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⑫ **EUROPEAN PATENT APPLICATION**

㉜ **Alarm control center.**

㉗ An alarm control center having means for interchange-
ably assigning alarm parameters for each sensor loop (102)
in an array of sensor loops and for interchangeably assign-
ing alarm outputs for each of the sensor loops. When the
alarm control center senses an alarm condition on one of
the sensor loops (102), the alarm control center increases
the scanning rate for that particular sensor loop to verify the
alarm condition.

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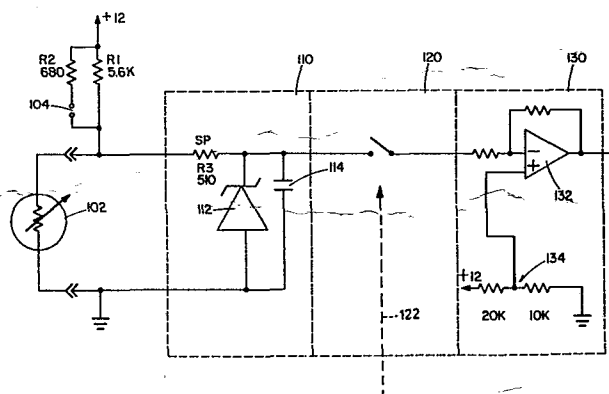
"Alarm control center"

BACKGROUND OF THE INVENTION

The invention relates to centralized monitor and control sys-
tems for monitoring the condition of alarm sensors and for controlling
different alarm outputs depending on the alarm sensor condition. Although
5   several sensor configurations are feasible the only type mentioned for
reasons of convenience will be the sensor loop.

In prior art multiple sensor loop systems, the sensor loop and
alarm outputs had to be connected to the central system in a specific or-
der of connection for proper operation of the system. For an initial
10   installation, these systems performed adequately. However, with many
industrial buildings, the security requirement and usage of various
rooms and areas will change thereby requiring the adding , deleting
and reasigning of several sensor loops. With the prior art systems,
these changes may be very extensive and tedious to implement while also
15   prone to numerous errors.

SUMMARY OF THE INVENTION

The object of this invention is to provide an alarm control
center in which the functional assignments of the input loops are readily
interchangeable.

20   Another objection of the invention is to provide an alarm con-
trol center in which the arlarm outputs are readily interchangeable.

A further object of the invention is to provide an alarm con-
trol center wherein the scanning frequency of a particular sensor loop
can be changed to verify an alarm condition in order to reduce false
25   alarms.

A further object of the invention is to provide an alarm con-
trol center wherein the integrity of the system is maintained during
power outages.

These objects are achieved in an alarm control center for in-
30   terfacing with:

a. a plurality of input sensor loops each of said loops having at least
one sensor element, each sensor element having a respective electri-

cal resistance range between a standard condition of an associated phy-
sical facility an~a hazardous condition of such physical facility and
b. an array of alarm output elements for outputting a plurality of res-
pective audio-visual alarm signalizations,

5   said alarm control center comprising:

1. first means for interchangeably preassigning respective alarm para-
meter values for each of said input sensor loops;

2. second means for interchangeably preassigning respective alarm sig-
nalizations for each of said input sensor loops;

10   2. scanning means for sequentially scanning said plurality of input sen-
sor loops;

4. conditioning means for conditioning the signals from each of the
scanned sensor loops;

3. comparing means for comparing the signal from each particular scanned

15   input sensor loop with the corresponding preassigned alarm parameter
value;

6. activating means for activating the associated alarm output elements
under control of an output signal from said comparing means indicating
a harzardous condition in the signal corresponding to the respective

20   input sensor loop.

The physical facility may be a door or window. In that case "closed"
would be the standard condition, while "open" would be a hazardous
condition. Of course in certain circumstances, the hazardous condition
would be allowable. The physical facility may also be the air condition

25   in a room. A certain temperature range and/or a certain clearness of the
air would represent the standard condition. Alternatively, a higher tem-
perature range or a diminished clearness of the air would be caused by
fire and/or smoke and thus represent a hazardous condition. Alarm out-
put elements could be represented by high-power sirens, local audio

30   buzzers, self-acting telephone dialers or displays (single lamps, seven
segment LED's or the like, or even video displays).
Preferably, the control center comprises switching means for periodical-
ly turning off and on selected circuits during power outages.

The input sensor array provides signals to an analog input sys-

35   tem located in the alarm control center. The purpose of the analog input
system is to provide necessary signal conditioning of the signals recei-
ved from the external environment. The analog input system also provides
protecting circuitry so that the alarm control center may be safe from sabotage.

The processor portion of the alarm control center is a micro-
processor-organized-special purpose computer which receives the sensor
signals after analog to digital conversion. The latter is the primary
signal measured by the processor.

5   If there are deviations from prescribed limits, the processor functions
to provide alarms via the alarm output system and also to communicate
conditional changes to a higher level station (such as a central console
or processor station) via its controller for external communications.

The processor also has local control and display. Control

10   is via a keyboard. This keyboard may be energized by an operator, or an
installer, provided he has the proper coded key to use the system. When
a user is present, and has the proper key inserted, the display on the
alarm control center is activated and provides detailed information re-
garding system operation.

15   The alarm output system is a combined software and hardware
configuration, which is programmable to allow a variety of different
alarm schemes to be implemented under user control. The alarm output
system is connected to an external alarm array which may include sirens,
autodialers, local audio buzzers and display.

20   In addition to local control of the alarm control center,
there is also a remote bus built into this system. The remote bus
input/output system is capable of handling up to 16 peripherals, which
may include a remote control unit, a card reader and keyboard, door con-
trol units, printers, etc.

25   The alarm control center has an external-communications con-
troller. The external communications-controller is designed to provide
an interface through the PTT network to a higher level system. In most
cases the higher level system is an alarm central station.

BRIEF DESCRIPTION OF THE DRAWINGS

30   With the above and additional objects and advantages in
mind as will hereinafter appear, the invention will be described with
reference to the accompanying drawings in which:

Fig. 1 is a block diagram of the main components of the
alarm control center;

35   Fig. 2 shows a schematic of a typical sensor loop;

Fig. 3 is a block diagram of the alarm control center;

Fig. 4 shows a block diagram of a typical remote control unit;

Fig. 5 shows in block diagram form the external communications
board;

Fig. 6 shows in block diagram form the power supply board of
the invention;

5   Fig. 7 provides in block diagram form, the organization of
the software used to control the alarm control center; and

Fig. 8 provides in block diagram form the organization of
the software used to control a typical remote control unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

10   In Fig. 1 there is shown in block diagram form the major com-
ponents of the alarm control center. For simplicity, the respective
interconnections between the subsystems and functional blocks have not
been shown. These components include an input/output board 100, a pro-
cessor board 200, an external communications board 300 and a power sup-
15   ply board 400, each provided with printed wiring and mounted discrete
and integrated circuit modules.

The I/O board 100 represents the interfacing of the processor
to the external world. The analog inputs and signal alarm outputs are
mounted on this board. The analog inputs originate from external sensor
20   loops which inputs are multiplexed under microprocessor control, the
multiplex output signal being provided to the processor board 200 for
further processing. The relevant subsystems 110, 120, 130 will be des-
cribed hereinafter. The processor board 200 contains among other ele-
ments the processor itself (205), associated memory (210/215), control
25   inputs via keyboard and operator/tamper switches (220), a digital dis-
play and indicator lights (225) and an analog-to-digital converter
(230).

The external communications board 300 provides interface to
a telephone system. Contained on this board is an interface transformer
30   with wire protection and the necessary hardware to automatically dial,
through the telephone exchange, to a central alarm station. After the
central station has been dialed, the communications board 300 contains
the hardware to sense the connection and a modem to facilitate two-
way data transmission. This communications board 300 also includes
35   necessary circuitry for secure data transmission including block check
character generation and detection means and encryption and decryption
means.

The power supply board 400 provides an interface to the line
voltage and a battery pack.The output of the power supply board 400
provides the necessary voltages and currents for operating the micro-
processor system, the input sensor array, the alarm output, as well as
some peripheral devices (not shown). Means are contained on the power
supply board 400 for detecting the loss of line voltage, failure of the
battery pack, or failure of the power supply itself.

The Input/Output Board

The Input/Output board 100 is capable of receiving the analog
signals from thirty-two separate sensor loops. Fig. 2 shows a typical
sensor loop and the relevant circuitry on the input/output board 100.
The sensor is indicated by reference number 102 and may comprise up to
ten individual 560-ohm sensors connected in a series loop. 12 volt DC
power is applied to one end of each sensor loop 102 from the power sup-
ply board 400 through respective resistors Rl, which typically are
5.6K-ohms, the other end of the each sensor loop 102 being connected
to ground. With this configuration, assuming a balanced loop, 6 volts
DC will appear at the junction of resistor Rl and the sensor loop 102,
when the sensor loop resistance is 5.6 kohms.

In certain situations fire detection sensors are used. These sensors
are characteristically low impedance devices. Thus, for retaining fle-
xibility, a resistor 2 of 680 ohms is provided in parallel with resis-
tor Rl to lower the overall effective resistance. Depending then on
which loop the fire detection devices are situated, a jumper may be in-
serted across the terminals 104 thereby connecting R2 in parallel with
Rl. The input/output board 100 also has a resistor R3 connected to the
junction of Rl and the sensor loop 102, which resistor R3 provides the
analog signal from the sensor loop 102.

In order to protect the system from sabotage, each input sen-
sor signal includes a line protection circuit 110 which comprises a
diode 112 in parallel with a capacitor 114 which coupled the loop
signal from resistor R3 to ground. The diode 112 is selected to conduct
at 15 volts. So arranged, the line protection circuit 110 provides pro-
tection from high voltage as well as RF signals being induced on the
sensor leads.

the input loop signal is then passed to a 32-to-1 multiplexer
120, which is controlled via signals on a bus 122 from the processor

board 200. In a typical arrangement, the multiplexer 120 may comprise
four 8-to-1 multiplexers having the inputs coupled to the respective
32 sensor loops while the outputs therefrom are coupled to a 4-to-1
multiplexer. This configuration would allow for the exclusive scanning
5   of predetermined groups of sensor inputs as well as the scanning of all
the sensor inputs. For simplicity only one input contact has been shown.

The output of the multiplexer 120 is then connected to a sig-
nal conditioner 130 which comprises an inverting amplifier 132 which
also provides a level shift so that the input signal, which nominally
10   is at 6 volts DC, is scaled down to 2 volts (inverted) for use on the
processor board 200. This is accomplished by applying the output of the
multiplexer 120 to the inverting input of the amplifier 132 while apply-
ing 4 volts DC, taken from a voltage divider 134, to the non-inverting
input thereof.

15   The input/output board 100 also contains eight alarm relays 140
which are shown schematically in Fig. 3. These may be arranged as nor-
mally opened, while they can be selectively closed by the installer.
Those relays may be energized individually under the control of the
processor and may be used to activate, for example alarms, lights, horns
20   sirens, or any other desired output.

The Processor Board

The processor board 200 is the basic control board in the
alarm control center. This board 200 is shown in Fig. 3 and includes a
microprocessor 205, ROM memory 210, RAM memory 215, an input keyboard
25   220, a four digit LED display 225 and an analog-to-digital converter
230. A suitable microprocessor which may be used in this system is the
Intel 8039 which includes 128 words of internal RAM not shown separately.
The primary interconnecting data path is formed by bus 207, data and
address/control lines not being shown separately. The external ROM
30   memory 210 contains the system program. Also accessed by the 8-bit bus
is the external RAM memory 215 which has a total of 1024 x 8 bits of
memory. Since this is a volatile memory, a battery shown hereinafter is
provided therefor in the event of the loss of line voltage by way of
battery back-up power system. A latch 235 is included for address lat-
35   ching by both the ROM 210 and RAM 215.

The analog input signals are passed through the A/D converter
230 which converts this signal to an 8-bit digital code which is trans-

mitted to the microprocessor 205 by the 8-bit I/O bus.

In parallel with the keyboard 220, the microprocessor 205
receives input digital data of various switch inputs 240 through a
16-bit I/O bus expander 250. The switch inputs include:

5   1. operator switch

          2. calibration switch

          3. tamper switch

          4. installer switch

          5. walk test switch

10   .   6. initialization switch

          7. line voltage

          8. battery

          9. power supply

A second 16-bit I/O bus expander 260 is used to provide the
15   systems outputs. Signals from the microprocessor 205 carried over the
8-bit bus cause the bus expander 260 to activate the appropriate alarm
relay in a plurality of relays 140.
Elements 102/110, 120, 130 have been shown in the previous figure. The
control by way of line 122 may be effected by appropriate signals on
20   bus 207.

The alarm control center has provisions for being remotely   .
operated. When the potected premises are being secured for the night,
for example, means are provided whereby the system may be activated
at or near the exit door. To this end, peripheral devices 270 are cou-
25   pled to the microprocessor 205 via a two-wire two-way bus 268.

There are nine different types of peripheral devices 270
which can be used with the alarm control center. These include a basic
remote control unit (BRCU), display RCU (DRCU), DRCU with electric
strike lock (ESL), security enable RCU (SRCU), SRCU with ESL, logging
30   printer unit (LPU), interface control unit (ICU), door control unit
(DCU) and security enable alarm control center.

The peripheral devices 270, while having different configu-
rations, are, in general, set up similarly as shown in Fig. 4. The
remote bus data-in signal is passed through filter 271, buffer 272 and
35   then to a microprocessor 273, which may be the same as microprocessor
205. Other inputs to the microprocessor 273 are from switched inputs
274 which may include a door sensor, a key switch and a tamper switch.

In addition, communication with further peripherals 270A may be had
along the same bus. Through a bus expander 275 the microprocessor 273
may interact with a card reader 276 and a keyboard 277, and may also
activate a door relay 278. A carrier loss detection circuit 279 is

5   also included and controls power to the peripheral device. This circuit
279, which may include a resistor/capacitor charging circuit not shown
coupled to a threshold detector arranged to trigger if the voltage
across the charging circuit is not discharged by the remote bus input,
is coupled to the output of the filter 271 and has an output coupled

10   to the microprocessor. Often, a separate display element 279A could be
useful, for example one or two LED's.

External Communications Board

The external communications board 300 provides the interface
of the alarm control center to the transmission system. This board

15   performs the following functions:

1. Accept messages for transmission from the alarm control
center to a higher level device;

2. Provide pulse or touch-tone dial capability for switched
network applications;

20   3. Offer encryption/decryption facilities for messages requi-
ring the same;

4. Compute block character check sums for each message trans-
mitted;

5. Provide modem serial data transmission capacity;

25   6. Provide receiver tone and ring detection;

7. Provide voice transmission capability for eavesdropping;

8. Receive messages and provide error checking capabilities;

9. Automatic retransmission of messages having communication
errors; and

30   10. Pass valid messages to the alarm control center.

Fig. 5 is a functional block diagram of the modules in the
communication board 300, all of which are either commercially availa-
ble items or have obvious constructions.

A microprocessor 305 is coupled to the bus 270 from the pro-

35   cessor board 200. The microprocessor 305 may be INTEL type number
8741. The microprocessor 305 has a first bus 310 coupled to a dual bus
expander 315 (INTEL 8243). The output from the bus expander 315 is

coupled, along with a second bus 320 from the microprocessor 305, to
a USART 325 type 8251A, an encryption/decryption module 330 type 8294,
a pulse dialer 335 type 14409 and a tone dialer 340 type 14410 (both
make Motorola). The input to and output from the USART 325 may be
applied selectively to a V24 interface 345 to dedicated lines 3450 or
to a modem 350 of type 14412. The selection is effected by switch 3250
that is microprocessor controlled. Block 324 symbolizes the provision
of necessary synchronizing signals. The output from modem 350 is applied
to telephone lines indicated by A, B, such as may be self-dialed. The
interconnection is effected through a relay 355 that is controlled
by the microprocessor 305, and by a switching circuit 360, controlled
by the pulse dialer 335. Return data communicated via telephone lines
A, B is processed through the switching circuit 360 and a filter am-
plifier 365 before being forwarded to modem 350 and USART 325.

      The relay 355 also selectively couples the switching circuit
360 with a voice alarm 370 detector, having an eavesdropping micropho-
ne 375 coupled thereto, and to the tone dialer 340. To access the te-
lephone lines A, B, the communications board 300 also includes a recei-
ver tone detection circuit 380 and a ring detection circuit 384 both
coupled to the microprocessor 305 through a switch 388 controlled via
the bus expander 315.

      Since some of the modules used on the external communications
board 300 require -12 volts DC, a secondary power supply 390 is inclu-
ded thereon and is energized by the main power supply 400.

      In another embodiment of the invention, the microprocessor 305
may be a type number INTEL 8035 and communicates with the microproces-
sor 205 via the peripheral devices 270 remote bus.

      Power Supply Board

      Fig. 6 shows a block diagram of the power supply board 400.
The power supply board 400 includes a transformer 410 which steps down
the mains voltage on input line 409 to 18 volts AC. The transformer
410 includes several input taps so that it is adaptable to several
line voltages. The 18 volt AC output from the transformer 410 is ap-
plied to a pair of diode bridges 420 for rectification. A stabilized
12 volt DC supply 430 is coupled to the output of the diode bridges
420 and provides the stabilized 12 volt DC used throughout the alarm
control systems. A 5 volt DC regulator 440 is coupled to the 12 volt

DC output to provide an output of 5 volts DC also used in the system.
A stabilization sensing circuit 450 is included in the power supply
board 400 which provides an output signal on line 451 to the micropro-
cessor 205 when there is a failure in the stabilized 12 volt DC supply
430. In case of such failure a single or multiple line 452 is provided
for either controlling a back-up facility, or for receiving emergency
power therefrom, or both.

In the event of failure of the input line voltage, the power
supply board 400 includes a battery pack 460 as a back-up power source.
Coupled to the battery pack 460 is a sensing and switching circuit 470
which checks the condition of the battery pack 460 and provides an out-
put signal on line 471 upon failure of the battery pack 460. A battery
charging circuit 480 is coupled to the output of the diode bridges 420
and maintains the battery pack 460 at full charge.

When there is a loss of stabilization, the stabilization sen-
sing circuit 450, in addition to its signalling output, disconnects the
12 volt DC supply from the output, disconnects the charging circuit
480 from the battery pack 460, and couples the battery pack 460 to the
12 volt DC output.

Notwithstanding the above, if the battery pack 460 output
voltage falls below a certain level, the sensing circuit 470, in addi-
tion to its signal to the microprocessor 205, disconnects the battery
pack 460 to prevent damage thereto due to extreme discharge. In certain
cases an additional power output line 481 could provide emergency power
to selected emergency signalling means.

There is also included on the power supply board 400, a line
voltage sensing circuit 490 coupled to the output of the diode bridges
420 which signals the microprocessor 205 on line 491 upon failure of
the line voltage.

Software

Fig. 7 provides a block diagram the organization of the soft-
ware used to control the alarm control center. Each block represents a
respective routine or software module. Solid lines represent change-
overs between program modules within the operating condition. Dotted
lines represent transitions that occur only once or only by way of syn-
chronization. The EXEC module 500 provides the communication and con-
trol of the entire software system. The system is first established as

regards the mode of operation, assignment of critical parameter values
and of the respective sensor loops via an initialization routine 510.
This routine is hardware programmable so that when there is a loss of
power followed by a power restoration or when a reset switch has been
5   pressed, the system will go to the selected program initialization.

Following initialization, the EXEC calls the various other
routines as required, which will now be described.

A loop scanning routine 520 sequentially interrogates all
the input sensor loops and decides whether an acceptable or a non-
10   acceptable tolerance exists with respect to an initial reference value
that is based on the type of sensor loop being examined. At initiali-
zation, the loop scanning routine 520 determines the existing voltage
at the relevant sensor loop and if it is within an acceptable tolerance
it takes this initial value as the reference voltage for that loop for
15   all later determinations of sensor loop conditions.

If upon interrogation of a sensor loop a change in status, i.e. a de-
viation from the stored reference value that is larger than a prede-
termined tolerance variation, is detected, the program presets a
change counter to zero and furthermore stores the new condition. When
20   in subsequent scans there is no change in status, i.e. no further
excessive deviation from the stored "new" condition, the counter upon
each successive scan is advanced by one and the counter position is
compared with a maximum. Since the scanning of a particular loop is
repeated approximately every 30 milliseconds, the counter is allowed
25   to go to 5, representing 150 ms during which the input has been in
the new condition. The loop scanner routine 520 then enters into ·
a high speed mode dedicating its scanning to the particular loop only
for 32 cycles. If during this period at least 70% of the time the
input parameter value is in the new condition, then this status is
30   processed as a valid input change. If no previous alarm exists for the
loop, preparations are made to call the alarm processor routine 540.

The switch scanner routine 530 monitors the operation of the
front panel keyboard, the installer and operator key switches, the
alarm control center door tamper switch, the installer initialization
35   and walk test switches, as well as the status of the line voltage,
battery and power supply.

The switch scanner routine 530 will call the alarm processor

routine 540 under the following conditions:

1. tamper switch detected when both the operator and installer switches are not set;

2. loss of line voltage;

3. failure of stand-by battery- and

4. failure of the power supply only, if the line voltage is present.

If in the case of failure of the stand-by battery there is al- so failure of either the line voltage or the power supply, the switch scanner routine 530 puts the alarm control center program into a "wait" state, stopping all further scanning and processing and retur- ning to the EXEC routine 500. The system may only be taken out of this "wait" condition by a hardware reset by the installer.

The alarm processing routine 540 receives the alarm calls triggered by failures in the input sensor loops, peripherals, tamper switches and hardware. For each alarm call, there are four possible modes of operation, namely night mode, guarded and unguarded, and day mode, guarded and unguarded. The alarm processing routine 540 first determines the particular mode of operation and then retrieves a preprogrammed tabled of alarm indications for the particular alarm call and mode of operation. The alarm indications are as follows:

1. ACC(ess) buzzer on

2. External alarm on

3. Power failure LED on

4. ACC alarm on

5. Deterrent siren and outdoor light on

6. I/O linkage

7. External autodial on

8. Spare

The alarm processing routine 540 then sets the bits for each specific output and then calls the alarm output generation routi- ne 555.

The alarm output generation routine 555 performs the task of actuating (or deactuating) the various alarm relays based upon multi-bit words set by the alarm processing routine 540.

The scrolling routine 560 provides for the programming of the alarm control center by controlling the digital data being dis-

played, for example, linewise on a cathode ray tube and by storing on
an appropriate position on the display the new information entered by
an operator or an installer. In similar way the display could be effec-
ted as a plurality of digits on 7-element LED displays. This scrolling
routine 560 is used in conjunction with the switch scanner routine 530
and depending upon whether the operator switch or the installer switch
is set, established those functions which may be performed.

In particular, an installer is able to change system para-
meters such as assignment of sensor loops, output circuits and periphe-
ral types. For each loop the installer can assign soecific output lin-
kages for output circuits, particularly relay positions for alarm
conditions, while for peripherals, various security levels. An instal-
ler may also adjust all the various timing delays, for example entrance
and exit delays, siren output and pause duration, and the operation
of a real time clock.

An operator, however, may only inhibit and reenable the sen-
sor loops, outputs, peripherals and the real time clock, and assign
and cancel security card and cipher codes.

The time interrupt routine 570 operates under control of
an internal 1 millisecond clock symbolized by subroutine block 574.
The time interrupt in first place is used to control, as symbolized by
subroutine block 571, among other things, the generation of audio
signals at the alarm control center, sucy as the buzzer. By means of
its subroutine module 572 the timer interrupt routine is coupled to
the scrolling routine (as also indicated by a dotted interconnection
line) in that it outputs and refreshes in a time multiplex fashion,
the appropriate display digit or LED bit. By means of its subroutine
module block 513 the timer interrupt routine is also coupled to the
remote bus processing routine 590 in that it controls the actual trans-
mitting and receiving of data over the remote bus.

The auto test routine 580 is performed whenever a mode swit-
ching is required (e.g. from a "day" mode to a "night" mode) or under
control of an operator or installer. During the routine, each sensor
loop is forced into a high state for two scanning cycles by temporarily
applying a higher-than nominal voltage by means not shwon. Next, in
similar manner a low state is applied for two scanning cycles and then
the loop is allowed to assume its normal state. If any inconsistency

occurs in the above testing or if a failure occurs in the battery,
power supply, tamper switches or peripherals, switching from day mode
to night mode is inhibited, or an appropriate error message is dis-
played. A similar procedure is effected in case of other mode transi-
5   tions.

The remote bus processing routine 590 forms the communication
with the peripheral devices. The routine first checks whether there is
an error in the received message. If so the routine discards the error
message and communicates again with the peripheral device in question.
10   Keeping track of the number of errors for the specific peripheral de-
vice, the remote bus processing routine 590 initiates an alarm call if
a predetermined maximum is exceeded. Assuming the message is error free,
the remote bus processing routine 590 updates the file for the particu-
lar peripheral device and appropriate processing procedures are initia-
15   ted which include switching the system mode, indicating an alarm, or
allowing a door to be opened.

In the event of the loss of line voltage or power supply
failure, the remote bus processing routine 590 periodically stops and
restarts remote bus communications. Each peripheral device 270 connec-
20   ted to the remote bus will then, through the use of the carrier loss
detectioncircuit 279 contained therein, switch itself off thereby con-
serving battery power until the remote bus communications is restarted.
In certain applications specific requirements must be fullfilled as
imposed by a specific user. Block 591 is therefor reserved for user-
25   defined software routines that would cooperate with further coutines
and or respective hard-ware facilities under control of EXEC 500.

Fig. 8 provides in block diagram the organization of the soft-
ware used for the peripheral devices. The system operation is controlled
by a further EXEC program 600. This EXEC 600 has, in peripheral opera-
30   tion, a more limited role. Typically, a peripheral device may be a
remote control unit designed to switch the system from day to night
modes and back. Such a device would operate when a user inserted his
coded key into the unit and turned it. The turning of the key would
initiate a sequence which would provide, if the user leaves the pre-
35   mises at night, a visual display of those loops which would prevent
proper operation, or loops which were previously inhibited by the user,
or else a signal that the system was okay. Corresponding to Fig. 7, the

EXEC program 600 is reached from an initialization routine 605.

As modes are switched from day to night, this is signalled by LED's on the peripheral itself. The peripheral also generates an audio tone indicating that the user started the run counting of his exit
5   delay. As the user opens doors to leave the premises, the audio tone changes in pitch so that the user knows that the system is functioning properly.

Incorporating these functions in a peripheral device, is handled by three routines called the scanning routine 610, the timer rou-
10 tine 620, and the remote bus processing routine 630.

A peripheral device is different from the alarm control center in that the scanning routine 610 scans both the input (relevant subroutine is symbolized by block 611) and the output (subroutine symbolized by block 612), the only difference being the direction of scan.
15 There is some limited processing of inputs in the peripheral devices, however major analysis of input signals from a peripheral device is performed by the alarm control center.

The timer program 620 in the peripheral has significance in that events are synchronized to system operation. There is a similar
20 timing capability in the alarm control center, however it is incorporated as part of the scrolling routine 560, which is time synchronized to the external world.

As in the alarm control center, the peripheral device also contains a timer interrupt section 640. The timer interrupt 640 performs
25 a similar function of audio generation, display generation and remote bus communication. It is the mirror image of the timer interrupt routine 570 in the alarm control center and has correspondingly a set-up with four sub-blocks (571, 572, 573, 574). A major difference however is the following. The timer interrupt routine 640 in the peripheral device
30 must, by way of its internal timing subroutine block 644 be synchronized to the timer interrupt routine 570 of the alarm control center as has been shown in the figure. This is necessary to ensure proper data communication between the alarm control center and the peripheral device. Therefore, to ensure proper synchronization, the peripheral device uti-
35 lizes the external interrupt to provide synchronization between the two units, within a few microseconds. This allows extremely reliable data communication on the remote bus 80, the remote bus communication

routine 630 is linked to routine 643 in similar manner as are the
routines 573/590 in Fig. 7.

System Operation

The alarm control center is designed such that there are two
levels of user interface, namely operator interface and installer
interface. the normal operator interface to the system is used on ente-
ring and leaving the premises. when an owner of a store, which is pro-
tected by the alarm control center system, enters his premises, he
initiates a procedure which switches his system from the night mode
(full protection) to the day mode (reduced protection). This interface
is handled through a remote control unit connected to the alarm con-
trol center. An alarm control center can handle up to 16 peripheral
devices consisting of 9 different types. Each peripheral device has an
individual address and an unique communication capability. Selection of
the peripheral device requires an incorporation of it into the system
which is the job of the skilled installer. As far as an operator is
concerned, his interface has the primary function of day/night and
night/day switching, and status display. In certain situations, more
sophisticated capabilities are provided such as card and cipher access
control of selective areas, incorporation of electric strike locks and
door strikes and using volume printers for remote camera control.

The operator switches the system by inserting his key into
a remote device and turning his key. This initiates a sequence of
events beginning with a test of the system status wich ultimately
leads to a display of the system condition at the time of key insertion,
and, switching operating modes.

Similarly, when the operator leaves his premise at night he
repeats the operation. He inserts his key into his remote control de-
vice, and if the display is proper, he leaves his premises. The system
switches from "reduced protection" to "full protection" if all opera-
tional parameters are in accordance with predefined specifications.

In the event that there has been an alarm in the system, the
operator is able to get preliminary information from his remote device,
provided the particular device has the necessary display means. In any
event, the operator can get full information by going to the alarm con-
trol center itself, inserting his operator key into the alarm control
center and turning it. The system will display information which allows

the operator to ascertain the nature of the problem.

The next level of user interface is the installer. In this
case we have a higher level user. The installer requires more informa-
tion from the system and also has more control over the alarm con-
trol center program. The installer normally sees the system at two dif-
ferent times. The first time is on initial installation. When the
installer initially connects a system, he must perform individual in-
stallation of all the sensors necessary to protect the premises. He
then proceeds to connect the wires to the alarm control center. Con-
nection is done by an interconnection scheme which allows very rapid
connection of individual wires into cable harnesses with connectors.
The connectors allow rapid plug-in of sensor loops to the I/O board
100 inside the alarm control center. The installer at installation
must connect the line voltage and battery to provide proper system
operation. After a system has been wired in, it is necessary to check
and align it. Checking alignment is automatically accomplished by the
microprocessor contained in the alarm control center when the appropri-
ate controls are pressed by the installer. In addition to checking and
aligning the input loops, the alarm control center also forces the
installer to step through all of the devices which he has the possi-
bility of programming. This is done so that the installer knows what
parameters are entered into the system and the alarm control center
has the proper information to initiate its surveillance of the
premises.

The second time the installer sees the system is when the
user has a problem. In this case, the installer's information is si-
milar to the user's information, namely the source of the problem.
The major function which the installer uses is an automatic repeat
viewing "walk test" of the individual loop creating problems.

Interfacing to the external environment is via two different
types of interfaces. The first interface is the interface of peripheral
devices connected to the alarm control center. This interface, the
remote bus, is designed to work at aggregate distances of up to 500
meters. From 1 to 16 peripheral devices may be connected on the re-
mote bus. Communication to peripheral devices utilizes synchronization
to hardware interrupts between the alarm control center and the
peripheral devices. Then communication begins with two modes of ope-

ration, namely individual peripheral addressing and group addressing.
The two communication modes are intermixed so that fast response may
be obtained to changes in individual peripheral status yet each peri-
pheral may have its time for communication to establish full operatio-
5   nal capability.

Communication to the external world is handled by a separate
communications printed circuit board 300 which is mounted in the alarm
control center. There is a possibility of using hierarchical communi-
cations modules. In the end it is designed that the alarm control cen-
10   ter is able to be monitored programmed, and controlled by a central
alarm station.

A different type of communication was necessary for the PTT
interface as contrasted with the remote bus communications. This is
because external communications requires a higher level of security
15   since it is more vulnerable to attempts to damage the communications
system. External communications uses parity bits, block checking cha-
racters and echo back procedures to minimize the effect of noise and
extraneous signals introduced into the communication line.
Moreover, the alarm control center communications board 300 has the
20   capability of providing encryption of the data to reduce the possibi-
lity of sabotage.

Numerous alterations of the structure herein disclosed
will suggest themselves to those skilled in the art. However, it is
to be understood that the present disclosure relates to a preferred
25   embodiment of the invention which is for purposes of illustration only
and not to be construed as a limitation of the invention. All such
modifications which do not depart from the spirit of the invention are
intended to be included within the scope of the appended claims.

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CLAIMS:

1.   An alarm control center for interfacing with:

a. a plurality of input sensor loops (102), each of said loops having
at least one sensor element, each sensor element having a respective
electrical resistance range between a standard condition of an associ-
ated physical facility an a hazardous condition of such physical faci-
lity and

b. an array of alarm output elements for outputting a plurality of
respective audio-visual alarm signalizations,

said alarm control center comprising:

1. first means for interchangeably preassigning respective alarm para-
meter values for each of said input sensor loops;

2. second means for interchangeably preassigning respective alarm sig-
nalizations for each of said input sensor loops;

3. scanning means (120) for sequentially scanning said plurality of
input sensor loops;

4. conditioning means (130) for conditioning the signals from each of
the scanned sensor loops;

5. comparing means for comparing the signal from each particular scan-
ned input sensor loop with the corresponding preassigned alarm parame-
ter value;

6. activating means for activating the associated alarm output elements
under control of an output signal from said comparing means indicating
a hazardous condition in the signal corresponding to the respective
input sensor loop.

2.   An alarm control center as claimed in claim 1, which further-
more comprises interface means for receiving and operatively forwarding
remotedly originated control signals for controlling said scanning
means, said comparing means, and said alarm activating means.

3.   An alarm control center as claimed in claim 1 or 2, which
furthermore comprises remote station means coupled to said interface
means and having selector means for generating under external control
activation/deactivation signals for further elements of said alarm con-
trol center.

4.   An alarm control center as claimed in claim 1, 2 or 3, having
security level selecting means for selectively a day mode of operation
and a night mode of operation, wherein during the night mode all of said
input sensor loops and alarm output elements are operational while du-
ring the day mode certain of said input sensor loops and alarm outputs
are inhibited, cycling means for automatically controlling transitions
between said day mode and said night mode at appropriate instants, and
halt means for automatically preventing the transition from one mode
to another under control of an alarm condition signal.

5.   An alarm control center as claimed in any of the claims 1
to 4, furthermore comprising a scanning selector for under control of
a warning signal selectively increasing the scanning rate of at least
one particular input sensor loop with respect to its standard scanning
rate for verifying the occurrence of an alarm condition in said at
least one particular input sensor loop.

6.   An alarm control center as claimed in any of the claims 1 to
6, which further comprises back-up battery (460) means for powering
said alarm control signal under control of a signalling signal produced
by a power outage sensor coupled to a mains-fed power supply means.

7.   An alarm control center as claimed in claim 6 which furthermore
comprises secondary cycling means for repetitively switching on and off
a remote station means coupled to said alarm control center under batte-
ry-powered conditions for extending battery operation time.

8.   An alarm control center as claimed in claim 7, further com-
prising suspending means for under control of a low voltage condition
of said battery back-up means suspending the operation of said alarm
control center for preventing excessive discharge of said back-up
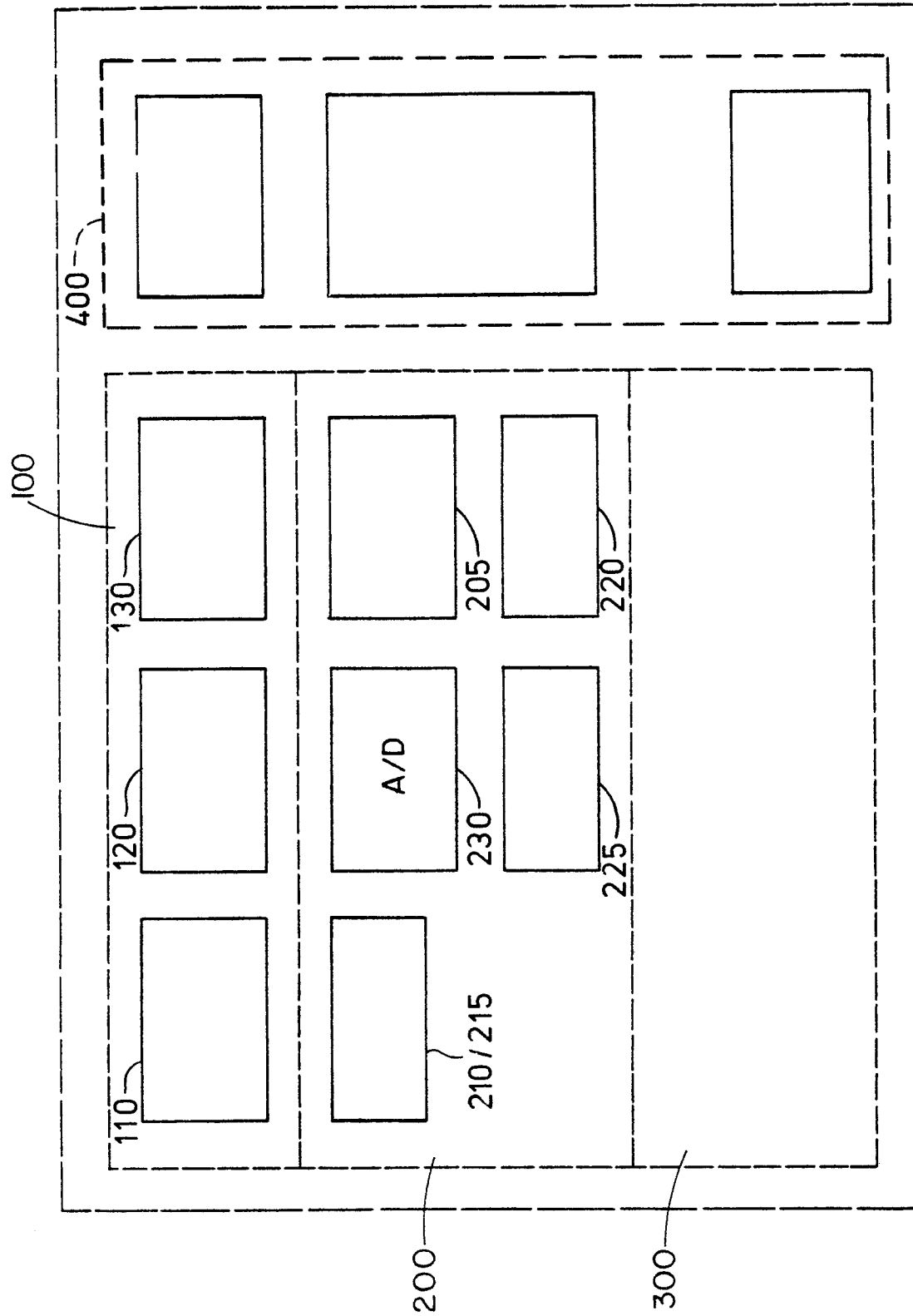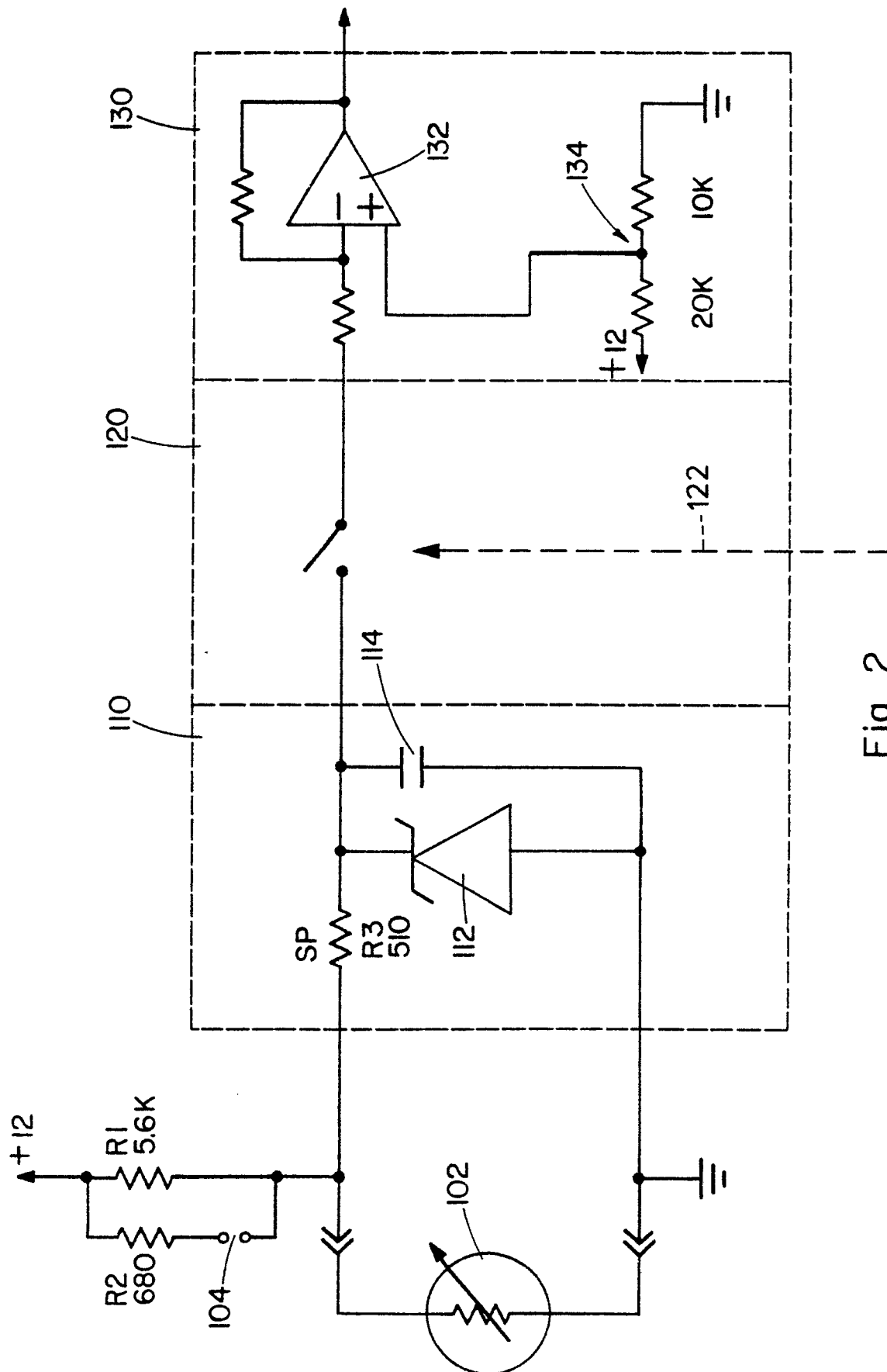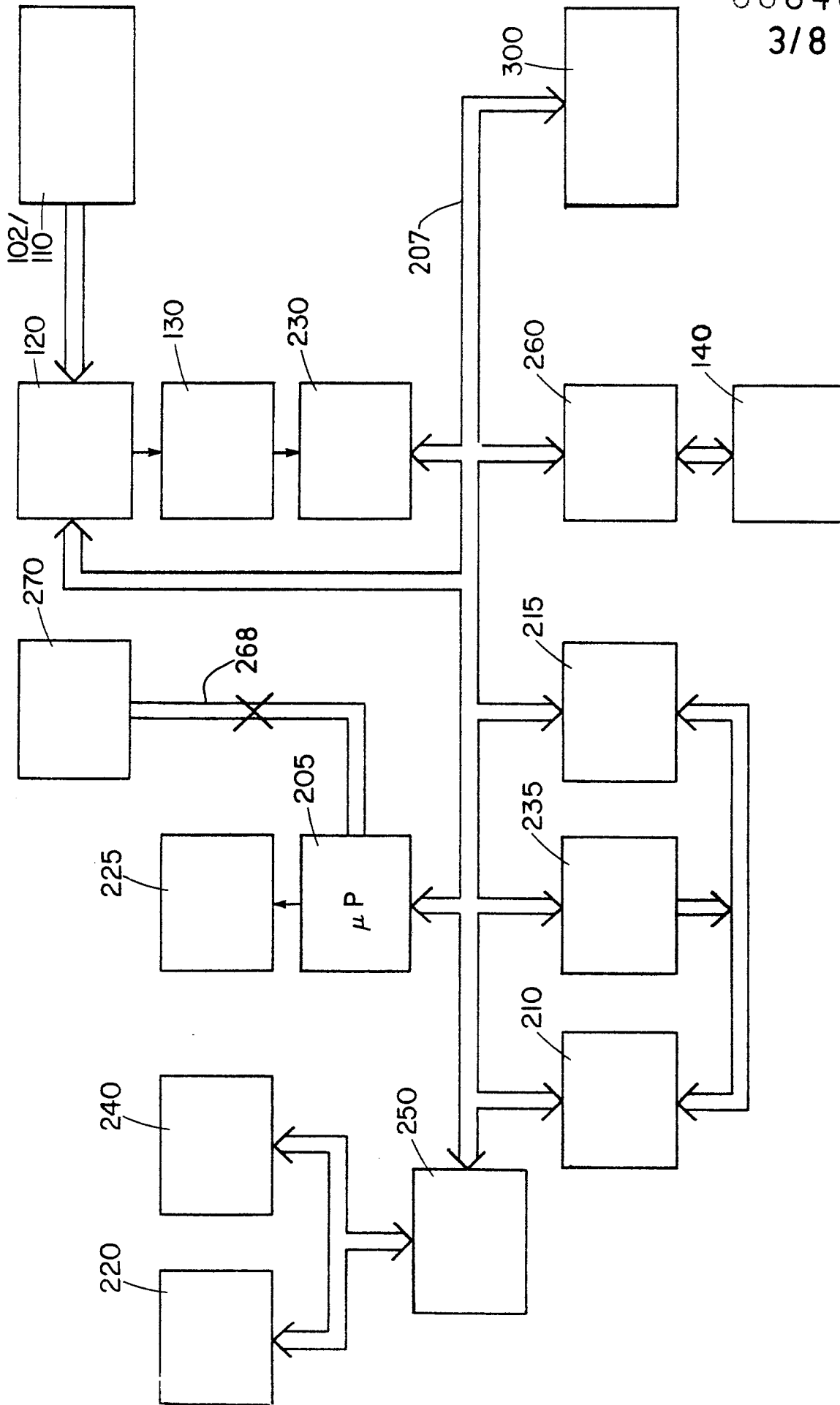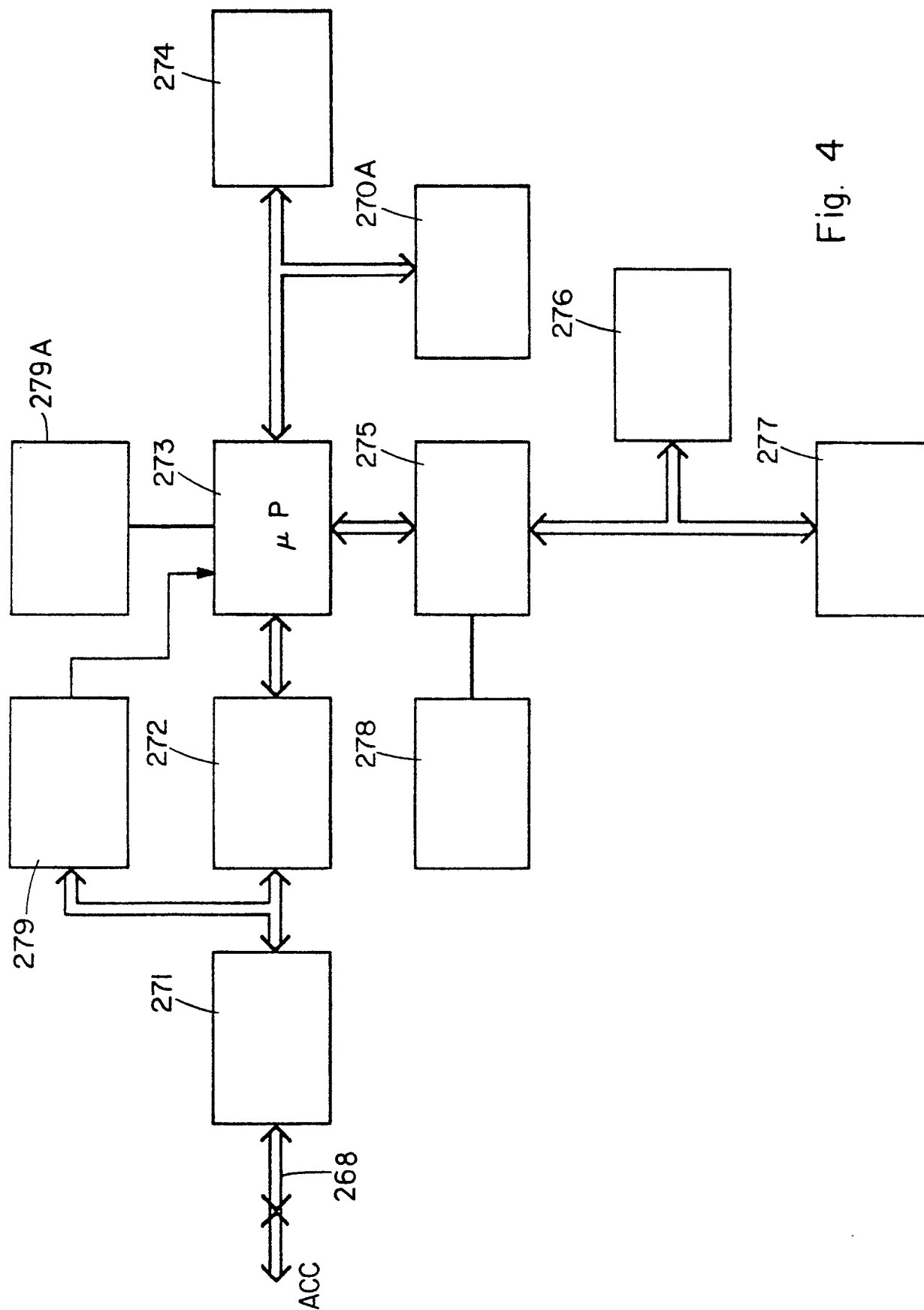battery means.

Fig. I
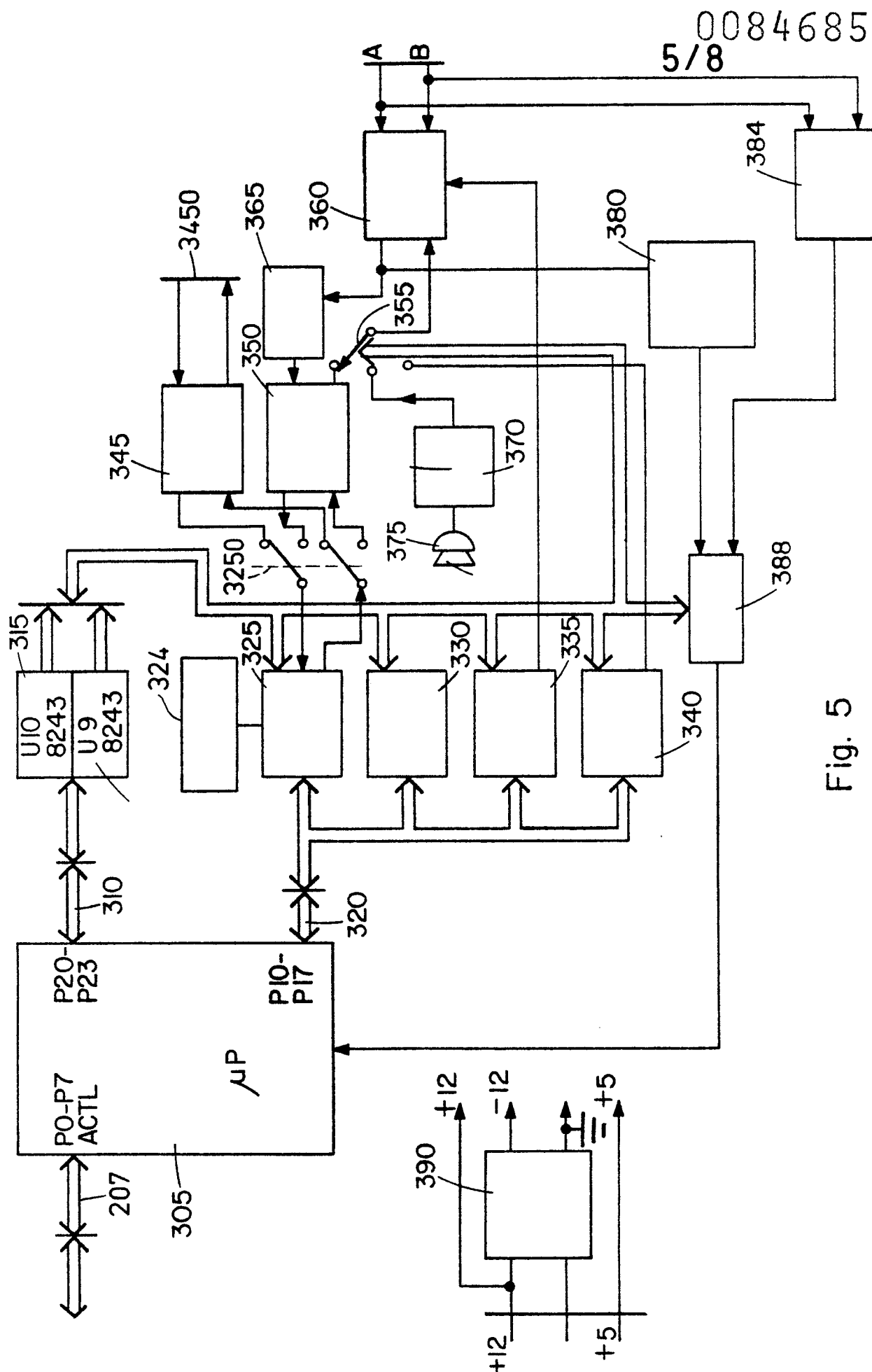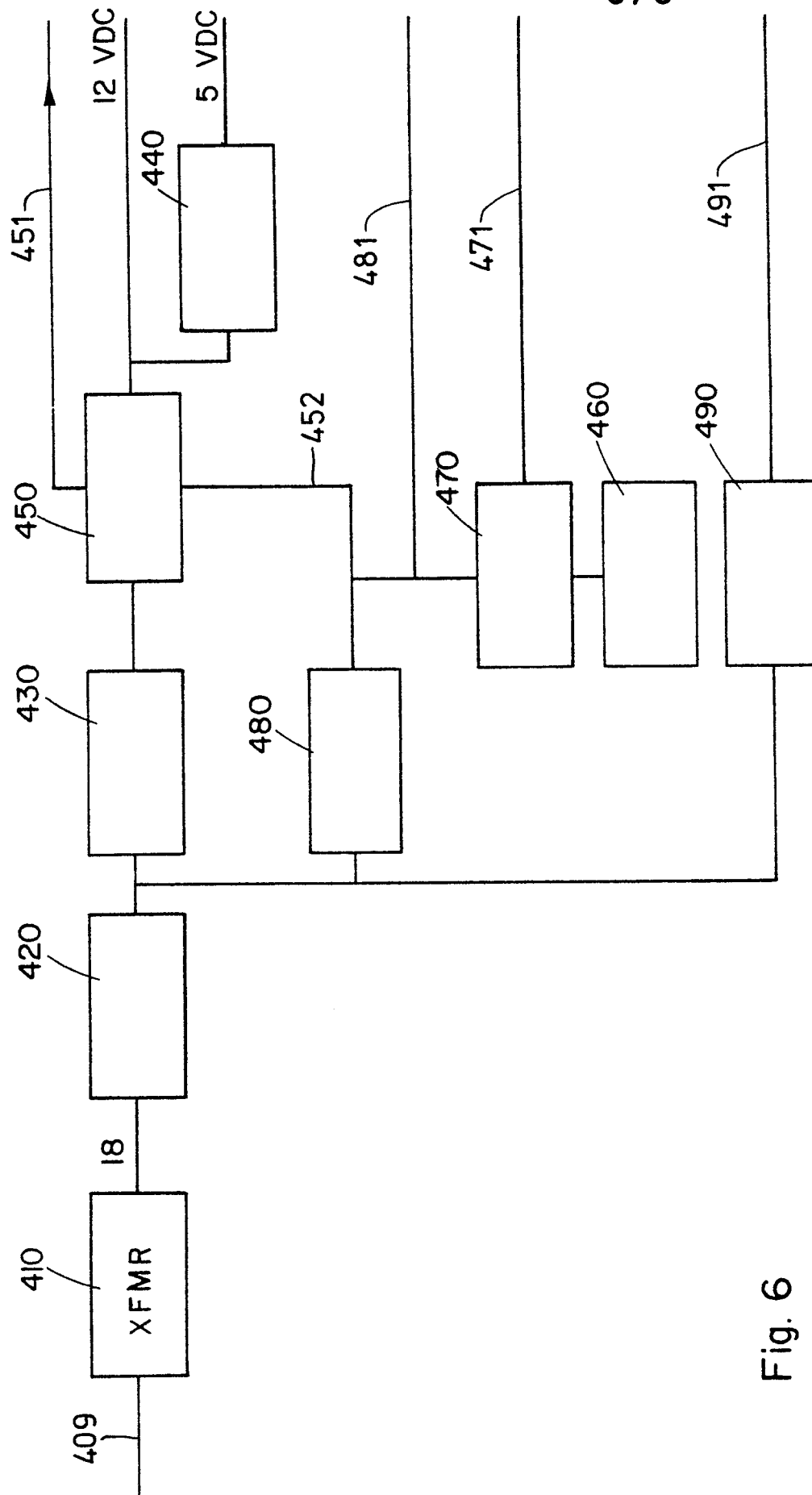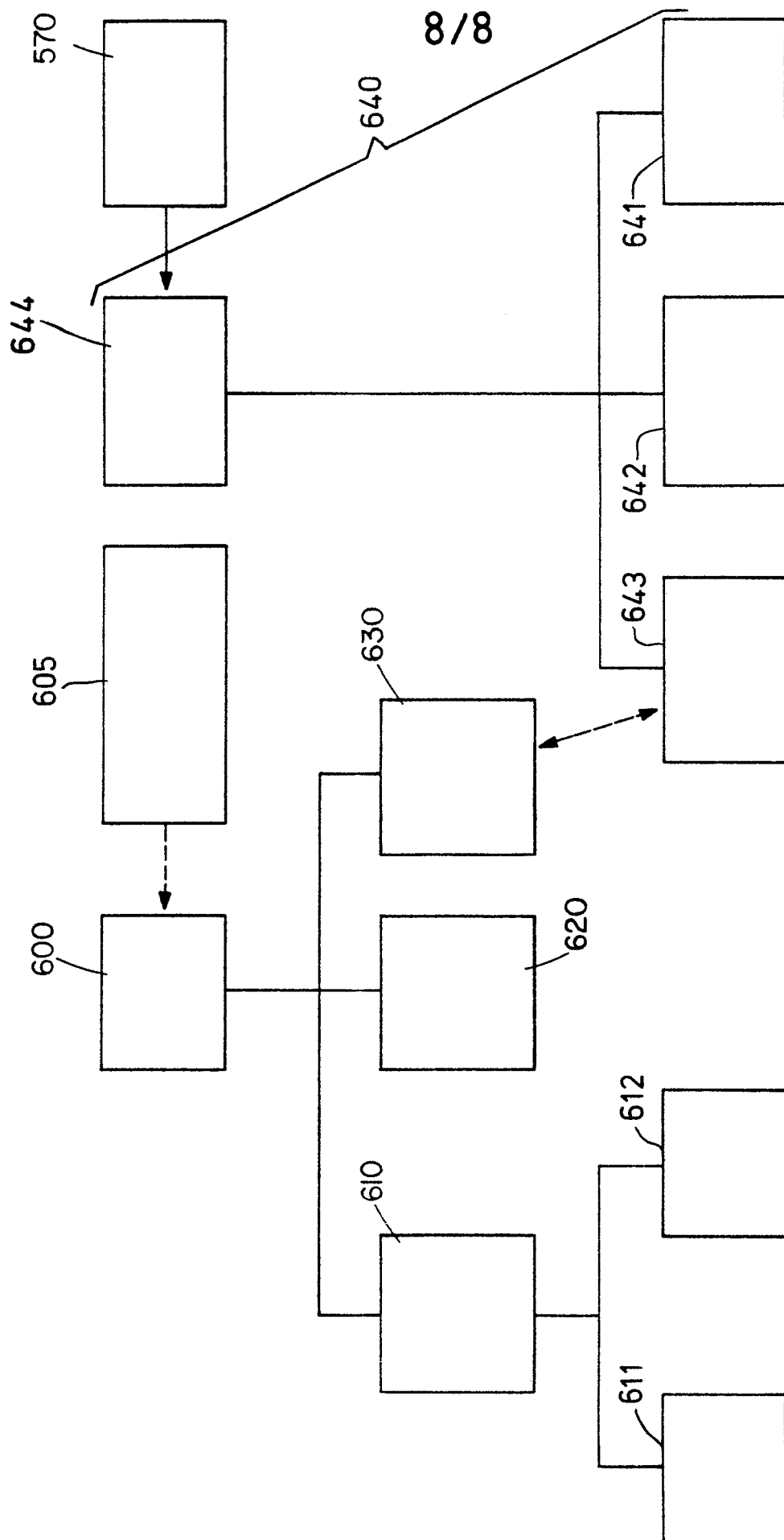
0084685

130

132

134

10K

20K

+12

120

122

110

114

SP R3
510

112

+12

R1
5.6K

R2
680

104

102

Fig. 2

102/
110

120

130

230

270

268

205

225

μP

235

215

260

140

300

207

210

250

240

220

Fig. 3

Fig. 4

Fig. 5

5 -VIII- PHA 21050

Fig. 6

Fig. 7

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Fig. 8

8 -VIII-PHA 21050

	DOCUMENTS CONSIDERED TO BE RELEVANT		CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X,Y	EP - A1 - 0 021 232 (F. FUSS KOM.-GES. ELEKTROTECHNISCHE FABRIK) * claims 1, 2, 11, 12, 14, 19; page 8; fig. 1 *	1-3, 6	G 08 B 25/00 G 08 B 27/00
Y	US - A - 4 095 220 (J.A. SADLER) * claims; fig. 2 *	2,6	
Y	DE- A1 - 3 023 598 (ELEKTROVOD LJUBLJANA ONPZ ELEKTROTEHNISKIH OBRTI * claim 1; page 5, lines 1, 2 *	1	**TECHNICAL FIELDS SEARCHED (Int.Cl. 3)**
A	US - A - 3 925 763 (R.T. WADHWANI et al.)		G 08 B 25/00 G 08 B 26/00 G 08 B 27/00 H 04 M 11/00
A	ERICSSON REVIEW, Vol. 56, No. 4, 1979 Stockholm C. HAGLAND et al. "ALARMCOM-a Computer-Controlled Alarm Communication System" pages 142 to 150		
Y	WIRELESS WORLD, Vol. 84, No. 1515, 1978 Haywards Heath R.J. CHANCE "Multiplexed Alarm" pages 73, 74 * whole document *		**CATEGORY OF CITED DOCUMENTS** X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons

The present search report has been drawn up for all claims

&: member of the same patent family, corresponding document

Place of search	Date of completion of the search	Examiner
Berlin	23-07-1982	BEYER