

(12) UK Patent Application (19) GB (11) 2 161 300 A

(43) Application published 8 Jan 1986

(21) Application No 8412628

(22) Date of filing 17 May 1984

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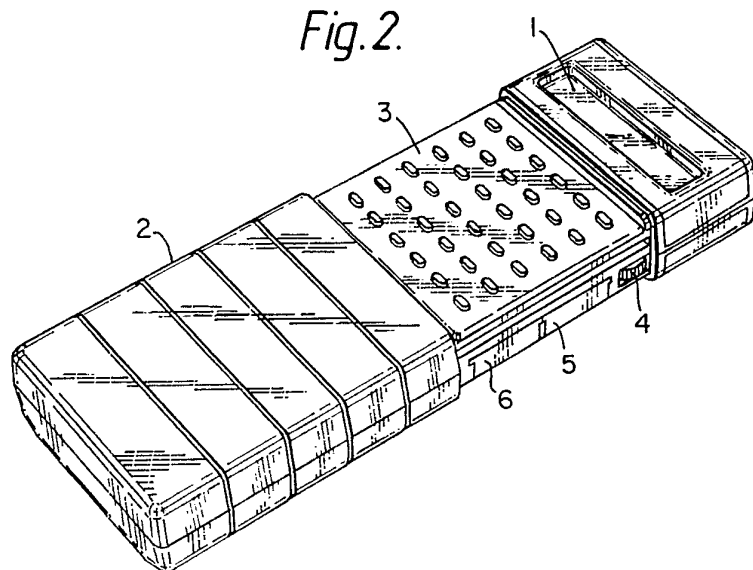
(52) Domestic classification  
G4A DT

(56) Documents cited  
GB A 2022884 WO A 8404186

(58) Field of search  
G4A

(54) Hand-held microprocessor apparatus

(57) Hand-held computer apparatus is described comprising a central microprocessor, power supply circuitry for the microprocessor, a keyboard (3) and associated circuitry arranged to access the microprocessor, a dot matrix display (1) and associated circuitry adapted to provide a visual display, and read only memory means adapted to program the microprocessor to operate in calculator or other modes. In accordance with the invention exchangeable EPROM means (5, 6) are adapted to be detached from and reconnected to the remainder of the circuit by the user. Cassettes each containing an EPROM are described. The apparatus includes increased voltage supply means adapted to supply a voltage sufficient to program or re-program such an EPROM when connected to the circuit.



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Fig. 1.

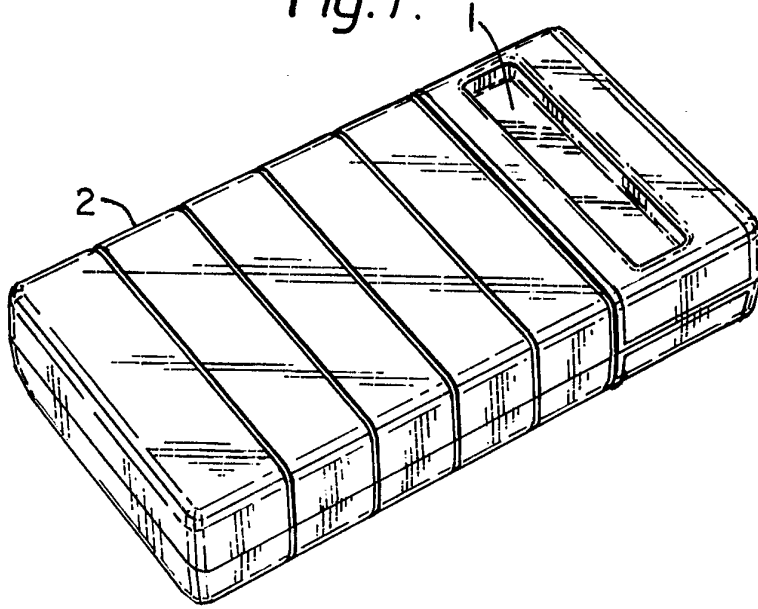


Fig. 2.

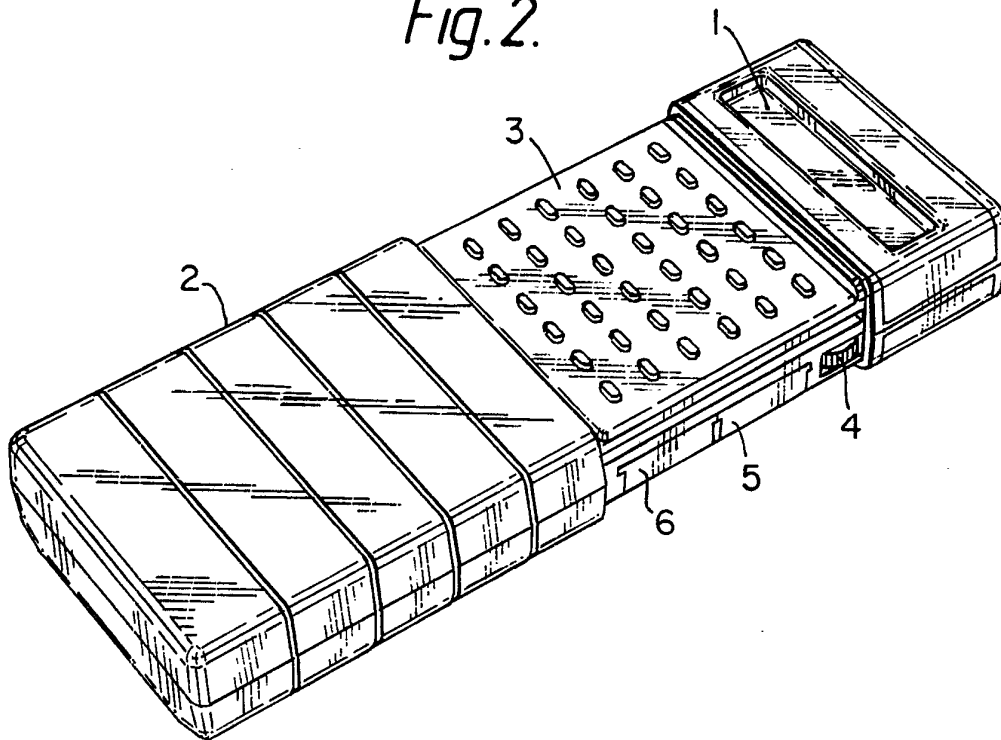


Fig. 3.

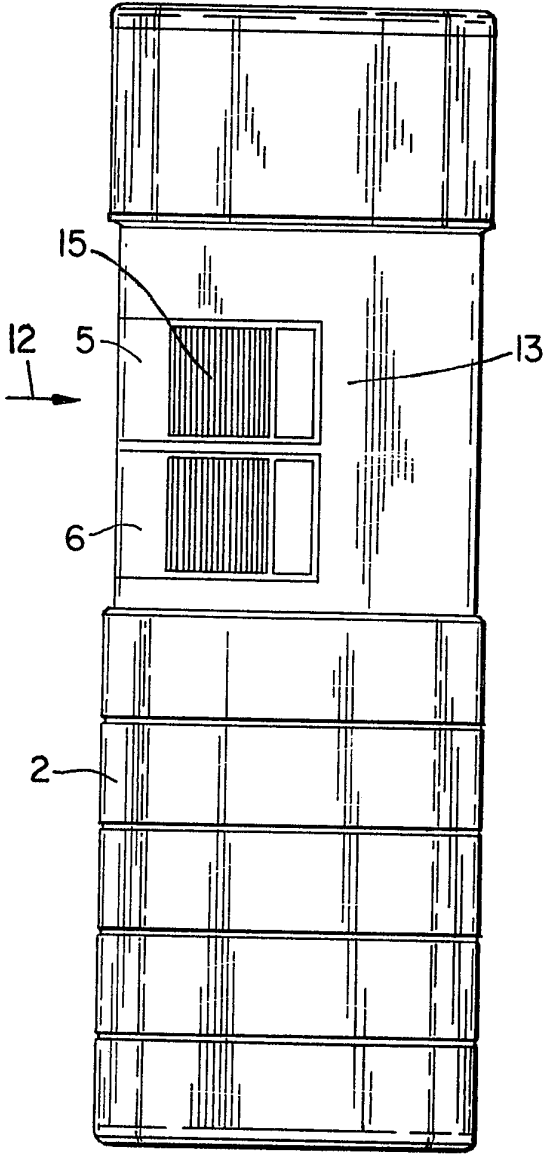
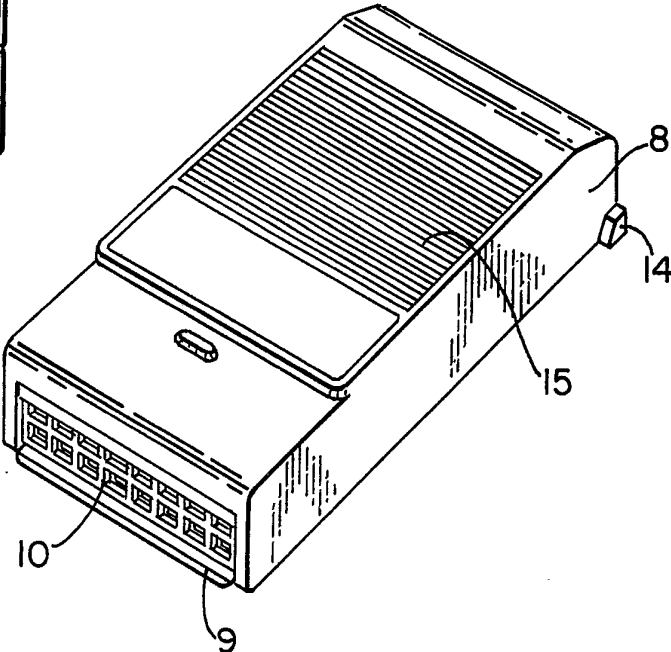


Fig. 4.



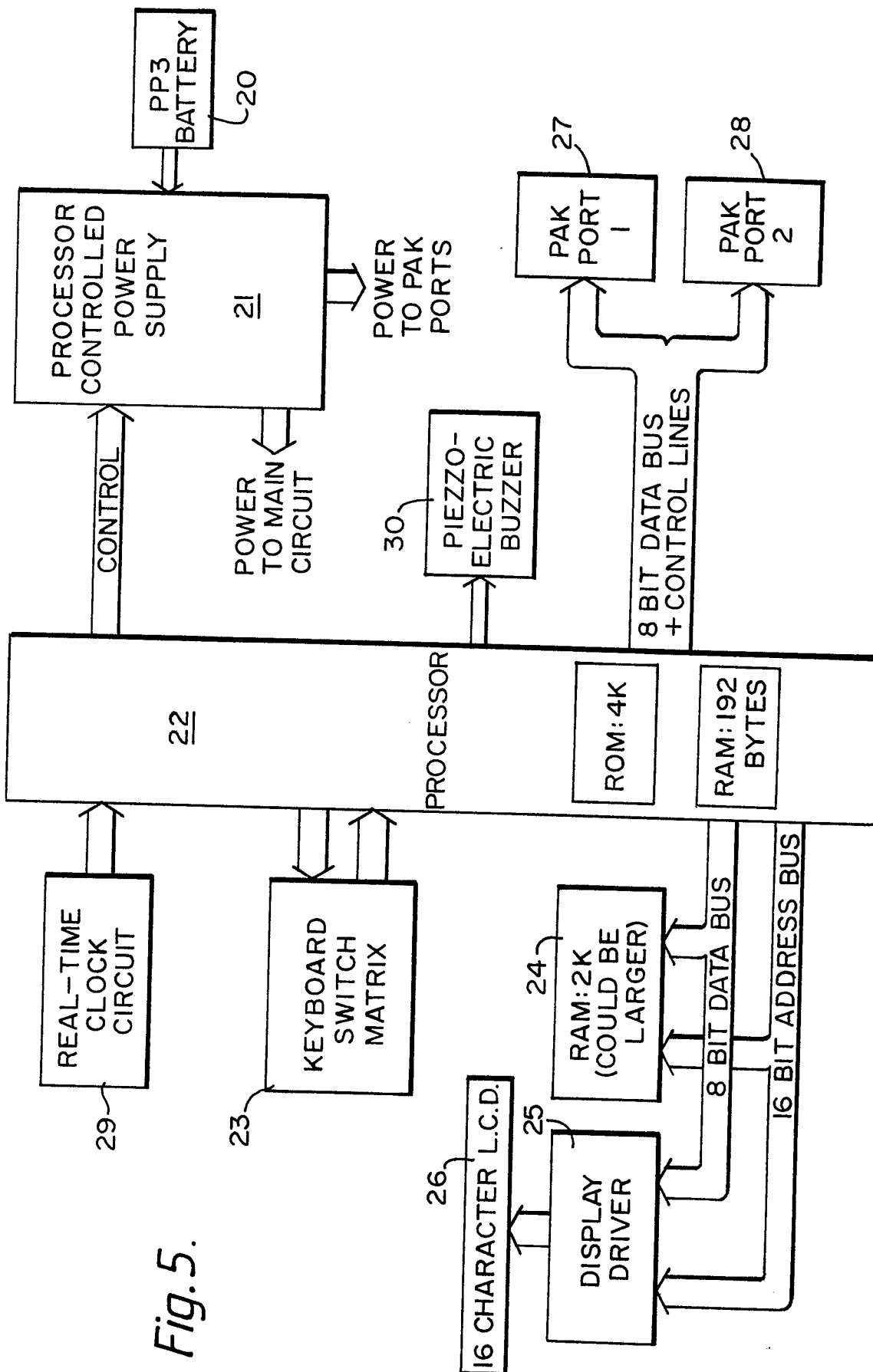


Fig. 5.

## SPECIFICATION

**Hand-held microprocessor apparatus**

5 This invention relates to hand-held microprocessor apparatus.

With the advent of very large scale integrated circuitry, there has been in recent years a rash of developments in the field of electronic equipment.

10 At the one end of the scale, the hand-held calculator has become ubiquitous. At the other end of the scale, computers have become ever smaller and ever more powerful, as circuit sophistication has increased.

15 Accompanying the increase in sophistication of processor circuits has been an increase in the sophistication of display systems. Original light-emitting diode or vacuum displays have been succeeded first by liquid crystal diode displays and subsequently liquid crystal matrix displays have become available, which, with appropriate driving circuitry, enable alpha numeric symbols and graphics symbols to be displayed and, under appropriate microprocessor control, scrolled, i.e.

25 moved to the left or to the right as read.  
In order to take full advantage of a microprocessor unit, memory circuitry needs to be provided. Volatile random access memory is provided in calculators and the like, e.g. to enable them to be programmed by the user, either by hand, or for example, by the use of a program recorded on a magnetic coating which is passed through an aperture in a hand-held calculator which reads the program into a volatile memory which is then used by the user. An alternative approach has been to supply plug-in fixed memory chips, so-called read only memories. Such sophisticated hand-held calculators are useful, but do not have the memory capacity of a normal computer. Perhaps more importantly, they do not provide any means of permanently storing information from one occasion to another between which times the calculator is to be switched off.

45 According to the present invention there is provided hand-held computer apparatus comprising a central microprocessor, power supply circuitry for the microprocessor, a keyboard and associated circuitry arranged to access the microprocessor, a dot matrix display and associated circuitry adapted to provide a visual display, read only memory means adapted to program the microprocessor to operate in calculator or other modes, exchangeable EPROM means adapted to be detached from and reconnected to the remainder of the circuit by the user, and increased voltage supply means adapted to supply a voltage sufficient to program or re-program an EPROM when so attached.

It is found that by adopting this overall architecture, it is possible to produce a hand-held micro-computer of much increased value and improved flexibility. This arises basically from the ability, using EPROMs, to store information permanently. With an appropriate choice of display and keyboard, the overall size of the device may be for example, around 140 mm long, 80 mm wide and 30

mm deep, a size which can easily be carried in a pocket or handbag, so enabling a full computer system to be carried round in ultra-compact fashion.

70 The major important sophistication of the circuit is the use of EPROMs which can be exchanged, i.e. can be attached or detached from the remainder of the circuitry. Most conveniently, each EPROM is provided in a standard packaging, called herein-after for convenience a cassette, which can be fitted into a suitable casing holding the keyboard and display and containing within it the remainder of the circuitry and a power supply, e.g. a 9 volt battery. The EPROMs are preferably connected by a plug/socket connector, the socket preferably being on the cassette and the pins on the remainder of the circuit in order to render the cassettes less liable to damage.

80 Since in order to program or re-program EPROMs, substantially higher voltages are required than those normally used to drive microprocessors and their associated displays, a supply of that high voltage must be provided in the apparatus. In a preferred version, a standard 9 volt battery is used to drive the microprocessor and display, and voltage tripling circuitry is provided to generate adequate voltage for programming or re-programming an EPROM.

85 Preferably the hand-held computer is configured with two sets of pins for the receipt of two cassettes, each of which may conveniently contain a 16 K EPROM.

90 If desired, a cassette may contain a ROM rather than an EPROM, e.g. to enable the computer to operate simply as a pre-programmed calculator on an appropriate program stored in that ROM.

95 In order to minimise the number of pins to use for the plug socket connections, the EPROMs in the cassettes are preferably provided each with appropriate circuitry such that the EPROMs may be serially addressed through relatively few connectors.

100 Depending on the EPROMs used and the nature of the programs on them, the hand-held computer of the present invention may be used for a wide variety of purposes. In one particular embodiment it may be used as an electronic note pad enabling material to be keyboarded in, recorded on an EPROM and subsequently retrieved. This is useful for diary applications and for data capture situations, e.g. mass observation surveys, building surveying, traffic watching and the like.

105 The invention is illustrated by way of example with reference to the accompanying drawings in which:-

110 *Figure 1* is a perspective view of a hand-held computer according to the invention,

*Figure 2* is a view similar to *Figure 1* and showing the computer with its keyboard and cassette socket exposed,

115 *Figure 3* is an under plan view of the computer shown in *Figure 2*, showing the positions of the EPROM cassettes,

*Figure 4* is a perspective view of an EPROM cassette showing its connector socket, and

120 *Figure 5* is a block circuit diagram of the com-

puter.

Referring first to Figure 1, this shows a hand-held computer with its casing in the generally closed position. A display window 1 is visible. The keyboard 3 of the computer may be revealed as shown in Figure 2 by sliding an outercasing 2 away from display 1. In the computer illustrated, keyboard 3 has 36 keys arranged in a 6 × 6 array. Not shown on the drawing are indicia or other markings indicating which key is which. Also visible in Figure 2 is a knurled adjustment knob 4 for adjusting the brightness of the display 1 and the ends of two cassettes 5, 6 which are inserted into the back of the main body of the computer. These are more clearly seen in the underneath plan view shown in Figure 3.

If the cover 2 is moved yet further away from the display 1, it may be removed wholly from the body of the computer to reveal, in the end of the main computer body, a battery compartment to which access may be had by a suitable plastics cover. The whole of the casing is conveniently moulded of plastics material.

Figure 4 shows a typical EPROM cassette. It consists of an outer plastics casing 8 having a cover plate 9 and having within it a small printed circuit board on which is mounted an EPROM with appropriate circuitry, one end of the circuit board being attached to a socket connector 10. Pins protruding from a circuit board in the interior of the main computer casing may have this connector pushed onto them by pushing the cassette in the direction shown by arrow 12 in Figure 3. The leading end of the cassette locates under a portion of the back of the casing indicated at 13 in Figure 3 while two projections 14, one on each side of the cassette, engage in appropriate recesses on the casing of the computer. In order to facilitate sliding the cassette in and out, its exposed surface when inserted has a series of moulded ridges and grooves 15.

Referring now to Figure 5, this shows the overall architecture of a typical embodiment, but without the EPROMs. The major components are a battery 20, power supply circuitry (including a voltage tripler) 21, main processor chip 22, keyboard 23, some random access memory 24, a display driver 25 and a display 26. The EPROMs plug into two ports 27, 28.

When the computer is switched on, the processor 22 controls all operations using software in an internal 4K ROM. These operations include:

- a) using input from a real time clock circuit 29 constantly to update the time registers in the processor's internal RAM,
- b) polling the keyboard 23 regularly to detect key presses,
- c) generating a display on display 26. This is accessed via a VLSI display drive 25 containing its own internal character generator ROM and display buffer RAM,
- d) directly driving a piezo-electric buzzer 30 under program control, when appropriate,
- e) accessing the EPROM or EPROMs in ports 27, 28. Two ports are shown, but an embodiment may have more. Each may be individually accessed via

a separate data bus and control lines. This bus is configured for byte-serial access using two lines (counter and reset) for address selection in the EPROM,

- f) controlling the power supply circuit 21, which generates all of the regulated voltages necessary for the system including the 21 volts required for EPROM programming. Power switching is under processor control.

## CLAIMS

1. Hand-held computer apparatus comprising a central microprocessor, power supply circuitry for the microprocessor, a keyboard and associated circuitry arranged to access the microprocessor, a dot matrix display and associated circuitry adapted to provide a visual display, read only memory means adapted to program the microprocessor to operate in calculator or other modes, exchangeable EPROM means adapted to be detached from and reconnected to the remainder of the circuit by the user, and increased voltage supply means adapted to supply a voltage sufficient to program or re-program an EPROM when so attached.

2. Computer apparatus according to claim 1 wherein the exchangeable EPROM means is provided by one or more EPROMs each provided in standard packaging which can be fitted into a casing holding the keyboard and display and containing within it the remainder of the circuitry and a power supply.

3. Computer apparatus according to claim 1 or 2 wherein the EPROMs are connectable by a plug/socket connector, the socket being associated with the EPROM and the pins with the remainder of the circuit.

4. Computer apparatus according to claim 3 and wherein the circuit is configured with two sets of pins for the receipt of two EPROMs.

5. Computer apparatus according to claim 3 or 4 including circuitry associated with each EPROM enabling it to be serially addressed.

6. Computer apparatus according to any one of claims 1 to 5 wherein a standard 9 volt battery is used to drive the microprocessor and display, and voltage tripling circuitry is provided to generate adequate voltage for programming or re-programming an EPROM.

7. Hand-held computer apparatus substantially as hereinbefore described with reference to the accompanying drawings.