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(54) START-UP SEQUENCE FOR HVAC CONTROLLER

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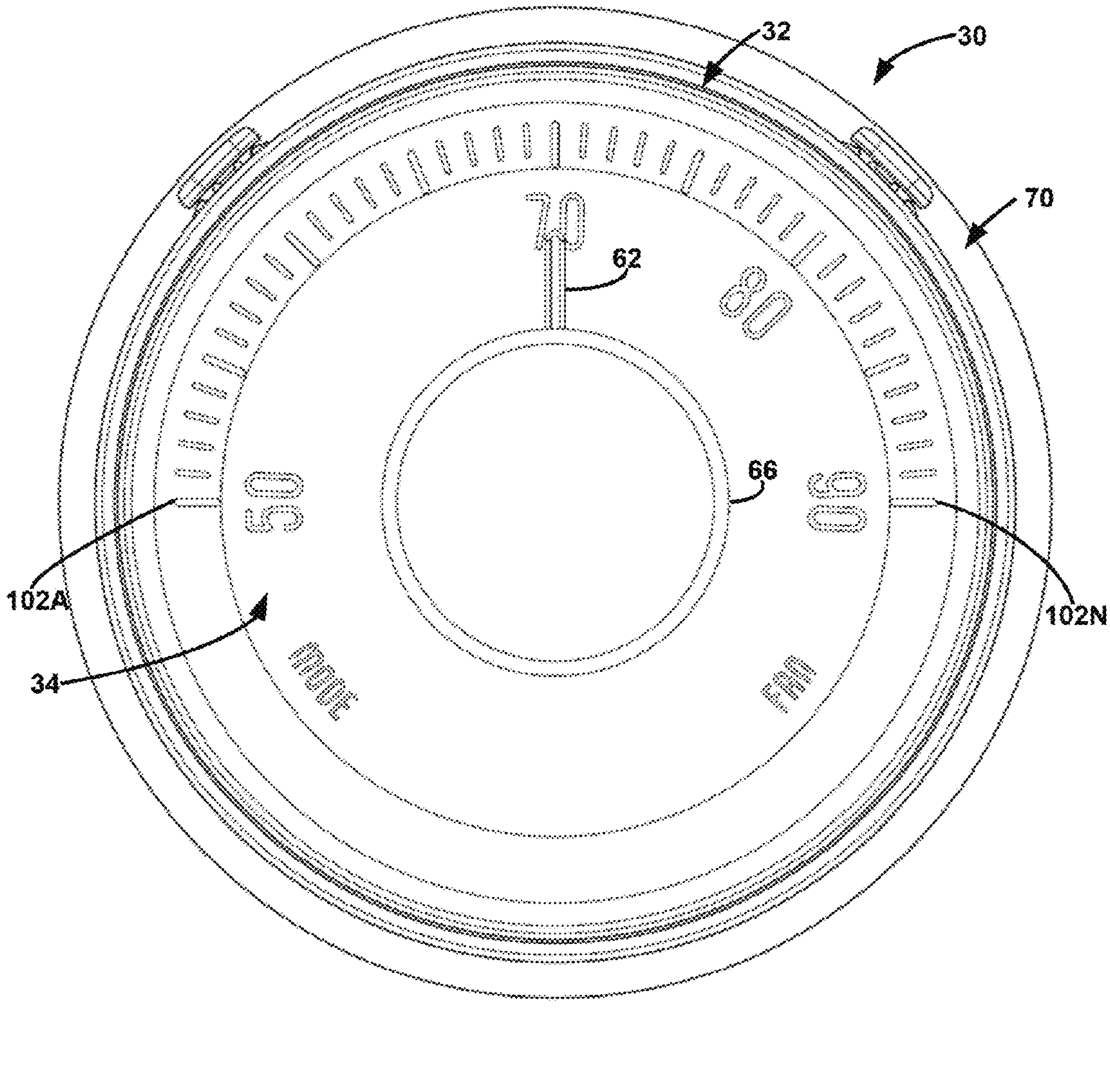
(57) **ABSTRACT**

In some examples, a device can control an HVAC system within a building. Includes an analog display including a set of markers, and where each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building; an electric motor; a pointer connected to the electric motor, where the electric motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and processing circuitry. The processing circuitry is configured to: determine a position of the electric motor while the pointer is positioned at one of the lower limit or the upper limit of the pointer range; and calibrate, a position function corresponding to the electric motor.



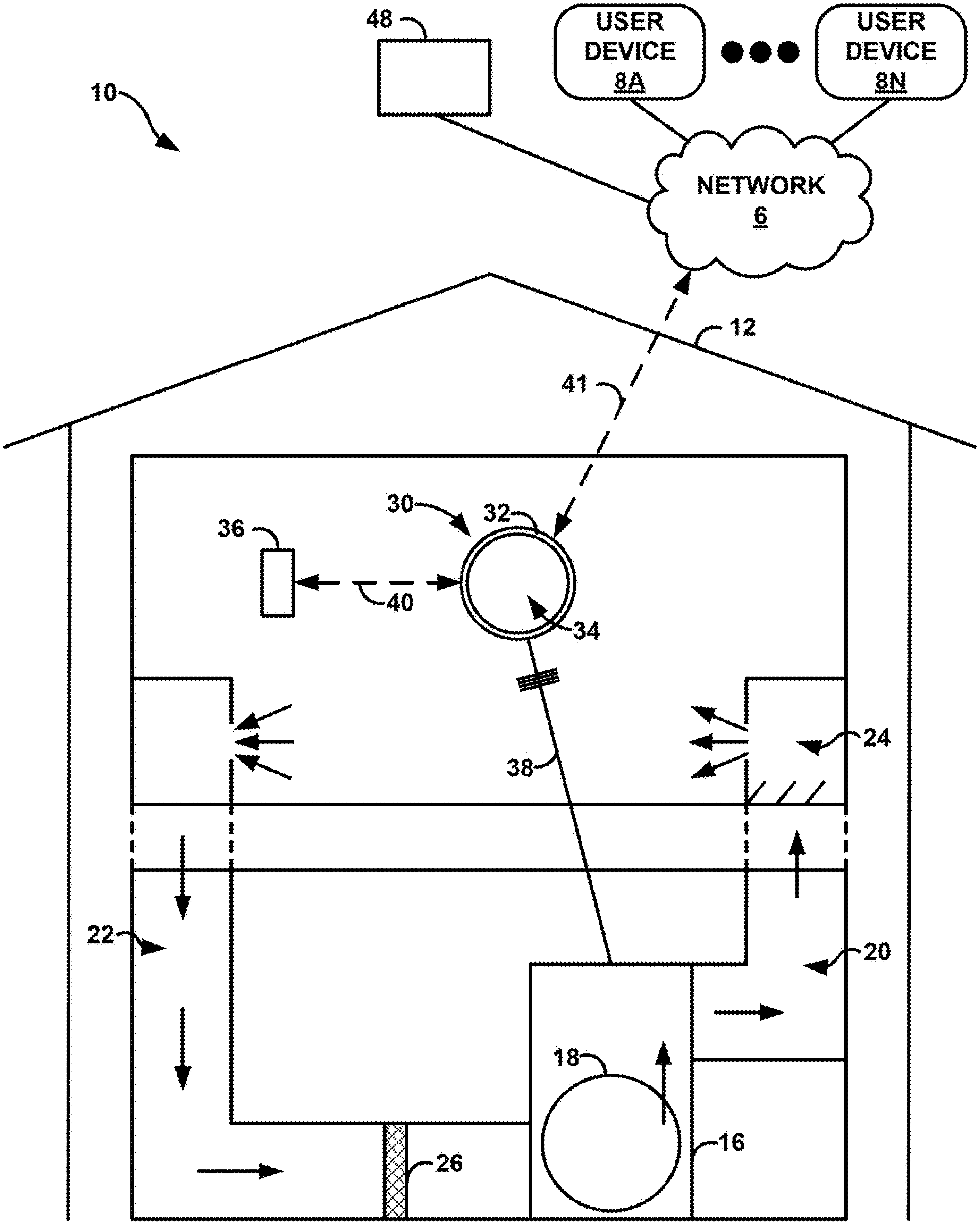

48
USER DEVICE 8A
USER DEVICE 8N
10
NETWORK 6
12
41
30
32
36
40
34
24
38
22
20
18
16
26

FIG. 1

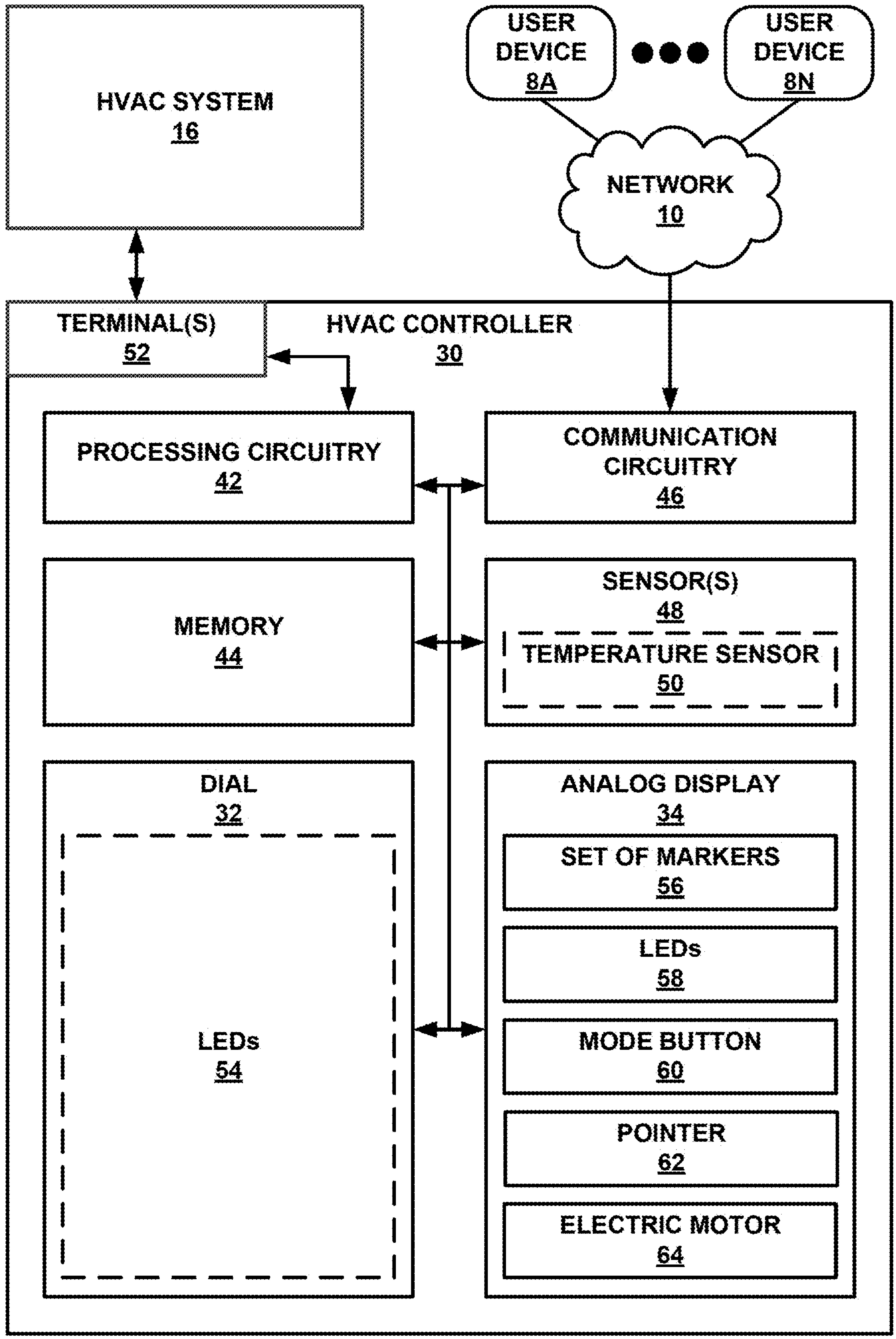

HVAC SYSTEM
16
USER DEVICE
8A
USER DEVICE
8N
NETWORK
10
TERMINAL(S)
52
HVAC CONTROLLER
30
PROCESSING CIRCUITRY
42
COMMUNICATION CIRCUITRY
46
MEMORY
44
SENSOR(S)
48
TEMPERATURE SENSOR
50
DIAL
32
LEDs
54
ANALOG DISPLAY
34
SET OF MARKERS
56
LEDs
58
MODE BUTTON
60
POINTER
62
ELECTRIC MOTOR
64

FIG. 2

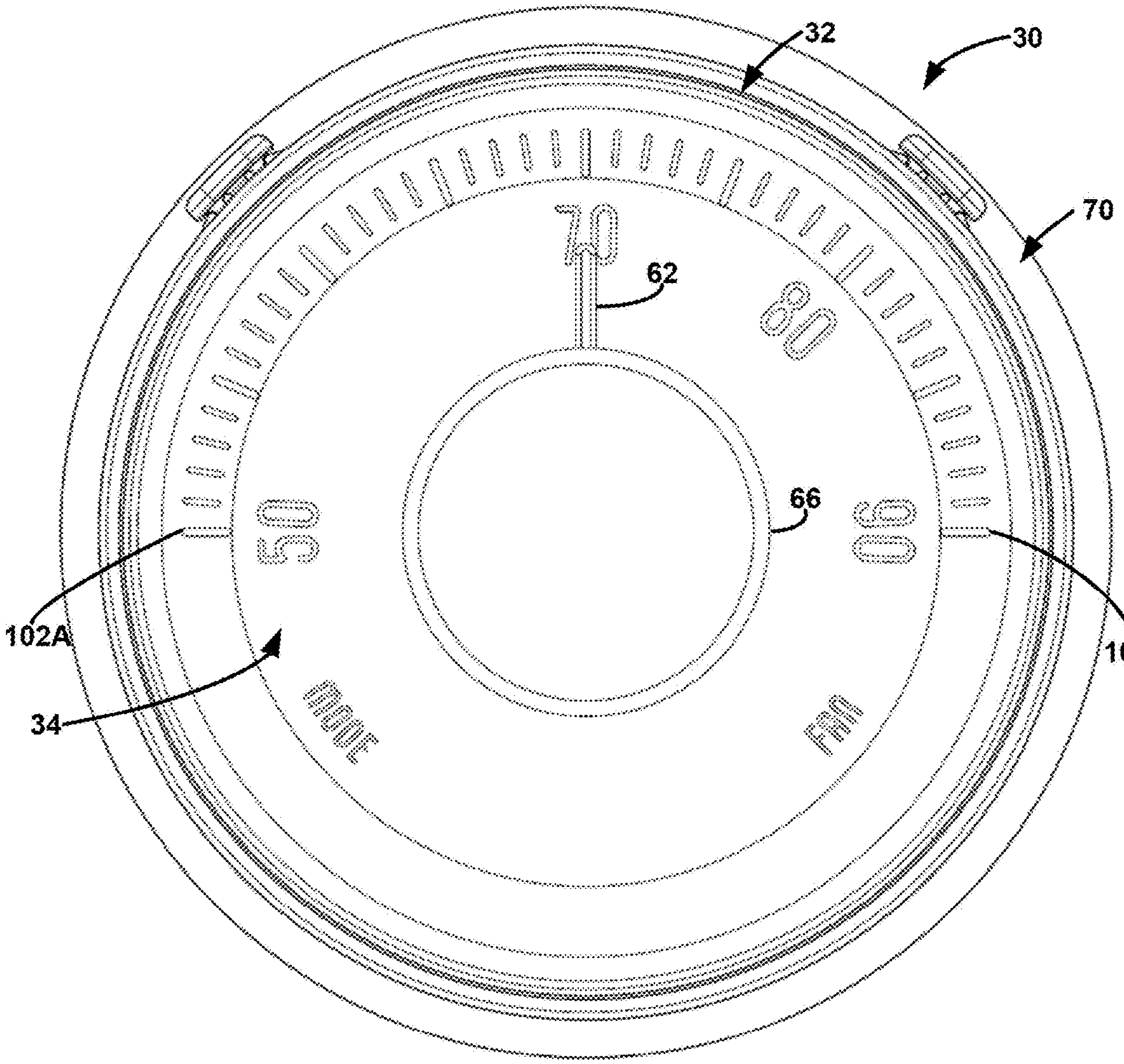


FIG. 3A

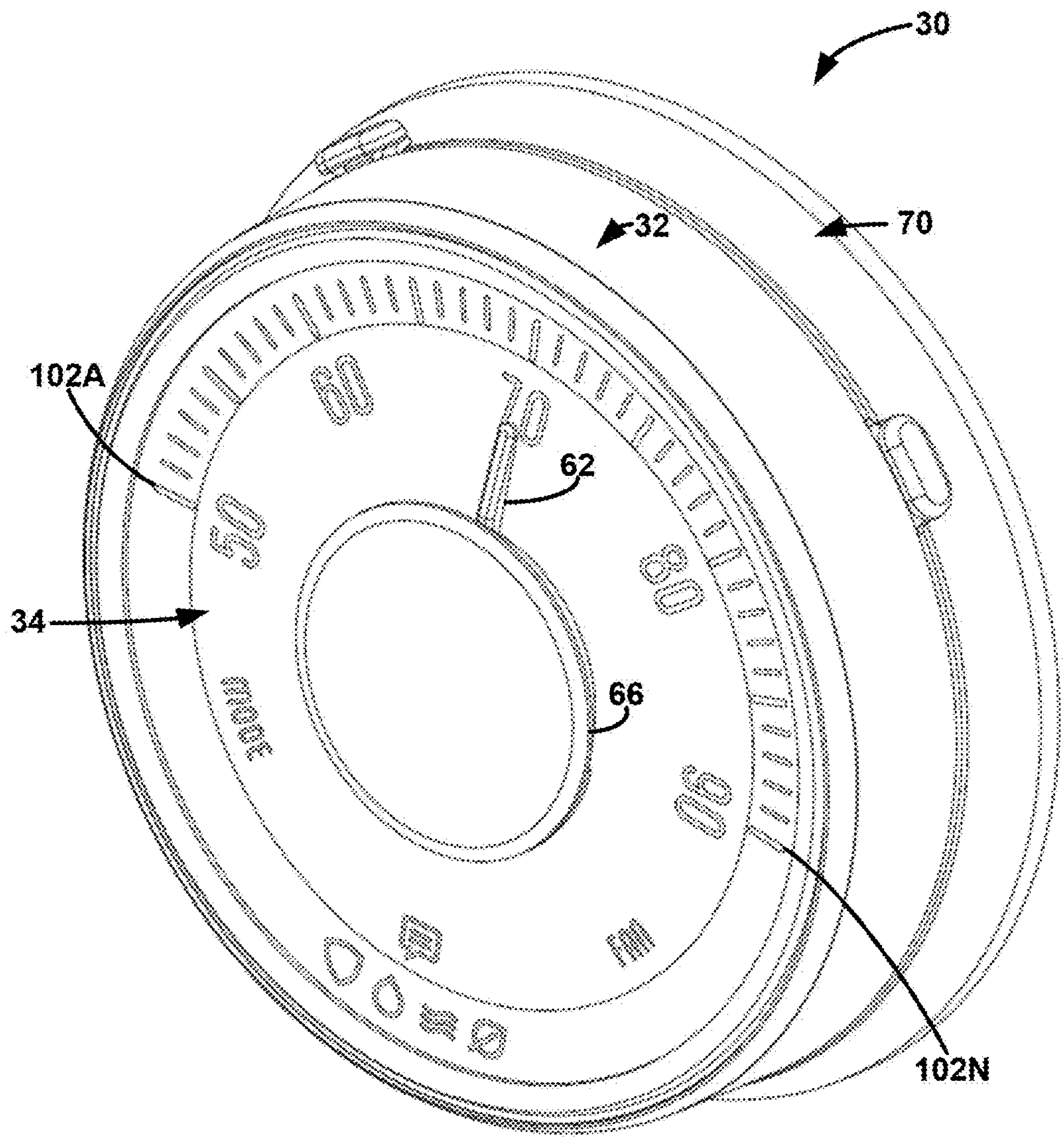


FIG. 3B

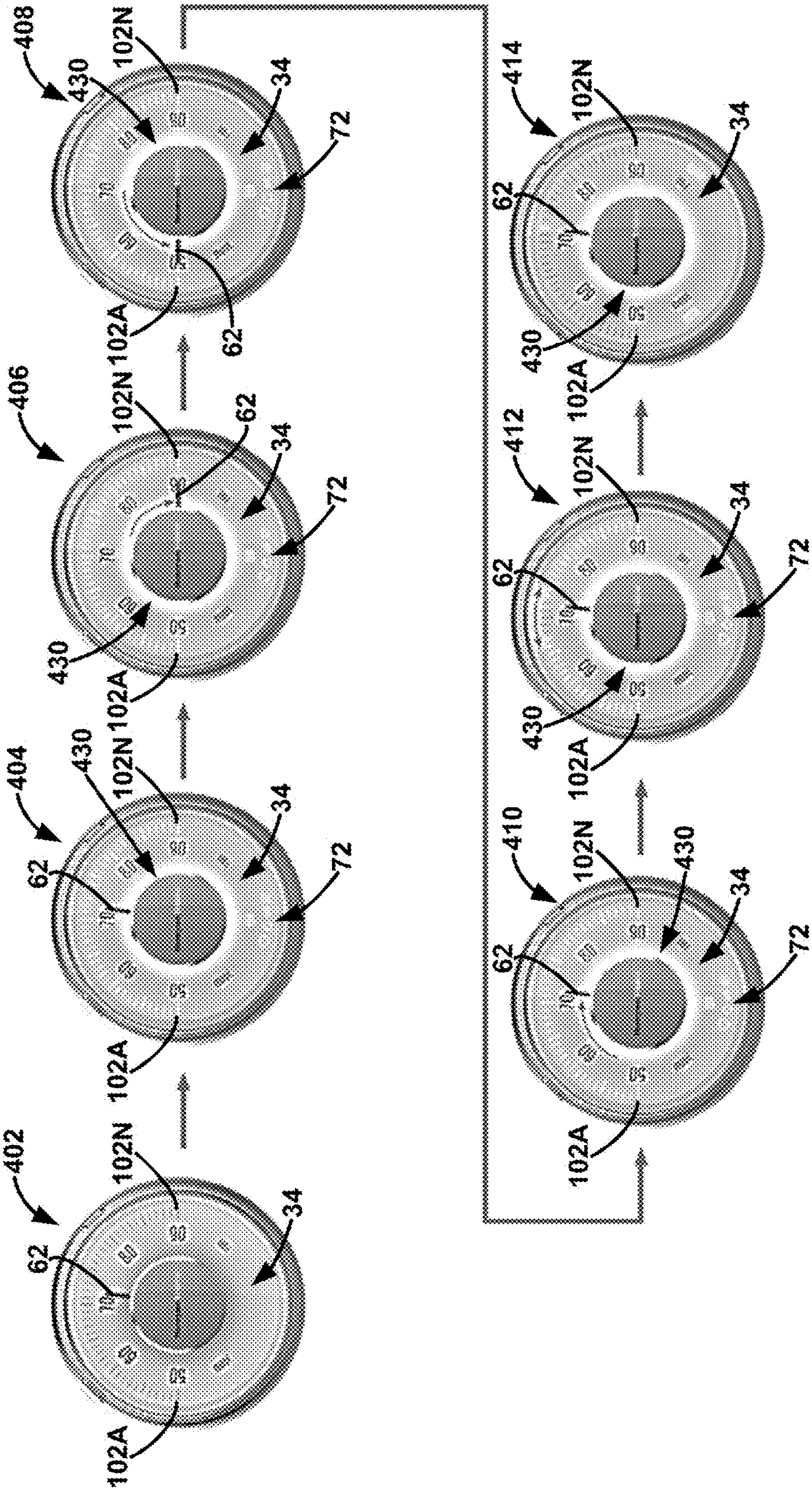


FIG. 4

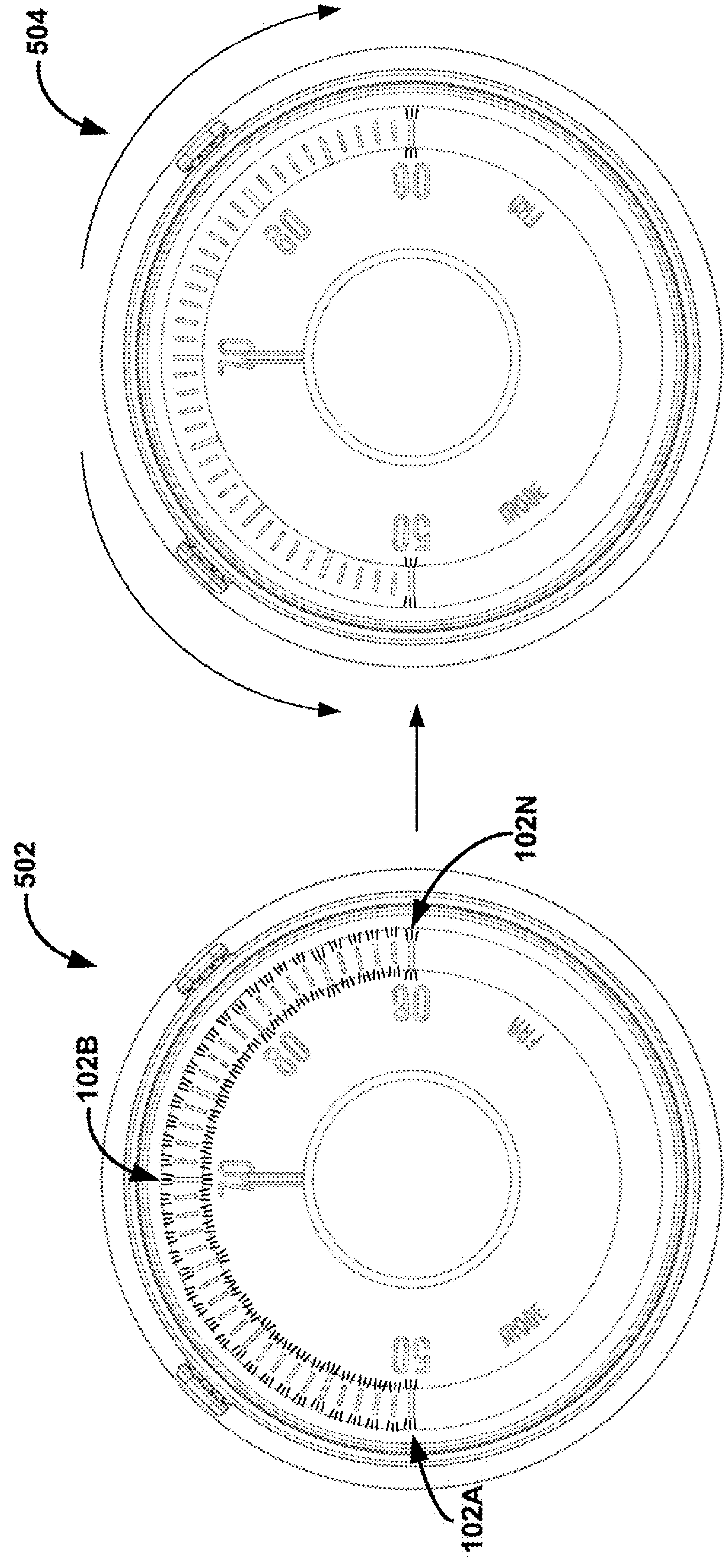


FIG. 5

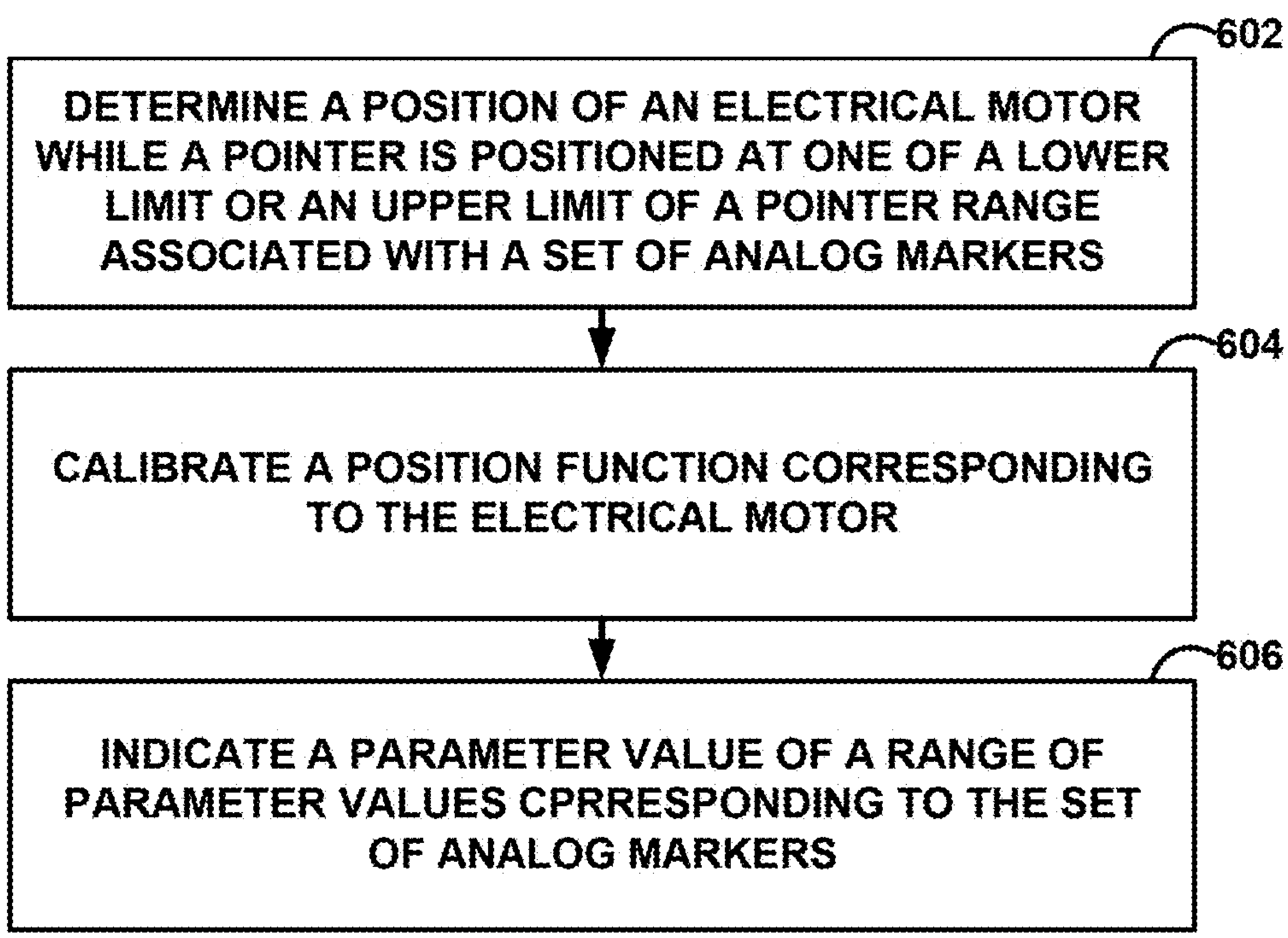

602
DETERMINE A POSITION OF AN ELECTRICAL MOTOR WHILE A POINTER IS POSITIONED AT ONE OF A LOWER LIMIT OR AN UPPER LIMIT OF A POINTER RANGE ASSOCIATED WITH A SET OF ANALOG MARKERS
604
CALIBRATE A POSITION FUNCTION CORRESPONDING TO THE ELECTRICAL MOTOR
606
INDICATE A PARAMETER VALUE OF A RANGE OF PARAMETER VALUES CPRRESPONDING TO THE SET OF ANALOG MARKERS

FIG. 6

START-UP SEQUENCE FOR HVAC CONTROLLER

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/958,105, filed Jan. 7, 2020, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The disclosure relates to heating, ventilation, and air condition (HVAC) systems and thermostats for buildings.

BACKGROUND

[0003] A heating, ventilation, and air conditioning (HVAC) controller can control a variety of devices such as a furnace, a heat pump including a geothermal heat pump, a boiler, air conditioning unit, forced air circulation, and other similar equipment to control the internal climate conditions of a building. In some examples, a thermostat can control different devices depending on the outside temperature, temperature inside the building, the time of day, and other factors. Environmental control systems may also include evaporative cooling systems as well as other systems such as window mounted heat exchangers and two-part heat exchangers, which may be used for heating or cooling building spaces.

SUMMARY

[0004] In general, this disclosure describes an HVAC controller including a display which can show a set point temperature for an area, a current temperature of the area, and one or more other parameters. In some examples, the HVAC controller may include an analog display including a set of markers and a pointer connected to an electric motor. The electric motor may set a position of the pointer to indicate, or "point," at a marker corresponding to a current temperature of the area. In some examples, the HVAC controller may additionally or alternatively indicate one or more set point temperatures for the area and one or more other parameters such as an air quality value, a humidity value, a water consumption value, a power consumption value, a current time, or any combination thereof.

[0005] The HVAC controller may perform a start-up sequence in response to transitioning from a deactivated state to an activated state. The start-up sequence may include a calibration of a position function corresponding to the electric motor such that the electric motor may place the pointer to accurately indicate a parameter value (e.g., a temperature value). Additionally, or alternatively, the start-up sequence may include a selective activation and/or a selective deactivation of one or more light-emitting diodes (LEDs) of the HVAC controller.

[0006] It may be beneficial to calibrate the position function so that the HVAC controller may control the pointer in order to accurately indicate the parameter value. The HVAC controller may perform the calibration during the start-up sequence in order to ensure that the HVAC controller accurately indicates the parameter value each time that the HVAC controller transitions from a deactivated state to an activated state. In some cases, when the HVAC controller deactivates, the position of the electric motor may become de-calibrated.

[0007] In some examples, a device controls a heating, ventilation, and air conditioning (HVAC) system within a building, the device comprising: an analog display comprising a set of markers, wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building; an electric motor; a pointer connected to the electric motor, wherein the electric motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and processing circuitry. The processing circuitry is configured to: determine a position of the electric motor while the pointer is positioned at one of the lower limit or the upper limit of the pointer range; and calibrate, based on the position of the electric motor while the pointer is positioned at the one of the lower limit or the upper limit, a position function corresponding to the electric motor to configure the electric motor to move the pointer to indicate the respective parameter value of the parameter associated with the building.

[0008] In some examples, a device controls a heating, ventilation, and air conditioning (HVAC) system within a building, the device comprising: an analog display comprising a set of markers, wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building; an electric stepper motor; a pointer connected to the electric stepper motor, wherein the electric stepper motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and processing circuitry. The processing circuitry is configured to cause the electric stepper motor to position the pointer at one of the lower limit or the upper limit of the pointer range; determine an initial value for the parameter; and cause the electric stepper motor to move the pointer from the one of the lower limit or the upper limit of the pointer range to the marker corresponding to the determined initial value for the parameter.

[0009] In some examples, a method includes determining, by processing circuitry, a position of an electric motor while a pointer is positioned at one of the lower limit or the upper limit of the pointer range, wherein the pointer is connected to the electric motor, and wherein the electric motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and calibrating, by the processing circuitry based on the position of the electric motor while the pointer is positioned at the one of the lower limit or the upper limit, a position function corresponding to the electric motor to configure the electric motor to move the pointer to indicate the respective parameter value of the parameter associated with the building, wherein an analog display comprises a set of markers, and wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building.

[0010] The summary is intended to provide an overview of the subject matter described in this disclosure. It is not intended to provide an exclusive or exhaustive explanation of the systems, device, and methods described in detail within the accompanying drawings and description below. Further details of one or more examples of this disclosure are set forth in the accompanying drawings and in the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF DRAWINGS

[0011] FIG. **1** is a block diagram illustrating an example heating, ventilation, and air conditioning (HVAC) system in a building, in accordance with one or more techniques described herein.

[0012] FIG. **2** is a block diagram illustrating an example HVAC controller including a dial and an analog display, in accordance with one or more techniques described herein.

[0013] FIG. **3**A is a conceptual diagram illustrating a front view of the controller of FIG. **2**, in accordance with one or more techniques described herein.

[0014] FIG. **3**B is a conceptual diagram illustrating an example perspective view of the controller of FIG. **2**, in accordance with one or more techniques described herein.

[0015] FIG. **4** is a conceptual diagram illustrating a sequence of configurations of a controller for calibrating the controller, in accordance with one or more techniques described herein.

[0016] FIG. **5** is a conceptual diagram illustrating a first configuration and a second configuration of a lighting process, in accordance with one or more techniques described herein.

[0017] FIG. **6** is a flow diagram illustrating an example process for calibrating a controller, in accordance with one or more techniques described herein.

DETAILED DESCRIPTION

[0018] FIG. **1** is a block diagram illustrating an example heating, ventilation, and air conditioning (HVAC) system **10** in a building **12**, in accordance with one or more techniques described herein. HVAC system **10** includes HVAC component(s) **16**, a supply air duct **20**, a return air duct **22** (collectively, "ducts **20**, **22**"), dampers **24**, and air filters **26**. Additionally, HVAC system **10** includes an HVAC controller **30** configured to control HVAC component(s) **16** to regulate one or more parameters within building **12**. HVAC controller **30** may include a dial **32** and an analog display **34**.

[0019] HVAC system **10** may include one or more devices for regulating an environment within building **12**. For example, HVAC controller **30** may be configured to control the comfort level (e.g., temperature and/or humidity) in building **12** by activating and deactivating HVAC component(s) **16** in a controlled manner. HVAC controller **30** may be configured to control HVAC component(s) **16** via a wired or wireless communication link **38**. In some examples, a wired communication link **38** may connect HVAC component(s) **16** and HVAC controller **30**. HVAC controller **30** may be a thermostat, such as, for example, a wall mountable thermostat. In some examples, HVAC controller **30** may be programmable to allow for user-defined temperature set points to control the temperature of building **12**. Based on sensed temperature of building **12**, HVAC controller **30** may turn on HVAC component(s) **16** or turn off HVAC component(s) **16** in order to reach the user-defined temperature set point. Although this disclosure describes HVAC controller **30** (and controllers shown in other figures) as controlling HVAC component(s) **16**, external computing device **36** may also be configured to perform these functions. The techniques of this disclosure will primarily be described using examples related to temperature, but the systems, devices, and methods described herein may also be used in conjunction with other sensed properties, such as humidity or air quality. In some examples, HVAC controller **30** may be configured to control all of the critical networks of a building, including a security system.

[0020] HVAC component(s) **16** may provide heated air (and/or cooled air) via the ductwork throughout the building **12**. As illustrated, HVAC component(s) **16** may be in fluid communication with one or more spaces, rooms, and/or zones in building **12** via ducts **20**, **22**, but this is not required. In operation, when HVAC controller **30** outputs a heat call signal to HVAC component(s) **16**, HVAC component(s) **16** (e.g., a forced warm air furnace) may turn on (begin operating or activate) to supply heated air to one or more spaces within building **12** via supply air ducts **20**. HVAC component(s) **16**, which include an air movement device **18** (e.g., a blower or a fan), can force the heated air through supply air duct **20**. In this example, cooler air from each space returns to HVAC component(s) **16** (e.g. forced warm air furnace) for heating via return air ducts **22**. Similarly, when a cool call signal is provided by HVAC controller **30**, a cooling device (e.g., an air conditioning (AC) unit) of HVAC component(s) **16** may turn on to supply cooled air to one or more spaces within building **12** via supply air ducts **20**. Air movement device **18** may force the cooled air through supply air duct **20**. In this example, warmer air from each space of building **12** may return to HVAC component(s) **16** for cooling via return air ducts **22**.

[0021] In some examples, HVAC component(s) **16** may include any one or combination of a fan, a blower, a furnace, a heat pump, an electric heat pump, a geothermal heat pump, an electric heating unit, an AC unit, a humidifier, a dehumidifier, an air exchanger, an air cleaner, a damper, a valve, and a fan, however this is not required. HVAC component(s) **16** may include any device or group of devices which contributes to regulating the environment within building **12** based on signals received from HVAC controller **30** or contributes to regulating the environment within building **12** independently from HVAC controller **30**.

[0022] Ducts **20**, **22** may include one or more dampers **24** to regulate the flow of air, but this is not required. For example, one or more dampers **24** may be coupled to HVAC controller **30** and can be coordinated with the operation of HVAC component(s) **16**. HVAC controller **30** may actuate dampers **24** to an open position, a closed position, and/or a partially open position to modulate the flow of air from the one or more HVAC components to an appropriate room and/or space in building **12**. Dampers **24** may be particularly useful in zoned HVAC systems, and may be used to control which space(s) in building **12** receive conditioned air and/or receives how much conditioned air from HVAC component (s) **16**.

[0023] In many instances, air filters **26** may be used to remove dust and other pollutants from the air inside building **12**. In the example shown in FIG. **1**, air filters **26** is installed in return air duct **22** and may filter the air prior to the air entering HVAC component(s) **16**, but it is contemplated that any other suitable location for air filters **26** may be used. The presence of air filters **26** may not only improve the indoor air quality but may also protect the HVAC component(s) **16** from dust and other particulate matter that would otherwise be permitted to enter HVAC component(s) **16**.

[0024] HVAC controller **30** may include any suitable arrangement of hardware, software, firmware, or any combination thereof. For example, HVAC controller **30** may include processing circuitry comprising microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), or equivalent discrete or integrated logic circuitry, or a combination of any of the foregoing devices or circuitry. Accordingly, the processing circuitry may include any suitable structure, whether in hardware, software, firmware, or any combination thereof, to perform the functions ascribed herein to HVAC controller **30**.

[0025] Although not shown in FIG. **1**, HVAC controller **30** may include a memory configured to store information within HVAC controller **30** during operation. The memory may include a computer-readable storage medium or computer-readable storage device. In some examples, the memory includes one or more of a short-term memory or a long-term memory. The memory may include, for example, random access memories (RAM), dynamic random access memories (DRAM), static random access memories (SRAM), magnetic discs, optical discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable memories (EEPROM). In some examples, the memory is used to store program instructions for execution by the processing circuitry of HVAC controller **30**. In some examples, the memory of HVAC controller **30** may be able to store data to and read data from memory included in external computing device **36** and/or memory included in external database **48**. The memory may be used for storing network settings such as an Internet Protocol (IP) address and/or a Media Access Control (MAC) address of HVAC controller **30**, external computing device **36**, and/or a router.

[0026] In some examples, HVAC controller **30** may include a set of wire terminals which make up a terminal block (e.g., a wall plate or a terminal plate) for receiving a set of control wires for one or more HVAC component(s) **16** of HVAC system **10**. The memory of HVAC controller **30** may store one or more wiring configurations for HVAC component(s) **16**, allowing HVAC controller **30** to determine which of HVAC component(s) **16** are connected to HVAC controller **30**. The memory of HVAC controller **30** may also store settings for HVAC system **10** which correspond to the one or more wiring configurations for HVAC component(s) **16**. For example, if HVAC controller **30** is wired to an AC unit of HVAC component(s) **16**, HVAC controller **30** may determine one or more settings for controlling the AC unit to turn on and turn off.

[0027] In some examples, the memory of HVAC controller **30** may store program instructions, which may include one or more program modules, which are executable by HVAC controller **30**. When executed by HVAC controller **30**, such program instructions may cause HVAC controller **30** to provide the functionality ascribed to it herein. The program instructions may be embodied in software, firmware, and/or RAMware.

[0028] In some examples, HVAC controller **30** may include a dial **32** which is located at an outer circumference of HVAC controller **30**. HVAC controller **30** may be fixed to a wall or another surface such that dial **32** may be rotated relative to one or more other components (e.g., analog display **34**) of HVAC controller **30**. Dial **32** may represent a user interface such that processing circuitry of HVAC controller **30** may receive, dial **32** and/or dial circuitry electrically connected to dial **32**, information indicative of a user input. In some examples, the user input may represent a user selection of a set point parameter value (e.g., a set point temperature), a user selection of information to be displayed by HVAC controller **30**, or a user selection of another setting. In some examples, dial **32** may smoothly rotate with respect to analog display **34**. In some examples, dial **32** may rotate with one or more positions such that as dial **32** rotates, dial **32** "snaps" into position after every interval of rotational distance. In some examples, dial **32** may smoothly rotate with respect to analog display **34** and HVAC controller **30** may output an audio signal (e.g., a clicking noise) for every interval of rotational position (e.g., every one degree) in which dial **32** rotates.

[0029] In some examples, dial **32** does not move inwards in response to a force applied to dial **32**. For example, dial **32** may rotate about a center axis which passes through a center of dial **32** without moving along the center axis in response to one or more forces applied to dial **32**. When HVAC controller **30** is mounted on a vertical surface such as a wall, HVAC controller **30** may prevent dial **32** from depressing inwards towards the vertical surface while allowing the dial **32** to rotate.

[0030] In some examples, dial **32** may include a set of light-emitting diodes (LEDs) configured to illuminate a portion or a whole of dial **32**, but this is not required. The processing circuitry of HVAC controller **30** may selectively illuminate one or more LEDs of the set of LEDs in order to indicate a set point temperature or convey other information. In some examples, the set of LEDs included in dial **32** may illuminate dial **32** to indicate that HVAC system **10** is in a heating or indicate that HVAC system **10** is cooling. For example, when HVAC system **10** is heating (e.g., HVAC controller **30** is outputting one or more instructions for HVAC component(s) **16** to increase a temperature within building **12**), the LEDs of dial **32** cause dial **32** to illuminate at a first color. When HVAC system **10** is cooling (e.g., HVAC controller **30** is outputting one or more instructions for HVAC component(s) **16** to decrease a temperature within building **12**), the LEDs of dial **32** cause dial **32** to illuminate at a second color. In this way, the LEDs of dial **32** may indicate whether HVAC system **10** is operating in heating or cooling.

[0031] Analog display **34** may include information relating to one or more aspects of an area in which HVAC controller **30** is located (e.g., a room in which HVAC controller **30** is located, a building in which HVAC controller **30** is located, an area outside of a building in which HVAC controller **30** is located, or any combination thereof). Analog display **34** may be round in shape and analog display **34** may be located an area within a circumference of dial **32** such that edges of dial **32** are visible around an outer circumference of analog display **34**. At least part of dial **32** and analog display **34** may represent an outer surface of HVAC controller **30**. In some cases, HVAC controller **30** may receive user input to one or both of dial **32** and analog display **34**.

[0032] A user may interact with HVAC controller **30** through a mobile phone, a tablet, a computer, or another device. For example, user devices **8**A-**8**N (collectively, "user devices **8**") may communicate with HVAC controller **30** via network **6**. HVAC controller **30** may, in some examples, be configured to communicate directly with network **6** without communicating with network **6** via a gateway device (e.g., a Wi-Fi router) within building **12**. In some examples, HVAC controller **30** may receive instructions from one or more of user devices **8**. The instructions may include, for example, a request to change a set point temperature for an area within building **12**. HVAC controller **30** may change the set point temperature in response to receiving the instruction. In turn, HVAC controller **30** may control HVAC component(s) **16** to control the temperature within building **12** to reach the new set point.

[0033] In some examples, responsive to detecting a rotation of dial **32** while HVAC controller **30** is in the idle state, HVAC controller **30** transitions out of the idle state to a set point state. HVAC controller **30** may change a temperature set point for an area within building **12** in response to detecting the rotation of dial **32**. In other words, HVAC controller **30** may determine that a rotation of dial **32** while HVAC controller **30** is in the idle state represents a user request to change a temperature set point. In transitioning out of the idle state, the processing circuitry of HVAC controller **30** may display the temperature set point for the area within building **12** on analog display **34**. Additionally, HVAC controller **30** may display the temperature set point changing as dial **32** rotates. For example, the analog display **34** may show the temperature setpoint cycle through a range of degrees, where each change from one degree to another degree is reflected on analog display **34**. In some examples, HVAC controller **30** may emit a noise each time the temperature set point changes from one degree value to another degree value. The noise may represent a clicking noise, a tapping noise, or another type of noise.

[0034] In some examples, HVAC controller **30** may control HVAC components **16** based on more than one set points. For example, HVAC controller **30** may determine whether one or both of a first set point mode and a second set point mode is activated. In some examples, the first set point mode represents a cooling temperature set point mode and the second set point mode represents a heating set point mode. In the cooling set point mode, the HVAC controller **30** may be configured to change a cooling set point, and in the heating set point mode, the HVAC controller **30** may be configured to change a heating set point. A cooling set point may represent a temperature set point for controlling HVAC components **16** to decrease or maintain a temperature within building **12** as compared with a temperature outside of building **12**. A heating set point may represent a temperature set point for controlling HVAC components **16** to increase or maintain a temperature within building **12** as compared with a temperature outside of building **12**.

[0035] In some examples, HVAC controller **30** is configured to receive user input representing an instruction to enter the first set point mode. In some examples, HVAC controller **30** is configured to receive user input representing an instruction to enter the second set point mode. HVAC controller **30** may enter the second set point mode in response to receiving user input representing a request to enter the second set point mode. For example, HVAC controller **30** may deactivate the first set point mode and activate the second set point mode in response to receiving information indicative of a user input to a mode button representing a request to enter the second set point mode. Alternatively, HVAC controller **30** may enter the first set point mode in response to receiving user input representing a request to enter the first set point mode. For example, HVAC controller **30** may deactivate the second set point mode in response to receiving information indicative of a user input to a mode button representing a request to enter the first set point mode.

[0036] HVAC controller **30** is configured to cause, based on the first set point mode being activated, the first set point of the device to change in response to receiving a rotation input to dial **32**. Additionally, HVAC controller **30** is configured to cause, based on the second set point mode being activated, the second set point of the device to change in response to receiving a rotation input to dial **32**. In this way, HVAC controller **30** may control one or both of the first set point and the second set point to change based on a rotation input to dial **32**.

[0037] HVAC controller **30** may, in some cases, perform one or more actions which represent a "start-up sequence." In some examples, HVAC controller **30** may execute the start-up sequence in response to detecting a transition of HVAC controller **30** from an activated state to a deactivated state. For example, if HVAC controller **30** is turned on, allowing HVAC controller **30** to perform one or more actions which HVAC controller **30** does not perform when turned off, HVAC controller **30** may perform the start-up sequence. In some examples, the start-up sequence may include a calibration of a position function corresponding to the electric motor of HVAC controller **30**. In some examples, the start-up sequence may include a selective activation and/or a selective deactivation of one or more LEDs of HVAC controller **30**.

[0038] In some examples, the electric motor of HVAC controller **30** represents a stepper motor which is configured to occupy a set of positions, where the number of positions in the set of positions is predetermined for the stepper motor. When the electric motor rotates from one position of the set of positions to an adjacent position of the set of positions, this rotation is referred to as a "step." For example, a stepper motor may be configured to occupy 360 positions, one position per rotational degree. In this example, the stepper motor would occupy each of the 360 positions to perform one full rotation. It is not required for an electric motor to include 360 positions per one rotation. A stepper motor may include any number of positions per rotation. As long as HVAC controller **30** is configured to determine the number of positions per rotation, HVAC controller **30** may be configured to determine a number of positions in which to rotate the electric motor in order to achieve a certain amount of rotation. For example, HVAC controller **30** may receive information indicative of a request to rotate the electric motor clockwise by 20% of a full rotation. Based on the known number of positions per rotation, HVAC controller **30** may calculate the number of positions which corresponds to 20% of a full rotation and output an instruction to rotate the electric motor clockwise by the calculated number of positions.

[0039] Although HVAC controller **30** may be configured to determine a relative number of positions in which to rotate the electric motor, in some cases, HVAC controller **30** might not be able to immediately determine, after an activation of HVAC controller **30**, a relative rotational position of the electric motor in relation to the set of analog markers located on the analog display. HVAC controller **30** may be configured to perform a calibration process in order to determine the relative rotational position of the stepper motor in relation to the set of analog markers on the analog display. In some examples, the electric motor may be coupled to a pointer extending radially from a center of HVAC controller **30** such that the electric motor is configured to control a rotation of the pointer. As an example, the pointer may be fixed to the electric motor or fixed to a component which is fixed to the electric motor such that the pointer rotates with the electric motor. In such an example, a 20-degree rotation of the electric motor may correspond to a 20-degree rotation of the pointer. The pointer may be configured to indicate any one of the set of analog markers. By controlling the electric motor, HVAC controller **30** may be configured to set the marker of the set of analog markers which the pointer indicates.

[0040] In some examples, HVAC controller **30** may include one or more physical barriers which prevent the pointer, and by extension the electric motor, from performing a full rotation. For example, the one or more physical barriers may confine the pointer to rotating within a pointer range. In some examples, the pointer range may correspond to a physical range of the set of analog markers on the analog display of HVAC controller **30**. A lower limit of the pointer range may correspond to a first marker of the set of markers and an upper limit of the pointer range may correspond to a last marker of the set of markers. The set of markers corresponds to a range of parameter values such that each marker of the set of markers corresponds to a respective parameter value of the range of parameter values. In this way, the lower limit of the pointer range corresponds to a lower limit of the range of parameter values and an upper limit of the pointer range corresponds to an upper limit of the range of parameter values. This information, in some cases, may be used during the calibration process in order to determine the relative rotational position of the electric motor in relation to the set of analog markers located on the analog display.

[0041] In order to perform the calibration process, processing circuitry of HVAC controller **30** may output a signal causing the electric motor to rotate to one or both of the lower limit of the pointer range and the upper limit of the pointer range. In some examples, HVAC controller **30** may output a signal causing the electric motor and the pointer to rotate to the upper limit of the pointer range. A physical barrier may prevent the electric motor and the pointer from rotating beyond the upper limit of the pointer range. Moreover, the processing circuitry of HVAC controller **30** may determine that a rotational position of the electric motor corresponds to the upper limit of the pointer range in response to determining that an attempt to rotate the electric motor beyond the upper limit of the pointer range is unsuccessful. In turn, the processing circuitry may save the rotational position (e.g., the step) of the electric motor which corresponds to the upper limit of the pointer range and thus corresponds to the upper limit of the range of parameter values denoted by the set of markers.

[0042] Subsequent to determining the rotational position of the electric motor which corresponds to the upper limit of the pointer range, in some cases, the processing circuitry of HVAC controller **30** may be configured to output a signal causing the electric motor and the pointer to rotate to the lower limit of the pointer range. A physical barrier may prevent the electric motor and the pointer from rotating beyond the lower limit of the pointer range. Moreover, the processing circuitry of HVAC controller **30** may determine that a rotational position of the electric motor corresponds to the lower limit of the pointer range in response to determining that an attempt to rotate the electric motor beyond the lower limit of the pointer range is unsuccessful. In turn, the processing circuitry may save the rotational position (e.g., the step) of the electric motor which corresponds to the lower limit of the pointer range and thus corresponds to the lower limit of the range of parameter values denoted by the set of markers.

[0043] HVAC controller **30** may include a communication device (not illustrated in FIG. **1**) to allow HVAC controller **30** to communicate via a wired or wireless connection **40** to external computing device **36**. The communication device may include a Bluetooth transmitter and receiver, a Wi-Fi transmitter and receiver, a Zigbee transceiver, a near-field communication transceiver, or other circuitry configured to allow HVAC controller **30** to communicate with external computing device **36**. In some examples, the communication device may allow HVAC controller **30** to exchange data with external computing device **36**. Examples of exchanged data include a desired temperature for building **12**, HVAC component(s) **16** connected to HVAC controller **30**, error codes, geographic location, estimated energy usage and cost, and/or other operating parameters or system performance characteristics for HVAC system **10**.

[0044] HVAC controller **30** may communicate via wired or wireless connection **40** with external computing device **36**. External computing device **36** may be, include, or otherwise be used in combination with a mobile phone, smartphone, tablet computer, personal computer, desktop computer, personal digital assistant, router, modem, remote server or cloud computing device, and/or related device allowing HVAC controller **30** to communicate over a communication network such as, for example, the Internet or other wired or wireless connection. Communicating via the wired or wireless connection **40** may allow HVAC controller **30** to be configured, controlled, or otherwise exchange data with external computing device **36**. In some examples, HVAC controller **30** communicating via wired or wireless connection **40** may allow a user to set up HVAC controller **30** when first installing the controller in building **12**. In some examples, HVAC controller **30** and external computing device **36** communicate through a wireless network device such as a router or a switch. In other examples, HVAC controller **30** and external computing device **36** communicate through a wired connection such as an ethernet port, USB connection, or other wired communication network.

[0045] HVAC controller **30** may, via the communication device, communicate via a wired or wireless connection **41** with external database **48**. In some examples, wired or wireless connection **41** enables HVAC controller **30** to communicate with external database **48** via a wireless connection which includes a network device such as a router, ethernet port, or switch. HVAC controller **30** and external database **48** may also communicate through a wired connection such as an ethernet port, USB connection, or other wired communication network. Communicating via the wired or wireless connection **41** may allow HVAC controller **30** to exchange data with external database **48**. As such, external database **48** may be at a location outside of building **12**. In some examples, external database **48** may be, include, or otherwise be used in combination with a remote server, cloud computing device, or network of controllers configured to communicate with each other. For example, HVAC controller **30** may receive data from HVAC controllers in nearby buildings through the internet or other city- or wide-area network. HVAC controller **30** may include the onboard database because it is unable to communicate via the communication device.

[0046] In some examples, external database **48** may be, or otherwise be included in, or accessed via, external computing device **36** (e.g., smartphone, mobile phone, tablet computer, personal computer, etc.). For example, HVAC controller **30** may communicate via a Wi-Fi network connection with a smartphone device to exchange data with external database **48**. By communicating via wired or wireless connection **41**, HVAC controller **30** may exchange data with external database **48**.

[0047] In some examples, HVAC controller **30** may display a setpoint as a bright white light at moving around a perimeter of HVAC controller **30**. As dial **32** rotates, the light may move with dial **32** to show a selected setpoint. If the setpoint is changed via a mobile application on one or more of user devices **8**, the light may move on HVAC controller **30** to show the selected setpoint. An application of one of user devices **8** may enable a user to view one or more aspects of HVAC controller **30**.

[0048] In some examples, if a Buoy water valve is installed, HVAC controller **30** may receive details on water usage and leak status. In some examples, if a security system is installed, HVAC controller **30** may control the security system.

[0049] FIG. **2** is a block diagram illustrating an example HVAC controller **30** including a dial **32** and an analog display **34**, in accordance with one or more techniques described herein. As seen in FIG. **2**, HVAC controller **30** includes processing circuitry **42**, memory **44**, communication circuitry **46**, sensor(s) **48**, and terminal(s) **52**. Sensor(s) **48** may, in some examples, include a temperature sensor **50**. In some examples, dial **32** includes LEDs **54**. Analog display **34** includes markers **56**, LEDs **58**, mode button **60**, pointer **62**, and electric motor **64**. In HVAC controller **30** may be configured to communicate with HVAC system **10** via terminal(s) **52** and/or communicate with user devices **8**A-**8**N (collectively, "user devices **8**") via network **6**.

[0050] HVAC controller **30** may be configured to control HVAC system **10** in order to regulate one or more parameters of a space (e.g., a building, one or more rooms within a building, a large vehicle, or a vessel). In some examples, HVAC controller **30** regulates a temperature within the space. HVAC controller **30** may regulate the temperature of the space by using HVAC system **10** to decrease a temperature of the space if the current temperature of the space is greater than a first set point temperature and/or increase a temperature of the space using HVAC system **10** if the current temperature of the space is less than a second set point temperature. In some examples, the first set point temperature (e.g., a cooling set point temperature) is less than the second set point temperature (e.g., a heating set point temperature). In some examples, the first set point temperature is equal to the second set point temperature.

[0051] Processing circuitry **42** may include fixed function circuitry and/or programmable processing circuitry. Processing circuitry **42** may include any one or more of a microprocessor, a controller, a DSP, an ASIC, an FPGA, or equivalent discrete or analog logic circuitry. In some examples, processing circuitry **42** may include multiple components, such as any combination of one or more microprocessors, one or more controllers, one or more DSPs, one or more ASICs, or one or more FPGAs, as well as other discrete or integrated logic circuitry. The functions attributed to processing circuitry **42** herein may be embodied as software, firmware, hardware or any combination thereof.

[0052] In some examples, memory **44** includes computer-readable instructions that, when executed by processing circuitry **42**, cause HVAC controller **30** and processing circuitry **42** to perform various functions attributed to HVAC controller **30** and processing circuitry **42** herein. Memory **44** may include any volatile, non-volatile, magnetic, optical, or electrical media, such as, for example, RAM, DRAM, SRAM, magnetic discs, optical discs, flash memories, or forms of EPROM or EEPROM. In some examples, the memory is used to store program instructions for execution by the processing circuitry of HVAC controller **30**.

[0053] Communication circuitry **46** may include any suitable hardware, firmware, software or any combination thereof for communicating with another device, such as user devices **8** or other devices. Under the control of processing circuitry **42**, communication circuitry **46** may receive downlink telemetry from, as well as send uplink telemetry to, one of user devices **8** or another device with the aid of an internal or external antenna. Communication circuitry **46** may include a Bluetooth transmitter and receiver, a Wi-Fi transmitter and receiver, a Zigbee transceiver, a near-field communication transceiver, or other circuitry configured to allow HVAC controller **30** to communicate with one or more remote devices such as user devices **8**. In some examples, communication circuitry **46** may allow HVAC controller **30** to exchange data with external computing device **123** of FIG. **1**. Examples of exchanged data include a desired temperature for the space, one or more control parameters for HVAC system **10**, error codes, geographic location, estimated energy usage and cost, and/or other operating parameters or system performance characteristics for HVAC system **10**.

[0054] In some examples, HVAC controller **30** includes one or more sensor(s) **48** including temperature sensor **50**. In some examples, temperature sensor **50** is located within a housing of HVAC controller **30**. In some examples, temperature sensor **50** is located remotely from HVAC controller **30** and may communicate with HVAC controller **30** via communication circuitry **46**. For example, temperature sensor **50** may be located in the same room or the same area as HVAC controller **30** while being separate from HVAC controller **30** such that heat generated from components of HVAC controller **30** does not affect a temperature signal generated by temperature sensor **50**. It may be beneficial for temperature sensor **50** to be located separately from HVAC controller **30** in order to obtain an accurate temperature reading. In some examples where temperature sensor **50** is located within the housing of HVAC controller **30**, HVAC controller **30** may prevent components from affecting a temperature signal generated by temperature sensor **50**. In some examples, at least a portion of the housing of HVAC controller **30** may include stainless steel and the housing may be coated with a material which hides fingerprints. In some examples, the term "housing" may be used herein to describe an outer surface of HVAC controller **30**, including on outer surface of dial **32**, an outer surface of analog display **34**, and an outer face of HVAC controller **30** which is fixed to a wall or another surface.

[0055] In some examples, a housing of HVAC controller **30** may be substantially cylindrical in shape, and dial **32** may represent a ring-shaped piece that is located at an outer circumference of HVAC controller **30**. In some examples, HVAC controller **30** includes a first face configured to be mounted on a plate which is fixed to a wall or another surface, a second face including a display, and a third face representing a side of HVAC controller **30**, the third face extending around a circumference of HVAC controller **30**. Dial **32** may include the third face of HVAC controller **30**. In some examples, dial **32** is configured to rotate with respect to one or more other components of HVAC controller **30**. For example, dial **32** is configured to rotate with respect to analog display **34**. In some examples, dial **32** is configured to rotate in response to a user input. Dial **32** may be electrically connected to dial circuitry (not illustrated in FIG. **2**) which may generate an electrical signal indicative of one or more rotational parameters (e.g., a rotational position, a rotational velocity, and/or a rotational acceleration) of dial **32**. The dial circuitry may output the electrical signal indicative of the one or more rotational parameters to processing circuitry **42**. In some examples, the dial circuitry is part of processing circuitry **42**.

[0056] Processing circuitry **42** may be configured to set and/or change one or more temperature set points corresponding to the space in which HVAC controller **30** regulates temperature. For example, a first set point temperature may represent a cooling set point temperature and a second set point temperature may represent a heating set point temperature. In some examples, if HVAC controller **30** is cooling and the current temperature is greater than the cooling set point temperature, processing circuitry **42** may control HVAC system **10** to regulate the temperature in the space to approach the cooling set point temperature over a period of time based on the current temperature and the cooling set point temperature. In some examples, if HVAC controller **30** heating and the current temperature is less than the heating set point temperature, processing circuitry **42** may control HVAC system **10** to regulate the temperature in the space to approach the heating set point temperature over a period of time based on the current temperature and the heating set point temperature.

[0057] In some example, processing circuitry **42** is configured to receive an instruction to change and/or set one or more temperature set points of HVAC controller **30** from dial circuitry electrically connected to dial **32**, where the instruction is indicative of a user selection of one or more temperature set points using dial **32**. For example, in response to a first rotation of dial **32**, processing circuitry **42** may set the cooling temperature set point value to a first temperature value if a cooling set point mode of HVAC controller **30** is activated. In some examples, HVAC controller **30** includes a mode button (not illustrated in FIG. **2**) electrically connected to processing circuitry **42** which is configured to generate a signal based on a user request to switch a set point mode between the cooling set point mode and a heating set point mode. In response to a second rotation of dial **32**, processing circuitry **42** may set the heating temperature set point value to a second temperature value if a heating set point mode of HVAC controller **30** is activated. In some examples, processing circuitry **42** is configured to receive an instruction to change and/or set one or more temperature set points of HVAC controller **30** from one or more of user devices **8** via network **6**. Processing circuitry **42** may change the one or more temperature set points based on such an instruction.

[0058] In some examples, dial **32** includes LEDs **54**. LEDs **54** may be, in some cases, a part of dial **32**. In some examples, each LED of LEDs **54** may be configured to output an optical signal. LEDs **54** may be arranged in an array around the circumference of dial **32** such that the optical signal output by each LED of LEDs **54** is emitted outwards from a face of HVAC controller **30** which includes analog display **34**. In some examples, processing circuitry **42** is configured to cause at least some of LEDs **54** to output an optical signal of a first color when HVAC controller **30** is in a heating set point mode and the current temperature is lower than the heating set point temperature. In some examples, processing circuitry **42** is configured to cause at least some of LEDs **54** to output an optical signal of a second color when HVAC controller **30** is in a cooling set point mode and the current temperature is greater than the cooling set point temperature. In some examples, the first color is red and the second color is blue, but this is not required. Each of the first color and the second color may represent any visible wavelength of light.

[0059] In some examples, analog display **34** includes LEDs **58**. In some examples, processing circuitry **42** is configured to selectively activate LEDs **58** in order to selectively illuminate one or more of the markers **56**. In some examples, processing circuitry **42** selectively illuminates one or more of the set of markers in order to indicate one or more temperature set points (e.g., the cooling set point and/or the heating set point). In some examples, HVAC controller **30** includes LEDs **58** instead of LEDs **54**. In some examples, HVAC controller **30** includes both of LEDs **54** and LEDs **58**. LEDs **58** may be located behind a surface of analog display **34** which includes the markers **56**. In some examples, LEDs **58** may emit optical signals which cause one or more of markers **56** to light up.

[0060] In some examples, markers **56** may include a set of temperature markers. The set of temperature markers may represent a range of temperatures. In some examples, the range of temperatures includes a lower-bound temperature and an upper-bound temperature. In some examples, the lower-bound temperature is 50 degrees Fahrenheit (° F.) and the upper-bound temperature is 90° F., but this is not required. The range of temperatures may include any range of temperatures. In some examples, each temperature marker of the set of temperature markers is in the shape of a dash, or a line. The set of temperature markers may be arranged in a semi-circular array the set of temperature markers are equally spaced apart. In some examples, markers **56** may include a set of numeric temperature indicators. Each numeric temperature indicator of the set of numeric temperature indicators may indicate a temperature associated with a respective temperature marker of the set of temperature markers.

[0061] In some examples, LEDs **58** may illuminate one or more of the set of temperature markers in order to indicate one or more temperature set points. For example, processing circuitry **42** may cause LEDs **58** to illuminate a first temperature marker of the set of temperature markers to indicate a first temperature set point and illuminate a second temperature marker of the set of temperature markers to indicate a second temperature set point. That is, the first temperature marker may by associated with a first temperature value corresponding to the first temperature set point, and the second temperature marker may by associated with a second temperature value corresponding to the second temperature set point. In some examples, processing circuitry **42** may cause LEDs **58** to change the temperature marker of the set of temperature markers that is illuminated to indicate the first temperature set point. In some examples, processing circuitry **42** may cause LEDs **58** to change the temperature marker of the set of temperature markers that is illuminated to indicate the second temperature set point.

[0062] In some examples, HVAC controller **30** may receive one or more inputs to mode button **60**. For example, HVAC controller **30** may operate according to a first temperature set point mode and a second temperature set point mode. In some examples, when HVAC controller **30** receives an input to mode button **60**, processing circuitry **42** may transition from operating according to the first temperature set point mode to operating according to the second temperature set point mode, or processing circuitry **42** may transition from operating according to the second temperature set point mode to operating according to the first temperature set point mode. When HVAC controller **30** is operating according to the first temperature set point mode, processing circuitry **42** may change a first temperature set point in response to receiving a user input to the dial **32**, and when HVAC controller **30** is operating according to the second temperature set point mode, processing circuitry **42** may change a second temperature set point in response to receiving a user input to the dial **32**.

[0063] For example, processing circuitry **42** may determine whether one or both of a cooling set point mode and a heating set point mode is activated. Processing circuitry **42** may receive a first rotation input to dial **32**. When processing circuitry **42** determines that the cooling set point mode is activated, processing circuitry **42** may cause a cooling set point to change from a first cooling set point value to a second cooling set point value in response to receiving a first rotation input to dial **32**. Processing circuitry may control LEDs **58** to transition from illuminating a first marker of the set of markers **56** to illuminating a second marker the set of markers **56**, wherein the first marker corresponds to the first cooling set point value and the second marker corresponds to the second cooling set point value. When the first cooling set point value is greater than a heating set point value, and when the second cooling set point value is greater than or equal to the heating set point value, processing circuitry **42** may cause the cooling set point to change from the first cooling set point value to the second cooling set point value without changing the heating set point value in response to receiving the first rotation input to dial **32**.

[0064] Alternatively, when processing circuitry **42** determines that the heating set point mode is activated, processing circuitry **42** may cause a heating set point to change from a first heating set point value to a second heating set point value in response to receiving a first rotation input to dial **32**. Processing circuitry may control LEDs **58** to transition from illuminating a first marker of the set of markers **56** to illuminating a second marker the set of markers **56**, wherein the first marker corresponds to the first heating set point value and the second marker corresponds to the second heating set point value. When the first heating set point value is less than a cooling set point value, and when the second heating set point value is less than or equal to the cooling set point value, processing circuitry **42** may cause the heating set point to change from the first heating set point value to the second heating set point value without changing the cooling set point in response to receiving the first rotation input to dial **32**.

[0065] In some examples, it may be beneficial for HVAC controller **30** to always maintain the heating set point to be less than or equal to the cooling set point. For example, if the HVAC controller **30** sets the heating set point to be greater than the cooling set point, the HVAC controller **30** may simultaneously attempt to heat building **12** and cool building **12** when the current temperature is between the heating set point and the cooling set point. Performing only one of heating and cooling is more energy efficient that performing both of heating and cooling at the same time. Consequently, it is beneficial for HVAC controller **30** to maintain the heating set point to be less than or equal to the cooling set point. Consequently, when processing circuitry **42** decreases the cooling set point to be lower than an initial heating set point value, processing circuitry **42** may also decrease the heating set point in unison with the cooling set point. Additionally, or alternatively, when processing circuitry **42** increases the heating set point to be greater than an initial cooling set point value, processing circuitry **42** may also increase the cooling set point in unison with the heating set point.

[0066] HVAC controller **30** may control LEDs **58** to indicate a change in the heating set point and/or a change in the cooling set point as the changes are happening. In one example, HVAC controller **30** may decrease the cooling set point by two degrees in response to receiving a rotation input to dial **32**, and HVAC controller **30** may control LEDs **58** to show the cooling set point "move" across the set of markers **56**. For example, as dial **32** is rotating, HVAC controller **30** may cause LEDs **58** to transition from illuminating a first marker of the set of markers **56** to illuminating a second marker of the set of markers **56**, and HVAC controller **30** may cause LEDs **58** to transition from illuminating the second marker of the set of markers **56** to illuminating a third marker of the set of markers **56**. The second marker is one degree lower than the first marker, and the third marker is one degree lower than the second marker. As such, a user may view the transition of the set point by observing the set of markers **56**. In some examples, LEDs **58** cause an illuminated marker to blink when a set point is changing, but this is not required.

[0067] Pointer **62** may extend along a radius of analog display **34** and pointer **62** may be configured to rotate about a center point of analog display **34** such that pointer **62** "points" at one or more markers of the set of markers **56**. In some examples, electric motor **64** may receive an electric signal from processing circuitry **42** which causes electric motor **64** to place pointer **62** in order to indicate a current temperature of the space (e.g., an area within building **12**) in which HVAC controller **30** is performing temperature regulation using HVAC components **16**. In some examples, processing circuitry **42** receives a temperature signal from temperature sensor **50**, the temperature signal indicating the current temperature of the space in real-time or near real-time. Processing circuitry **42** may cause electric motor **64** to place (e.g., rotate) the pointer **62** based on the temperature signal in order to indicate the current temperature by pointing pointer **62** at a marker of the set of markers **56** which corresponds to the current temperature. In this way, pointer **62** may point at a marker of the set of markers **56** to indicate the current temperature of space, and LEDs **58** may illuminate one or more markers of the set of markers **56** to indicate one or more respective temperature set points for controlling HVAC components **16** to regulate the temperature within the space.

[0068] In some examples, the electric motor **64** represents a stepper motor which is configured to occupy a set of positions, where the number of positions in the set of positions is predetermined for the stepper motor. In one example, a stepper motor may be configured to occupy 360 positions, one position per rotational degree. In this example, the stepper motor would occupy each of the 360 positions to perform one full rotation. It is not required for an electric motor to include 360 positions per one rotation. A stepper motor may include any number of positions per rotation.

[0069] HVAC controller **30** may perform a sequence which includes calibrating a position function associated with the electric motor **64** and/or performing a lighting process using any one or combination of LEDs **58**. In some examples, HVAC controller **30** may perform the sequence in response to identifying a transition of HVAC controller **30** from a deactivated state to an activated state. In this way, the sequence may be referred to herein as a start-up sequence. However, performing the sequence is not limited to examples is which HVAC controller **30** identifies the transition. HVAC controller **30** may perform the sequence on a scheduled bases or in response to receiving information indicative of a request to perform the sequence.

[0070] For example, each marker of the set of markers **56** may correspond to a respective parameter value of a parameter associated with the building **12**. The electric motor **64** is configured to rotate the pointer **62** within a pointer range from a lower limit to an upper limit. In some examples, the pointer range represents a portion of analog display **34** over which electric motor **64** is capable of rotating pointer **62**. Processing circuitry **42** may determine a position of the electric motor **64** while the pointer **62** is positioned at one of the lower limit or the upper limit of the pointer range. Processing circuitry **42** may calibrate, based on the position of the electric motor **64** while the pointer **62** is positioned at the one of the lower limit or the upper limit, a position function corresponding to the electric motor **64**. The position function allows the electric motor **64** to move the pointer **62** to indicate the respective parameter value of the parameter associated with the building **12**. In some examples, the parameter comprises temperature, and the respective parameter value comprises a current temperature within an area of the building **12**. In some examples, processing circuitry **42** is further configured to output an instruction causing the electric motor **64** to set a position of the pointer **62** in order to indicate the current temperature within the area of the building **12**.

[0071] In some examples, to determine a position of the electric motor **64** while the pointer **62** is positioned at one of the lower limit or the upper limit of the pointer range, the processing circuitry **42** is configured to determine the position of the electric motor **64** while the pointer **62** is positioned at a first one of the lower limit or the upper limit of the pointer range. In one example, processing circuitry **14** may determine the position of the electric motor **64** while the pointer **62** is positioned the lower limit. In another example, processing circuitry **14** may determine the position of the electric motor **64** while the pointer **62** is positioned the upper limit.

[0072] Processing circuitry **42** may determine, subsequent to determining the position of the electric motor **64** while the pointer **62** is positioned at the first one of the lower limit or the upper limit, a position of the electric motor **64** while the pointer **62** is positioned at a second one of the lower limit or the upper limit. For example, if processing circuitry **42** first determines the position of the electric motor **64** while the pointer **62** is positioned at the lower limit of the pointer range, processing circuitry **42** may subsequently determine the position of the electric motor **64** while the pointer **62** is positioned at the upper limit of the pointer range. If processing circuitry **42** first determines the position of the electric motor **64** while the pointer **62** is positioned at the upper limit of the pointer range, processing circuitry **42** may subsequently determine the position of the electric motor **64** while the pointer **62** is positioned at the lower limit of the pointer range.

[0073] Processing circuitry **42** may calibrate the position function corresponding to the electric motor **64** based on both of the position of the electric motor **64** while the pointer **62** is positioned at the first one of the lower limit or the upper limit and the position of the electric motor **64** while the pointer **62** is positioned at the second one of the lower limit or the upper limit. The position of the electric motor **64** may represent a current position of a set of rotational positions which electric motor **64** is occupying. Consequently, the position of the electric motor **64** while the pointer **62** is positioned at the first one of the lower limit or the upper limit may represent a first position and the position of the electric motor **64** while the pointer **62** is positioned at the second one of the lower limit or the upper limit may represent a second position. A number of positions may exist between the first position and the second position. Processing circuitry **42** may control electric motor **64** to rotate such that electric motor **64** occupies any one of the first position, the second position, or the number of positions between the first position and the second position.

[0074] In some examples, processing circuitry **42** is configured to identify a transition of HVAC controller **30** from a deactivated state to an activated state. Processing circuitry **42** may determine, in response to identifying the transition, the position of the electric motor **64** while the pointer **62** is positioned at the upper limit. Additionally, or alternatively, processing circuitry **42** may determine, in response to identifying the transition, the position of the electric motor **64** while the pointer **62** is positioned at the lower limit.

[0075] To determine the position of the electric motor **64** while the pointer **62** is positioned at the lower limit, the processing circuitry **42** is configured to output an instruction to cause the electric motor **64** to rotate the pointer **62** to the lower limit of the pointer range. Subsequently, processing circuitry **42** may receive data indicative of the position of the electric motor **64** while the pointer **62** is positioned at the lower limit of the pointer range. The position of the electric motor **64** may represent a position which electric motor **64** is occupying while pointer **62** is located at the lower limit of the pointer range.

[0076] In some examples, the first one of the lower limit or the upper limit comprises the upper limit of the pointer range. To determine the position of the electric motor **64** while the pointer **62** is positioned at the upper limit, the processing circuitry **42** is configured to output an instruction to cause the electric motor **64** to rotate the pointer **62** to the upper limit of the pointer range. Subsequently, processing circuitry **42** is configured to receive data indicative of the position of the electric motor **64** while the pointer **62** is positioned at the upper limit of the pointer range.

[0077] The set of markers **56** may correspond to a range of parameter values of the parameter associated with the building **12**. To calibrate a position function corresponding to the electric motor **64**, the processing circuitry **42** is configured to first set a reference position of the electric motor **64**. In one example, the reference position may correspond to the position of the electric motor **64** while the pointer is positioned the lower limit of the pointer range. In another example, the reference position may correspond to the position of the electric motor **64** while the pointer is positioned the upper limit of the pointer range. Subsequently, processing circuitry **42** may determine, based on the reference position, a transfer function which defines a relationship between the parameter associated with the building **12** and the position of the electric motor **64**. In some examples, HVAC controller **30** comprises a substantially circular shape including a circumference, wherein the set of markers **56** extend at least partially around the circumference, and wherein the pointer **62** is closer to the center of the circular shape than the set of markers **56**.

[0078] In some examples, processing circuitry **42** may calculate the transfer function based on one or both of the position which electric motor **64** is occupying while pointer **62** is located at the lower limit of the pointer range and the position which electric motor **64** is occupying while pointer **62** is located at the upper limit of the pointer range. For example, when processing circuitry **42** determines the position which electric motor **64** is occupying while pointer **62** is located at the upper limit of the pointer range, processing circuitry **42** may set the position as an upper limit reference point. Based on the upper limit reference point, processing circuitry **42** may control electric motor **64** to set pointer **62** to indicate any one of markers **56**. For example, processing circuitry **42** may apply the transfer function to identify a position of electric motor **64** which sets pointer **62** to indicate a marker of the set of markers **64**. Processing circuitry **42** may control electric motor **64** to occupy the determined position so that pointer **62** indicates the marker.

[0079] In some examples, LEDs **58** are configured to illuminate any one or combination of the set of markers. Furthermore, one or more projection LEDs (not illustrated in FIG. **2**) are configured to emit a halo-shaped projection on the analog display **34**. Processing circuitry **42** is configured to output an instruction to activate, while the calibration is occurring, both of LEDs **58** and the set of projection LEDs. Processing circuitry **42** is configured to output, subsequent to the calibration, an instruction to deactivate the set of markers **56** sequentially starting with a center marker of the set of markers **56** and ending with a first marker of the set of markers **56** and a last marker of the set of markers **56**.

[0080] FIG. **3**A is a conceptual diagram illustrating a front view of HVAC controller **30**, in accordance with one or more techniques described herein. As seen in FIG. **3**A, HVAC controller **30** includes dial **32**, analog display **34**, and wall plate **70**. Analog display **34** includes pointer **62**, center plate **66**, and a set of markers **102**A-**102**N (collectively, "set of markers **102**"). The set of markers **102** may be an example of the set of markers **56** of FIG. **2**.

[0081] In some examples, HVAC controller **30** includes one or more LEDs (e.g., LEDs **58** of FIG. **2**) which may illuminate any one or combination of the set of markers **102** in order to indicate one or more parameter values of the range of parameter values displayed on the surface of analog display **34**. Dial **32** may represent a rotatable dial which is located at an outer circumference of analog display **34**. For example, dial **32** may rotate about a center of HVAC controller **30** while a surface of analog display **34** remains fixed in place. That is, when dial **32** rotates about the center of HVAC controller **30**, the surface of analog display **34** and the wall plate **70** do not rotate. Dial **32** is configured to rotate clockwise and rotate counterclockwise. HVAC controller **30** may control one or more temperature set points based on rotation inputs to dial **32**. For example, HVAC controller **30** may increase one or more temperature set points responsive to receiving a clockwise rotation input and HVAC controller **30** may decrease one or more temperature set points responsive to receiving a counterclockwise rotation input. HVAC controller **30** may control one or more other parameters based on rotation inputs to dial **32**. For example, HVAC controller **30** may control one or more modes of operation, control one or more humidity set points, or control one or more other set points responsive to rotation inputs to dial **32**.

[0082] In some examples, the LEDs of HVAC controller **30** may illuminate one or more markers of the set of markers **102** in order to indicate one or more temperature set points. For example, HVAC controller **30** may illuminate a first marker of the set of markers **102** to indicate a first temperature set point and HVAC controller **30** may illuminate a second marker of the set of markers **102** to indicate a second temperature set point. That is, the first marker may correspond to a first temperature value and the second marker may correspond to a second temperature value, where the first temperature set point is the first temperature value and the second temperature set point is the second temperature value. In some examples, the first temperature set point and the second temperature set point are at the same temperature value, and HVAC controller illuminates one marker of the set of markers **102** which corresponds to the temperature value of the first temperature set point and the second temperature set point. In some examples, HVAC controller **30** may indicate more than two temperature set points or indicate less than two temperature set points by illuminating one or more of markers **102**.

[0083] One or more LEDs may project a ring of light onto a face of analog display **34** from wall plate **70**. For example, at least some of the one or more LEDs may project light perpendicular to the face of analog display **34**, and a reflective component beneath center plate **66** may reflect the light radially from underneath center plate **66** onto the surface of analog display **34**. In this way, the light projected onto the surface of analog display **34** may be in the shape of a halo. As seen in FIG. **3**A, the first marker **102**A of the set of markers **102** corresponds to a first parameter value of a range of parameter values and the last marker **102**N of the set of markers **102** corresponds to a last parameter value of the range of parameter values. In this example, the range of parameter values represents a range of temperatures extending from 50° F. to 90° F. However, this range is not meant to be limiting. Although in the example of FIG. **3**A only a four parameter values (e.g., 50, 70, 80, and 90) are displayed, other parameter values are evident based on the relative placement of the parameter values on analog display **34**. For example, the group of markers of the set of markers corresponding to a sub-range of parameter values from 50° F. to 90° F. includes 11 markers. In this way, each marker corresponds to one parameter value and the marker preceding the last marker **102**N corresponds to 89° F.

[0084] An electric motor (e.g., electric motor **64** of FIG. **2**) may be located underneath and/or proximate to center plate **66**. Electric motor **64** may be configured to move (e.g., rotate) pointer **62** such that pointer **62** indicates a parameter value of the range of parameter values shown on the face of analog display **34**. In some examples, the rotation of pointer **62** is confined to an area of analog display **34** which includes the set of markers **102**. For example, electric motor **64** may be configured to rotate pointer **62** within a 180 degree range from first marker **102**A to second marker **102**. In some examples, physical barriers (not illustrated in FIG. **3**A) prevent electric motor **64** from rotating pointer **62** beyond first marker **102**A or prevent electric motor **64** from rotating pointer **62** beyond the last marker **102**N. In the example of FIG. **3**A, pointer **62** indicates a marker of the set of markers **102** which corresponds to 70° F. In some examples, HVAC controller **30** controls pointer **62** to indicate a current temperature in a space which HVAC controller **30** regulates. As such, in the example of FIG. **3**A, pointer **62** indicates that the current temperature in the space is 70°. HVAC controller **30** may determine a temperature of the space based on a signal received from a temperature sensor (e.g., temperature sensor **50** of FIG. **2**). HVAC controller **30** may control electric motor **64** in order to rotate pointer **62** such that pointer **62** indicates the current temperature.

[0085] FIG. **3**B is a conceptual diagram illustrating an example perspective view of HVAC controller **30**, in accordance with one or more techniques described herein. As seen in FIG. **3**B, dial **32** is a round component which is located at an outer circumference of the analog display **34**, which is also round. Wall plate **70** may be fixed to a wall or another surface. Analog display, dial **32**, and other components of HVAC controller **30** may be fixed to wall plate **70** such that HVAC controller **30** is fixed to the wall or another surface. In some examples, wall plate **70** and analog display **34** are configured to remain fixed in one place, whereas dial **32** and pointer **62** are configured to rotate about a center of HVAC controller **30**. At least a portion of controller **30** may be substantially cylindrical in shape, with a front face including analog display **34**, a side face including dial **32** which is rotatable with respect to analog display **34**, and a back face which is fixed to wall plate **70**. The controller illustrated in FIGS. **3**A-**3**B is one example of controller **30** of FIGS. **1**-**2**, but controller **30** of FIGS. **3**A-**3**B is not meant to be limited to the example of FIGS. **3**A-**3**B. HVAC controller **30** may include other example controllers not illustrated in FIGS. **3**A-**3**B.

[0086] FIG. **4** is a conceptual diagram illustrating a sequence of configurations of HVAC controller **30** which represent a calibration process for HVAC controller **30**, in accordance with one or more techniques described herein. For example, FIG. **4** includes configuration **402**, configuration **404**, configuration **406**, configuration **408**, configuration **410**, configuration **412**, and configuration **414**, which all represent possible configurations of the light emitted by analog display **34** and possible configurations of a position of pointer **62**. In some examples, an electric motor (e.g., electric motor **64** of FIG. **2**) is connected to pointer **62** and the electric motor **64** controls pointer **62** to rotate within a pointer range. As seen in FIG. **4**, analog display includes a set of markers **102** which extend from marker **102**A to marker **102**N. Marker **102**A corresponds to a temperature of 50° F. and marker **102**N corresponds to a temperature of 90° F., meaning that pointer **62** may indicate any temperature within a range from 50° F. to 90° F. However, this range is not meant to be limiting. Markers **102** may indicate any range of parameter values.

[0087] Configuration **402** represents a possible configuration of HVAC controller **30** while HVAC controller **30** is in a deactivated state. While in the deactivated state, in some cases, the LEDs of HVAC controller **30** (e.g., LEDs **58**) might not emit light to illuminate one or more of the set of markers **102** and/or project light onto a surface of analog display **34**. Additionally, or alternatively, in some cases, processing circuitry **42** of HVAC controller **30** might not have access to information indicating a rotational position of the electric motor **64** and the pointer **62** relative to the set of markers **102**. Configuration **404** represents a possible configuration of HVAC controller **30** following a transition of HVAC controller **30** from a deactivated state to an activated state. As seen in configuration **404**, LEDs of HVAC controller **30** project halo **430** onto a surface of analog display **34**, and markers **102** are illuminated following the transition of HVAC controller **30** from the deactivated state (configuration **402**) to the activated state (configuration **404**). In some examples, LEDs **58** illuminate the set of markers **102** and a set of projection LEDs project halo **430** onto the surface of analog display **34**. LEDs **58** and the set of projection LEDs may transition from emitting no light to emitting a maximum intensity of light over a period of time, such as within a range from 0.5 seconds to 1.5 seconds. The LEDs may, for example, brighten over a period of one second. Additionally, or alternatively, one or more LEDs illuminating indicators **72** may brighten over a period of time such as one second.

[0088] In some examples, HVAC controller **30** may perform a calibration process in order to determine a rotational position of the electric motor **64** and calculate a transfer function which may be used to position pointer **62** to accurately indicate a parameter value, such as a temperature or humidity value. To perform the calibration process, processing circuitry **42** of HVAC controller **30** may control electric motor **64** to rotate pointer **62** to an upper limit of a pointer range. In the example of FIG. **4**, the pointer range may extend from marker **102**A to marker **102**N. That is, electric motor **64** may rotate pointer **62** such that pointer **62** points at any one of markers **102**, but electric motor **64** might not be able to rotate pointer **62** such that pointer **62** points at the "bottom" half of analog display **34**. For example, a physical barrier may prevent electric motor **64** from rotating pointer **62** counterclockwise from marker **102**A and a physical barrier may prevent electric motor **64** from rotating pointer **62** clockwise from marker **102**N.

[0089] As seen in configuration **406**, electric motor **64** rotates pointer **62** clockwise to the upper bound of the pointer range, which corresponds to marker **102**N. In some examples, a physical barrier (not illustrated in FIG. **4**) prevents electric motor **64** from rotating pointer **62** past the upper bound of the pointer range. In some examples, processing circuitry **42** of HVAC controller **30** may be configured to identify when electric motor **64** rotates pointer **62** to the upper bound of the pointer range, and the processing circuitry may associate the position of electric motor **64** with an upper limit of the range of parameter values shown on analog display **34**. For example, HVAC controller **30** may identify the position of electric motor **64** when pointer **62** is at an upper limit of the pointer range.

[0090] HVAC controller **30** may rotate pointer **62** counterclockwise from the upper bound of the pointer range to a lower bound of the pointer range in order to transition from configuration **406** to configuration **408**. As seen in FIG. **4**, the lower bound of the pointer range corresponds to marker **102**A. In some examples, a physical barrier may (not illustrated in FIG. **4**) prevent electric motor **64** from rotating pointer **62** past the lower bound of the pointer range. In some examples, processing circuitry of HVAC controller **30** may be configured to identify a rotational position of electric motor **64** when pointer **62** is at the lower bound of the pointer range, and the processing circuitry **42** may associate the rotational position of electric motor **64** with a lower limit of the range of parameter values shown on analog display **34**. The rotational position of electric motor **64** when pointer **62** is at the lower bound of the pointer range may represent a position which electric motor **64** occupies when pointer **62** is at the lower bound of the pointer range.

[0091] In some examples, HVAC controller **30** may determine the rotational position of the electric motor **64** based on a position which electric motor **64** is occupying. For example, the electric motor **64** may represent a stepper motor which is configured to occupy a set of positions. A stepper motor may include any number of positions per rotation. As long as HVAC controller **30** is configured to determine the number of positions per rotation, HVAC controller **30** may be configured to determine a number of positions in which to rotate electric motor **64** in order to achieve a certain amount of rotation. For example, HVAC controller **30** may receive information indicative of a request to rotate electric motor **64** clockwise by 20% of a full rotation. Based on the known number of positions per rotation, HVAC controller **30** may calculate the number of positions which corresponds to 20% of a full rotation and output an instruction to rotate electric motor **64** clockwise by the calculated number of positions.

[0092] Although HVAC controller **30** may be configured to determine a relative number of positions in which to rotate the electric motor **64**, in some cases, HVAC controller **30** might not be able to immediately determine, after an activation of HVAC controller **30**, a relative rotational position of the electric motor **64** in relation to the set of markers **102** located on the analog display **34**. HVAC controller **30** may be configured to perform the calibration process in order to determine the relative rotational position of the electric motor **64** in relation to the set of markers **102** on the analog display. In some examples, the electric motor **64** may be coupled to pointer **62** which extends radially from a center of HVAC controller **30** such that the electric motor **64** is configured to control a rotation of the pointer **62**. As an example, the pointer **62** may be fixed to the electric motor **64** or fixed to a component which is fixed to electric motor **64** such that the pointer **62** rotates with the electric motor **64**. In such an example, a 20-degree rotation of electric motor **64** may correspond to a 20-degree rotation of pointer **62**.

[0093] In some examples, HVAC controller **30** may generate, based on the determined position of the rotational position of pointer **62** at the lower bound of the pointer range and the position of the rotational position of pointer **62** at the upper bound of the pointer range, a transfer function which allows processing circuitry of HVAC controller **30** to set a rotational position of pointer **62** in order to accurately indicate a parameter value of the range of parameter values represented by the analog display of HVAC controller **30**. Subsequent to generating the transfer function, HVAC controller **30** may transition to configuration **410**, where pointer **62** is indicating a parameter value within the range of parameter values represented on analog display **34**. In some examples, the range of parameter values represents a range of temperatures, and pointer **62** indicates a current temperature value proximate to HVAC controller **30** while occupying configuration **410**, however this is not required. At the point of configuration **410**, the calibration of a position function corresponding to the electric motor **64** may be complete. At configuration **412**, HVAC controller **30** may sequentially deactivate the LEDs which illuminate the set of markers **102** over a period of time. In some examples, the period of time is one second. For example, controller **30** may first deactivate the marker corresponding to 70° F., which is at the top of HVAC controller **30**. Subsequently, HVAC controller **30** may deactivate set of markers in a cascading fashion. At the same time, HVAC controller **30** may fade LEDs illuminating indicators **72** until indicators **72** are no longer visible. At configuration **414**, the start-up sequence is complete.

[0094] FIG. **5** is a conceptual diagram illustrating a first configuration **502** and a second configuration **504** of a lighting process, in accordance with one or more techniques described herein. In some cases, the first configuration **502** and the second configuration **504** may be examples of the lighting cascade configuration **412** of FIG. **4**. For example, the transition from configuration **502** to configuration **504** may take place over a period of time. The top marker **102**B, corresponding to 70° F. may be deactivated first. The two markers adjacent to top marker **102**B may be deactivated after top marker **102**B is deactivated, and the rest of the markers may be deactivated sequentially until the first marker **102**A and the last marker **102**N are the only markers left illuminated. The first marker **102**A and the last marker **102**N may be deactivated to complete the lighting process. During the cascading deactivation of markers **102**, the LEDs illuminating one or more indicators may be faded until the indicators are no longer visible.

[0095] FIG. **6** is a flow diagram illustrating an example process for calibrating HVAC controller **30**, in accordance with one or more techniques described herein. Although the process of FIG. **6** is described with respect to HVAC controller **30** of FIG. **2**, the process may be performed using another controller or other devices.

[0096] In some examples, processing circuitry of HVAC controller **30** may be configured to determine a position of an electric motor **64** while a pointer **62** is positioned at one or a lower limit or an upper limit of a pointer range associated with a set of analog markers **102** (**602**). In some examples, HVAC controller **30** may first determine the position of electric motor **64** while pointer **62** is placed at the upper limit of the pointer range and subsequently determine the position of electric motor **64** while pointer **62** is placed at the lower limit of the pointer range, but this is not required. In some examples, HVAC controller **30** may first determine the position of electric motor **64** while pointer **62** is placed at the lower limit of the pointer range and subsequently determine the position of electric motor **64** while pointer **62** is placed at the upper limit of the pointer range. In some examples, HVAC controller **30** may determine the position of electric motor **64** while pointer **62** is placed at the lower limit of the pointer range without determining the position of electric motor **64** while pointer **62** is placed at the upper limit of the pointer range. In some examples, HVAC controller **30** may determine the position of electric motor **64** while pointer **62** is placed at the upper limit of the pointer range without determining the position of electric motor **64** while pointer **62** is placed at the lower limit of the pointer range.

[0097] HVAC controller **30** may calibrate a position function corresponding to electric motor **64** (**604**) based on one or both of the position of electric motor **64** while pointer **62** is placed at the upper limit of the pointer range or the position of electric motor **64** while pointer **62** is placed at the lower limit of the pointer range. In some examples, to calibrate the position function corresponding to electric motor **64**, HVAC controller **30** may generate a transfer function which establishes a relationship between a position of electric motor **64** and the range of parameter values shown on analog display **34**. HVAC controller **30** may indicate a parameter value of a range of parameter values corresponding to the set of analog markers (**606**).

[0098] It is to be recognized that depending on the example, certain acts or events of any of the techniques described herein can be performed in a different sequence, may be added, merged, or left out altogether (e.g., not all described acts or events are necessary for the practice of the techniques). Moreover, in certain examples, acts or events may be performed concurrently, e.g., through multi-threaded processing, interrupt processing, or multiple processors, rather than sequentially.

[0099] In one or more examples, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium and executed by a hardware-based processing unit. Computer-readable media may include computer-readable storage media, which corresponds to a tangible medium such as data storage media, or communication media including any medium that facilitates transfer of a computer program from one place to another, e.g., according to a communication protocol. In this manner, computer-readable media generally may correspond to (1) tangible computer-readable storage media which is non-transitory or (2) a communication medium such as a signal or carrier wave. Data storage media may be any available media that can be accessed by one or more computers or one or more processors to retrieve instructions, code and/or data structures for implementation of the techniques described in this disclosure. A computer program product may include a computer-readable medium.

[0100] By way of example, and not limitation, such computer-readable storage media can include one or more of RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage, or other magnetic storage devices, flash memory, or any other medium that can be used to store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if instructions are transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. It should be understood, however, that computer-readable storage media and data storage media do not include connections, carrier waves, signals, or other transitory media, but are instead directed to non-transitory, tangible storage media. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc, where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0101] Instructions may be executed by one or more processors, such as one or more DSPs, general purpose microprocessors, ASICs, FPGAs, or other equivalent integrated or discrete logic circuitry. Accordingly, the term "processor" or "processing circuitry," as used herein may refer to any of the foregoing structure or any other structure suitable for implementation of the techniques described herein. In addition, in some aspects, the functionality described herein may be provided within dedicated hardware and/or software modules. Also, the techniques could be fully implemented in one or more circuits or logic elements.

[0102] The techniques of this disclosure may be implemented in a wide variety of devices or apparatuses, including a wireless handset, an integrated circuit (IC) or a set of ICs (e.g., a chip set). Various components, modules, or units are described in this disclosure to emphasize functional aspects of devices configured to perform the disclosed techniques, but do not necessarily require realization by different hardware units. Rather, as described above, various units may be combined in a single hardware unit or provided by a collection of interoperative hardware units, including one or more processors as described above, in conjunction with suitable software and/or firmware.

[0103] Various examples have been described. These and other examples are within the scope of the following claims.

What is claimed is:

1. A device for controlling a heating, ventilation, and air conditioning (HVAC) system within a building, the device comprising:

an analog display comprising a set of markers, wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building;

an electric motor;

a pointer connected to the electric motor, wherein the electric motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and

processing circuitry configured to:

determine a position of the electric motor while the pointer is positioned at one of the lower limit or the upper limit of the pointer range; and

calibrate, based on the position of the electric motor while the pointer is positioned at the one of the lower limit or the upper limit, a position function corresponding to the electric motor to configure the electric motor to move the pointer to indicate the respective parameter value of the parameter associated with the building.

2. The device of claim **1**, wherein the one of the lower limit or the upper limit represents a first one of the lower limit or the upper limit, and wherein the processing circuitry is further configured to:

determine, subsequent to determining the position of the electric motor while the pointer is positioned at the first one of the lower limit or the upper limit, a position of the electric motor while the pointer is positioned at a second one of the lower limit or the upper limit; and calibrate the position function corresponding to the electric motor based on both of the position of the electric motor while the pointer is positioned at the first one of the lower limit or the upper limit and the position of the electric motor while the pointer is positioned at the second one of the lower limit or the upper limit.

3. The device of claim **2**, wherein the first one of the lower limit or the upper limit comprises the upper limit of the pointer range, and wherein the second one of the lower limit or the upper limit comprises the lower limit of the pointer range.

4. The device of claim **2**, wherein the first one of the lower limit or the upper limit comprises the lower limit of the pointer range, and wherein the second one of the lower limit or the upper limit comprises the upper limit of the pointer range.

5. The device of claim **2**, wherein the processing circuitry is further configured to:

identify a transition of the device from a deactivated state to an activated state;

determine, in response to identifying the transition, the position of the electric motor while the pointer is positioned at the upper limit; and

determine, in response to identifying the transition, the position of the electric motor while the pointer is positioned at the lower limit.

6. The device of claim **2**, wherein to determine the position of the electric motor while the pointer is positioned at the lower limit, the processing circuitry is configured to:

output an instruction to cause the electric motor to rotate the pointer to the lower limit of the pointer range; and

receive data indicative of the position of the electric motor while the pointer is positioned at the lower limit of the pointer range.

7. The device of claim **2**, wherein the first one of the lower limit or the upper limit comprises the upper limit of the pointer range, and wherein to determine the position of the electric motor while the pointer is positioned at the upper limit, the processing circuitry is configured to:

output an instruction to cause the electric motor to rotate the pointer to the upper limit of the pointer range; and

receive data indicative of the position of the electric motor while the pointer is positioned at the upper limit of the pointer range.

8. The device of claim **1**, wherein the parameter comprises temperature, and wherein the respective parameter value comprises a current temperature within an area of the building.

9. The device of claim **8**, wherein the processing circuitry is further configured to:

output an instruction causing the electric motor to set a position of the pointer in order to indicate the current temperature within the area of the building.

10. The device of claim **1**, wherein the set of markers corresponds to a range of parameter values of the parameter associated with the building, and wherein to calibrate the position function corresponding to the electric motor, the processing circuitry is configured to:

set a reference position of the electric motor corresponding to the position of the electric motor while the pointer is positioned at the one of the lower limit or the upper limit of the pointer range;

determine, based on the reference position, a transfer function which defines a relationship between the parameter associated with the building and the position of the electric motor.

11. The device of claim **1**, wherein the device comprises a substantially circular shape including a circumference, wherein the set of markers extend at least partially around the circumference, and wherein the pointer is closer to the center of the circular shape than the set of markers.

12. The device of claim **1**, further comprising:

a first set of light-emitting diodes (LEDs) configured to illuminate any one or combination of the set of markers; and

a second set of LEDs configured to emit a halo-shaped projection on the analog display, and wherein the processing circuitry is configured to:

output an instruction to activate, while the calibration is occurring, both of the first set of LEDs and the second set of LEDs; and

output, subsequent to the calibration, an instruction to deactivate the set of markers sequentially starting with a center marker of the set of markers and ending with a first marker of the set of markers and a last marker of the set of markers.

13. The device of claim **1**, wherein the processing circuitry is configured to calibrate the position function in response to the device transitioning from a deactivated state to an activated state.

14. A device for controlling a heating, ventilation, and air conditioning (HVAC) system within a building, the device comprising:

an analog display comprising a set of markers, wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building;

an electric stepper motor;

a pointer connected to the electric stepper motor, wherein the electric stepper motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and

processing circuitry configured to:

cause the electric stepper motor to position the pointer at one of the lower limit or the upper limit of the pointer range;

determine an initial value for the parameter; and

cause the electric stepper motor to move the pointer from the one of the lower limit or the upper limit of the pointer range to the marker corresponding to the determined initial value for the parameter.

15. The device of claim **14**, wherein the processing circuitry is further configured to:

determine a second value for the parameter;

cause the electric stepper motor to move the pointer from the marker corresponding to the determined initial value for the parameter to the marker corresponding to the determined second value for the parameter.

16. The device of claim **14**, wherein the processing circuitry is further configured to:

based on a difference between the initial value for the parameter and a value of the parameter associated with the one of the lower limit or the upper limit, determine a number of positions to cause the electric stepper motor to move the pointer from the one of the lower limit or the upper limit of the pointer range to the marker corresponding to the determined initial value for the parameter; and

cause the electric stepper motor to move the determined number of positions.

17. The device of claim **14**, further comprising: a physical stopper that prevents the pointer from moving beyond the one of lower limit or the upper limit; and

wherein the processing circuitry is configured to cause the electric stepper motor to position the pointer at one of the lower limit or the upper limit of the pointer range by moving the pointer until the pointer is stopped by the physical stopper.

18. A method comprising:

determining, by processing circuitry, a position of an electric motor while a pointer is positioned at one of the lower limit or the upper limit of the pointer range, wherein the pointer is connected to the electric motor, and wherein the electric motor is configured to rotate the pointer within a pointer range from a lower limit to an upper limit; and

calibrating, by the processing circuitry based on the position of the electric motor while the pointer is positioned at the one of the lower limit or the upper limit, a position function corresponding to the electric motor to configure the electric motor to move the pointer to indicate the respective parameter value of the parameter associated with the building,

wherein an analog display comprises a set of markers, and wherein each marker of the set of markers corresponds to a respective parameter value of a parameter associated with the building.

19. The method of claim **18**, wherein the one of the lower limit or the upper limit represents a first one of the lower limit or the upper limit, and wherein the method further comprises:

determining, by the processing circuitry subsequent to determining the position of the electric motor while the pointer is positioned at the first one of the lower limit or the upper limit, a position of the electric motor while the pointer is positioned at a second one of the lower limit or the upper limit; and

calibrating, by the processing circuitry, the position function corresponding to the electric motor based on both of the position of the electric motor while the pointer is positioned at the first one of the lower limit or the upper limit and the position of the electric motor while the pointer is positioned at the second one of the lower limit or the upper limit.

20. The method of claim **19**, wherein method further comprises:

identifying, by the processing circuitry, a transition of the device from a deactivated state to an activated state;

determining, by the processing circuitry in response to identifying the transition, the position of the electric motor while the pointer is positioned at the upper limit; and

determining, by the processing circuitry in response to identifying the transition, the position of the electric motor while the pointer is positioned at the lower limit.

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