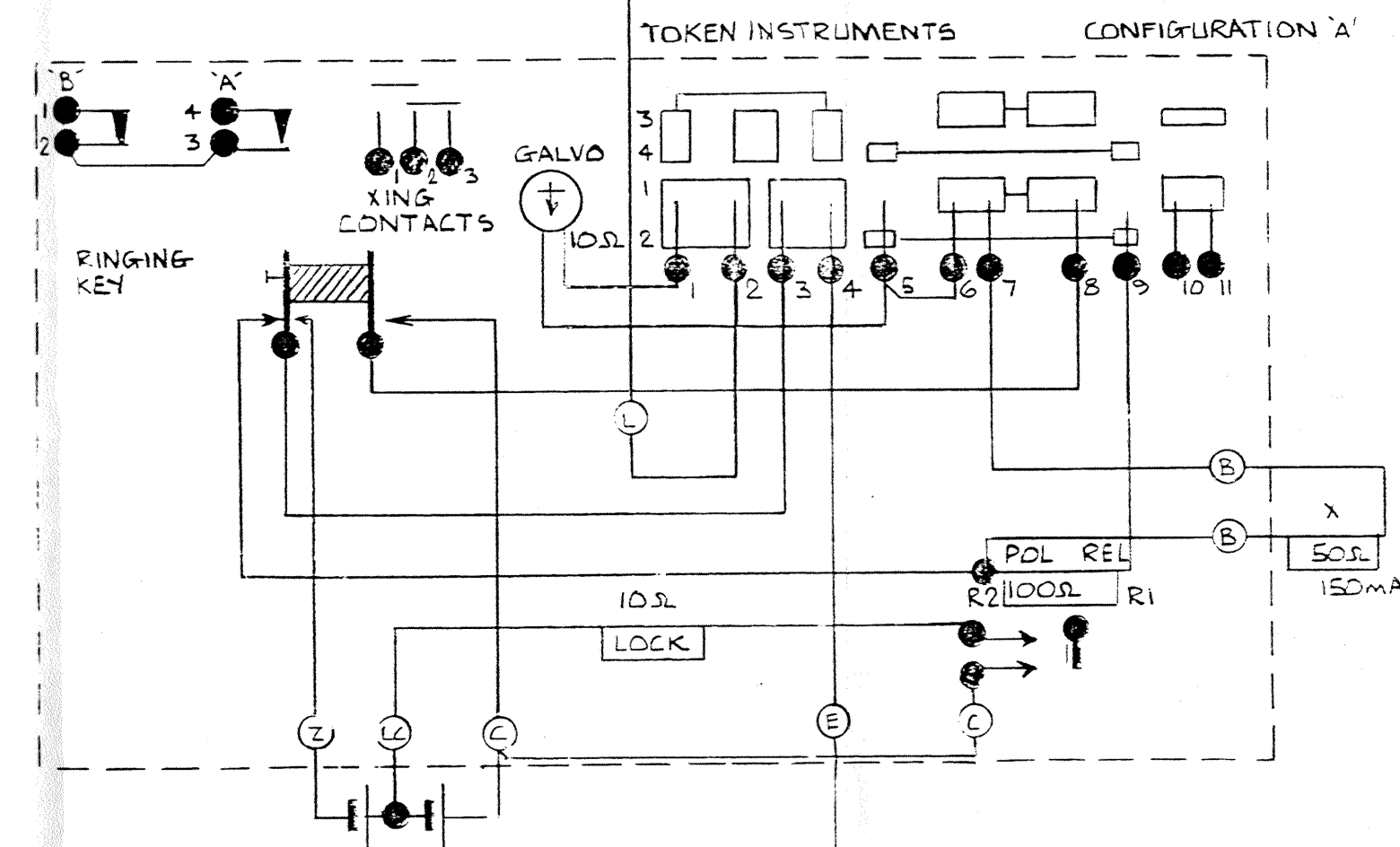
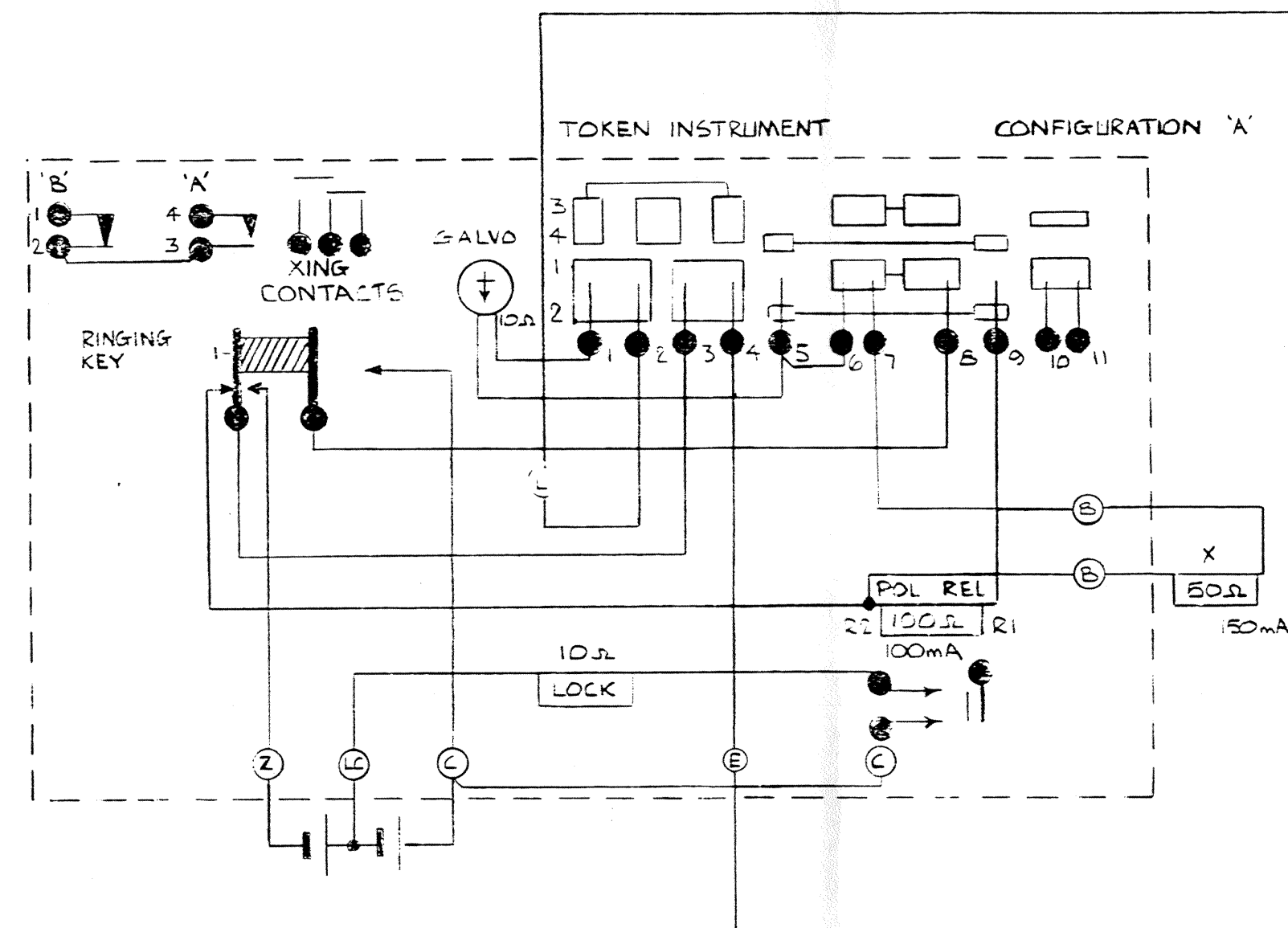
FIGURE 3.

continued

OPERATION OF SINGLE LINES

LLANFAIR

MENAI BRIDGE



OPERATING NOTES
NORMAL LINE CURRENT APPROX 110mA
OPERATING VALUES ARE MINIMUM FIGURES

POSITIVE TO R1 FOR RELAY
CORRECT OPERATION

LLANFAIR
STAND-BY TOKEN WORKING

AMENDMENTS

REDMAN/JAN 90
J. RODDY