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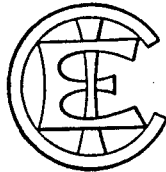
Diagrams, charts, tables

Part 4: Recommendations for the preparation of circuit diagrams.

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CONTENTS

	Pages
FOREWORD	5
PREFACE	5
Clause	
1. Scope	7
2. Purpose of a circuit diagram	7
3. Contents of a circuit diagram	7
4. General guiding principles	7
4.1 Layout	9
4.2 Functional grouping	9
5. Arrangement of symbols on diagrams	9
5.1 Methods for indicating symbol location	11
5.2 Methods of circuit representation	11
5.3 Separation of symbols in detached representation	15
5.4 Methods of referencing parts in the case of detached representation	15
5.5 Representation of unused elements	17
5.6 Representation of contacts	21
6. Representation of circuits	21
6.1 General	21
6.2 Representation of supply	21
6.3 Representation of main circuits	23
6.4 Detailed recommendations	31
6.5 Simplifications	39
6.6 Recommended layout for some fundamental circuits	43
7. Markings and designations	45
7.1 Item designation	45
7.2 Designation of terminals and junctions	45
8. Explanatory notes	45
9. Inscription of technical data	45
10. Examples of complete circuit diagrams	45
FIGURES 37 to 48.1	50

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIAGRAMS, CHARTS, TABLES

Part 4: Recommendations for the preparation of circuit diagrams

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This recommendation has been prepared by Sub-Committee SC 3B, Preparation of Diagrams, Charts and Tables. Item Designation, of IEC Technical Committee No. 3, Graphical Symbols.

A first draft, prepared by the Secretariat of SC 3B, was discussed at the meeting held in Helsinki in 1971, and a second draft was discussed at the meeting held in Paris in 1972. The draft was submitted to the National Committees for approval under the Six Months' Rule in April 1973.

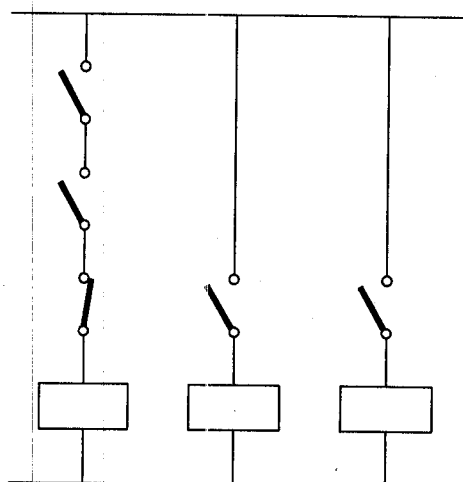
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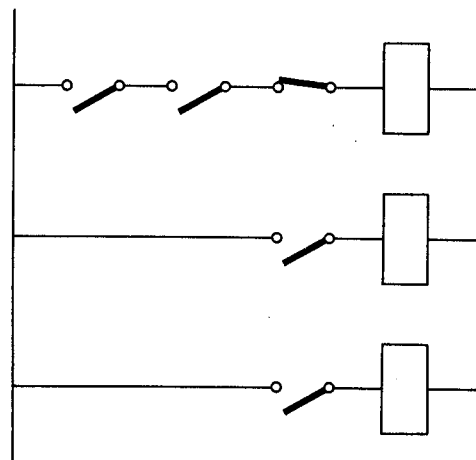
Lines representing conductors on a diagram should be straight with a minimum of cross-overs and changes of direction. Individual circuits should preferably be arranged vertically as shown in Figure 1 or horizontally as shown in Figure 2.

In Figures 1 to 36, T-junctions are shown without a dot. In accordance with IEC Publication 117, Recommended Graphical Symbols, it is equally permissible to draw T-junctions with a dot or a circle. One of the three methods should be used consistently in each diagram or set of diagrams.



486/74

FIGURE 1



487/74

FIGURE 2

4.2 Functional grouping

It is recommended that symbols for circuit elements performing a basic function, not necessarily in the same constructional unit, be grouped together. Whenever possible, functional groups should be arranged so that the sequence of events or signal flow are clear, with other elements also arranged to serve this purpose. Circuits should preferably be drawn so that this sequence is shown from left to right or from top to bottom.

5. Arrangement of symbols on diagrams

5.1 Methods for indicating symbol location

5.1.1 Grid reference system

The grid reference system is described in IEC Publication 113-3. For examples, see:

- Figure 38 (pages 51 and 52), using references with sheet numbers and row designations,
- Figure 39 (page 53), using references with column designations,
- Figures 43 (page 60) and 44 (page 62), using references with rectangular zone designations.

5.1.2 Tabular system

Along a horizontal edge of the drawing, the item designations are repeated above or below the corresponding symbols. These item designations are usually arranged in rows, a row for capacitors, a row for resistors, etc. See Figure 47 (page 65). A similar vertical arrangement is also permissible.

5.1.3 Circuit reference system

Circuits such as shown in Figures 1 and 2 may be identified by circuit numbers. For example, see Figure 40, page 54.

5.2 Methods of circuit representation

The following methods of representation are defined in IEC Publication 113-1:

- assembled representation,
- semi-assembled representation,
- detached representation.

5.2.1 Assembled representation

In simple diagrams, it may be satisfactory to show the symbols for the parts of multipart components such as relays, keys, switches, etc., in close proximity. For example, see Figure 3.

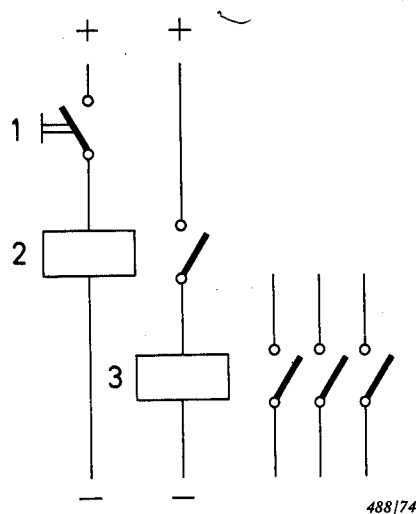


FIGURE 3

5.2.2 Semi-assembled representation

Semi-assembled representation with straight mechanical linkage symbols, for example, see Figure 37 (page 50), may result in bends of circuit lines and crossing of lines, and this considerably reduces the clarity of the circuit representation.

To clarify the diagram, it may be necessary to allow crossings, bends and branching of linkage lines. For example, see Figure 14 (page 27) and Figure 38, sheet 2 (page 52).

5.2.3 Detached representation

Detached representation, see Figure 39 (page 53), leads to a considerable simplification of drawings, but introduces the problem of indicating which parts belong to the same component. Some recommended methods are described in Sub-clause 5.4.

5.3 Separation of symbols in detached representation

When detached representation is used, the symbols for the parts of a multipart component will usually be spread over the circuit diagram.

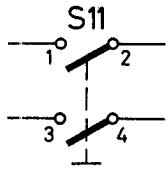
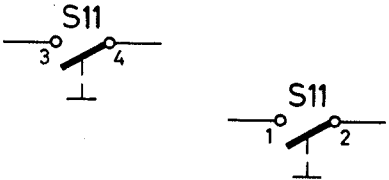
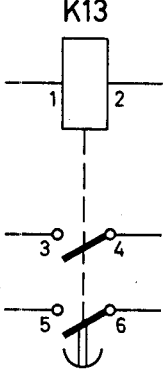
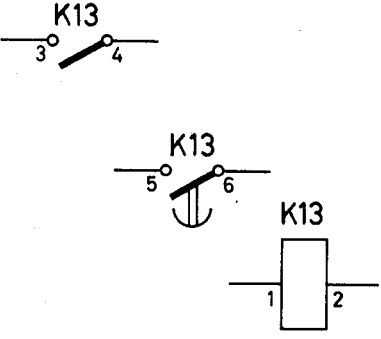
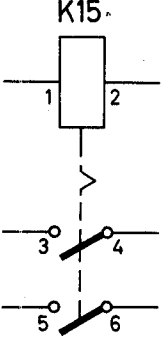
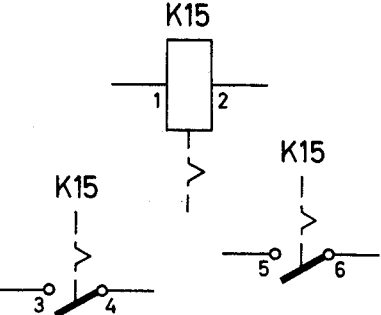
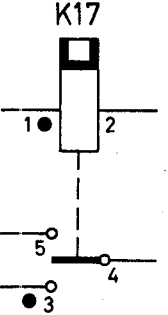
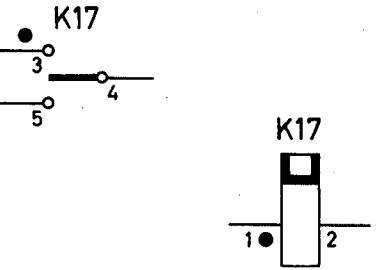
Where necessary, symbols for relays, manually operated switches, etc., are shown with qualifying symbols to describe the operation, e.g. symbols denoting polarization, delay, automatic reset, etc.

The same amount of information should be given in diagrams where detached representation is used. In principle, therefore, the qualifying symbol should be shown associated with each symbol part concerned.

Table I shows some examples of how this can be done.

TABLEAU I
Exemples

TABLE I
Exemples

N° No.	Représentation assemblée Assembled representation	Représentation développée Detached representation
1		
2		
3		
4		

489/74

5.4 Methods of referencing parts in the case of detached representation

On a diagram in detached representation, the symbol for each part shall be referenced so that:

- it can be seen without ambiguity that all the various parts of any given component in fact belong to that component,
- the location of any given symbol on the diagram can easily be found.

This information may be given by:

- a) inset diagrams, or
- b) tables.

If it is not possible to place the inset diagrams or tables in line with the corresponding circuits, they may be located elsewhere on the diagram or on a separate sheet. In this case, they should be supplemented by an indication of the location of the operating device.

Note. — Such references may not be necessary in certain simple cases where the addition of the mechanical linkage symbol is sufficient. See for example switch — S1 in Figure 39 (page 53).

5.4.1 Inset diagrams

Figure 39 (page 53) gives an example of this method. For each contactor or relay, an inset diagram showing all its coils and contacts is shown below the circuit which contains the coil. For example, in column 7 the diagram for contactor +A4 — K1 appears below the symbol for its coil. The reference at the left of a contact symbol indicates the column where the contact is shown in a circuit. Thus the symbol for contact with terminal markings 21-22 is to be found in column 8 of the diagram.

Similarly, for each contact shown in the circuit diagram a reference to the position of the coil is given. For example for contact +A2 — K3, shown in a circuit near the top of column 6, the reference 5 indicates that coil +A2—K3 can be found in column 5.

Figure 44 (page 62) is an example where all inset diagrams are placed together to the right on the drawing and shown in topographical representation. Topographical representation may be specially suitable for components with complicated contact units where there is no space for terminal markings. The arrangement of the terminals is shown in this example as seen from the wiring side.

Another method of indicating the location of symbols for multipart components is by inset diagrams as shown in Figures 43.1 and 43.2 (page 61).

5.4.2 Representation by table

The inset diagrams may be replaced by tables giving the same information. For relays, contactors, etc., Table II is typical and applies to contactor +A4 — K1 in Figure 39.

TABLE II

Make contact	Break contact	Column
1-2	21-22	3
3-4		3
5-6		3
13-14		7
23-24		8

Note. — Symbols may be used, instead of words, for column headings. For example, see Figure 40 (page 54).

If there are terminal markings on the component or if they are known by convention, they should be shown in the table. In other cases, an arbitrary identification, e.g. a dot, should be used in the table.

5.5 Representation of unused elements

On the final diagrams, prepared after design and development, unused elements, e.g. contacts, windings and terminals, should be shown or referenced.

In semi-assembled representation, the unused elements shown should be linked with the other elements of the same multipart component, e.g. the unused contacts of a relay on the dashed line representing the mechanical coupling. For example, see Figure 37 (page 50).

When detached representation as described in Sub-clause 5.4 is used, the absence of a reference in the inset diagram or table denotes that the element is not used in the equipment. Example, see Figure 39 (page 53) and Table II, contact 23-24 of contactor + A4 — K1.

5.6 Representation of contacts

Wherever practicable, consistent orientation of contact symbols for relays, contactors, etc., is recommended. When using detached representation in circuits with complicated contact arrangements, a clear layout of the diagram without crossings has preference over consistency in contact symbol orientation.

All contact symbols shown on one mechanical linkage symbol should have the same direction of movement when actuated by the same actuating device.

For contacts which are not electrically and not manually operated, it is necessary that the circuit diagram should contain an indication of the means of operation. The contact symbol should be drawn in a position consistent with that indication.

The indication adjacent to a symbol may consist of:

- A graph:* Examples of graphs are given in the left hand column of Table III. In these examples, 0 on the vertical axis stands for "contact open" and 1 for "contact closed".
- A symbol for the operating device:* For cam-operated devices (chosen as an example of operating devices), the symbols shown in the right-hand column of Table III may be used.
- A note, designation or table:* A short text such as shown in Figure 4 may be suitable in some cases.

Example: Motor equipped with centrifugal switch.

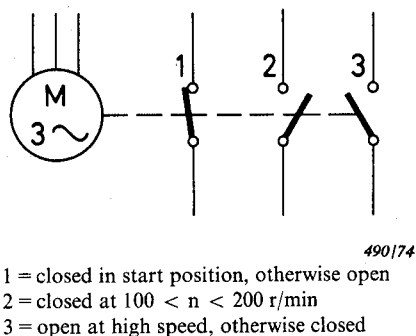


FIGURE 4

TABLE III

Example	Description in circuit diagram:		Explanation
	by graph	by cam symbol	
1			Contact closed at temperatures equal to or exceeding 15 °C
2			Contact closes when temperature increases to 15 °C and then opens when temperature decreases to 10 °C
3			If it is desirable to show that the reset value is only of secondary interest, the reset value is shown in brackets: contact closes when speed decreases to 5 m/s and opens when speed increases to about 5.2 m/s
4			Contact closed between 60° and 180° and also between 240° and 360° (0°), otherwise opened
5			Contact opened between position X and position Y, otherwise closed
6			Contact closed only when passing position X
7			Contact closed only in end position X
8			Contact opened only in end position X

491/74

6. Representation of circuits

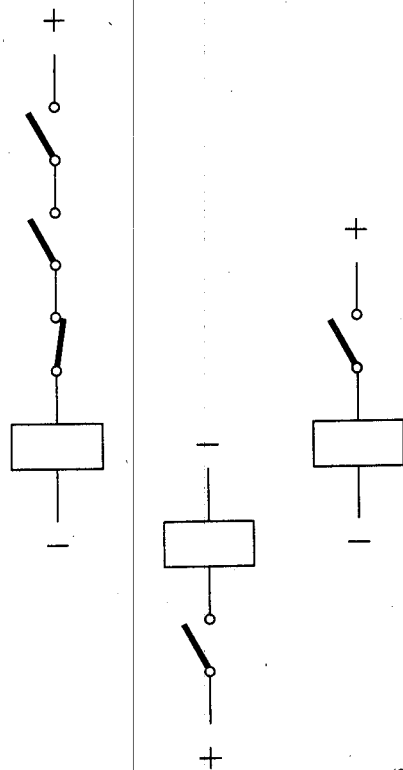
6.1 General

The general principles given in Clause 4 apply to representation of circuits.

6.2 Representation of supply

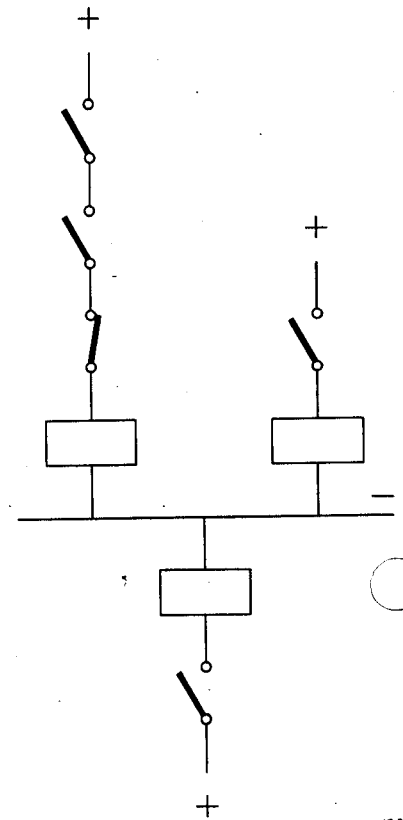
The supply may be represented by:

- lines as shown in Figures 1 and 2,
- symbols such as +, —, ~, etc., as shown in Figure 5,
- a combination of both, see Figure 6.



492/74

FIGURE 5



493/74

FIGURE 6

The arrangement of d.c. circuits and single-phase circuits on the diagram is made easier and clearer by placing the circuits between supply lines.

In multi-phase circuits, all the supply lines may be shown together to one side, or above or below the circuit. Symbols for the conductors of three-phase systems should preferably be shown in conventional phase sequence order, starting from the top or from the left of the diagram. Neutral conductors should be shown below or to the right of the phase conductors.

6.3 Representation of main circuits

A circuit diagram for the control equipment of a power plant or an industrial plant should also show the main power circuits to such an extent that the study of the function of the control equipment is facilitated. It may often be sufficient to show the main circuits or part of them in single-line representation. In certain cases, however, it may be necessary to use multiline representation, e.g. to show how measuring transformers are connected.

6.4 Detailed recommendations

6.4.1 Alignment of similar items

Similar elements in circuits drawn vertically are preferably aligned horizontally. Example, Figure 7.

For circuits drawn horizontally similar elements are preferably aligned vertically. Example, Figure 8.

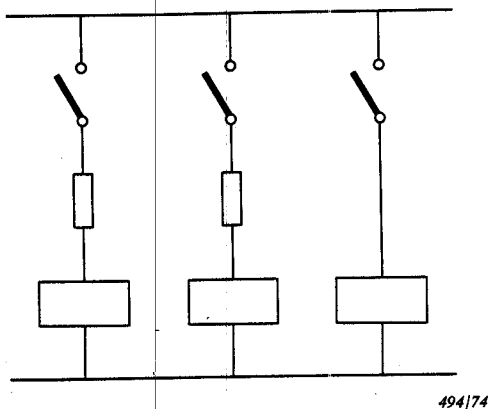


FIGURE 7

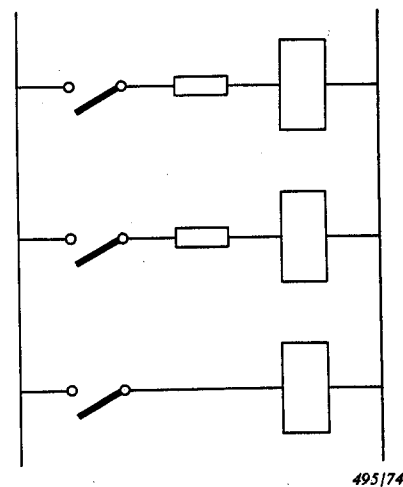


FIGURE 8

6.4.2 Connection of functionally related elements

The connections between functionally related elements should be short so that the relationship is made clear. See Figure 9.

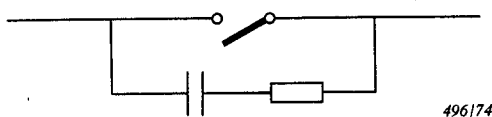


FIGURE 9

Parallel paths of equal importance should be symmetrically displaced with respect to the main path. See Figure 10.

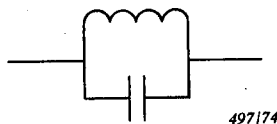


FIGURE 10

6.4.3 Connecting lines

a) Long connection lines between parts of the circuit should be avoided.

b) When mechanical functions are closely related to certain electrical functions, linkage of the symbols should be shown, see Figure 11.

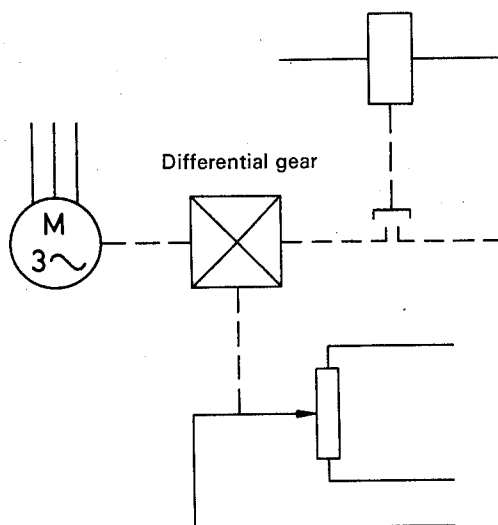


FIGURE 11

498/74

6.4.4 Use of alternative connection symbols

The symbol for alternative connections (73B of IEC Publication 117) may be used on the circuit diagram to show the connections which have to be made to render the equipment suitable for various alternative applications. The meaning of the numbers must be explained by a note or table on the diagram. See for example Figure 43 (page 60).

Note. — With this technique, it may be convenient to show the symbols for some parts twice; see for example Figure 43, where make contact 1Z.11 appears in zone B5 for alternative applications 4 and 7 and in zone B8 for application 8.

6.4.5 Crossing and branching

IEC Publication 117 provides a possibility of showing a connection at a crossing point in the diagram by means of a dot (symbol 70). Crossing points with a dot and those without a dot may not easily be distinguished when using certain reproduction techniques. IEC Publication 117 therefore gives a method of staggering (symbol 69) which avoids ambiguity.

Two lines representing conductors which cross on a diagram should not change direction at this point. The change of direction should therefore occur at a short distance from the crossing point. See Figure 12.

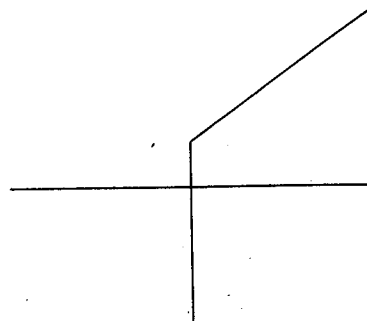


FIGURE 12

499/74

Lines representing conductors which are joined together should preferably be drawn at right angles to one another.

6.4.6 Oblique crossing

Oblique crossing lines may be used to connect corresponding elements in symmetrical circuits. Example, Figure 13.

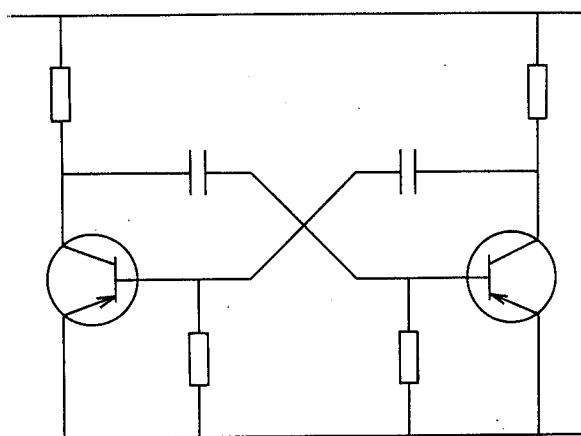


FIGURE 13

500/74

6.4.7 Boundary lines for functional or constructional units

When it is desirable in a circuit diagram to show that a part of it represents a functional or constructional unit (e.g. group of apparatus, relay set, etc.), this can be done by a long chain boundary line as in Figure 14. The diagram should be laid out to give maximum clarity, even if this means that the boundary line has an irregular shape.

When such a sub-assembly is not completely represented, it should be identified by a reference number or an annotation. Figure 15 shows the use of a boundary line surrounding a sub-assembly identified by the reference number A2 and that of the diagram 609012.

As circuit diagrams should be drawn according to the general principles in Clause 4, it may happen that a diagram within a boundary line representing a unit contains symbols for parts which do not belong to the unit. Such symbols should then be shown within a boundary line of different type and by adding a designation or a note.

Example: In Figure 16 the outer boundary line shows a unit Q6 consisting of contactor, thermal relay and fuses. Push-buttons S1 and S2 are functionally related items but are not located in unit Q6.

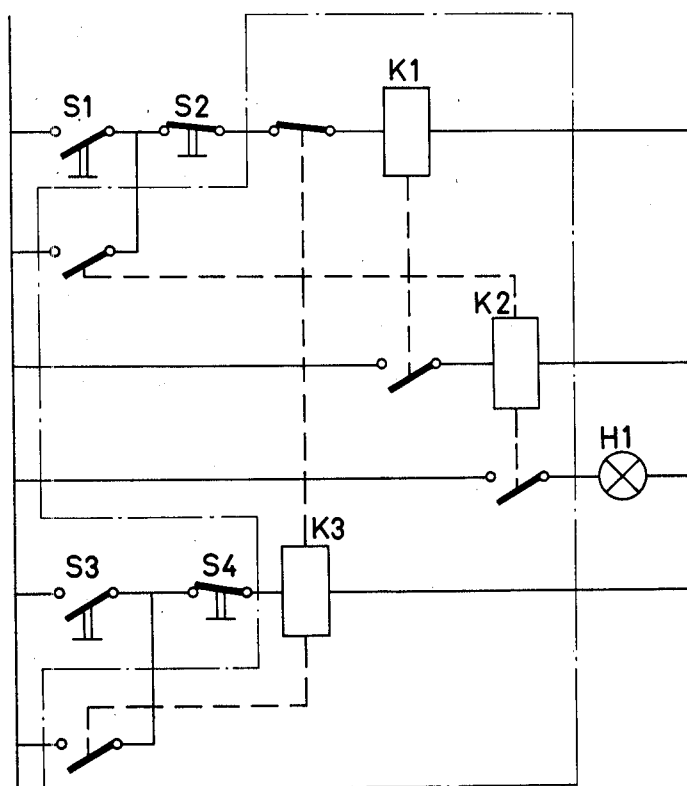


FIGURE 14

501/74