

# PATENT SPECIFICATION

827,666



Date of Application and filing Complete

Specification: December 4, 1956

No. 37039/56

Application made in Netherlands on December 7, 1955

Complete Specification Published: February 10, 1960

Index at Acceptance:—Classes 40(6), T; and 106(1), C(1F:1X:2E:2J).

International Classification:—G06f. H03f.

## COMPLETE SPECIFICATION

### DRAWINGS ATTACHED

### Improvements in or relating to Circuits Embodying Semiconductive Electrical Memory Elements

We, PHILIPS ELECTRICAL INDUSTRIES LIMITED, of Spencer House, South Place, Finsbury, London, E.C.2., a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to circuits embodying electrical memory elements which are acted upon by regularly-recurring pulses (hereinafter called "actuating pulses") and respond to these pulses by producing or failing to produce pulses of current through a rectifier according as free charge-carriers are or are not stored in a semiconductor functioning as a memory component.

In known circuits of this kind the actuating pulses supply energy for the change-over from one remembered condition to the other, and the strength of the read-out pulses is always smaller than that of the input numerical pulses, called "read-in" pulses, by which the memory elements are brought into a given condition. This fact often necessitates additional amplifier elements or transformers; for example if each read-out pulse is to be used as a read-in pulse for a succeeding memory element, as in the case, for example, of shift registers and counting circuits of electronic computers.

The present invention has for its object to provide a circuit which is based on entirely different principles and yields considerable advantages over known circuits. It comprises a circuit which embodies transistors and storage rectifiers arranged alternately and functioning as memory elements in virtue of their being able to store free-charge-carriers, and which embodies also means for applying a series of recurrent first actuating impulses to the emitter/collector path in each transistor and means

for applying a series of recurrent second actuating pulses, isochronous with but not synchronous with the first-mentioned series, to the said storage rectifiers, the arrangement being such that free charge-carriers become stored or not stored in any storage rectifier according as free charge-carriers are or are not present in the base zone of the preceding transistor at the instant when a said first actuating pulse occurs; and that free charge-carriers do or do not become stored in the base zone of any transistor, by way of an isolating rectifier which has the same pass direction as the base, according as free charge-carriers are or are not present in the preceding storage rectifier at the instant when a said second actuating pulse occurs; and that the isolating rectifier holds the potential of the said base zone at a floating value when free charge-carriers have been stored therein.

The invention is based on recognition of the fact that a considerable storage of free charge-carriers in the base zone of a transistor can be set up by means of comparatively little energy and current. This storage of freely movable electrons and holes, which is brought about by the read-in pulses, persists for a relatively considerable time which may be approximately 50 microseconds or even more and depends on the rate of recombination of the electrons and holes in pairs. If an actuating pulse is applied to the collector of a transistor when charge-carriers have been stored in this way in the base zone the transistor becomes conductive, but this conductivity is achieved to only a small extent at the expense of the charge-carriers stored in the base zone because the emitter injects fresh free charge-carriers into the base zone during the conductive condition. Consequently the read-out current pulses are considerably stronger

[Price 3s. 6d.]

Price 3s. 6d.

Price 2s.