Dec. 19, 1939. J. T. MARVIN ET AL 2,183,967

CONTROL APPARATUS

Filed Nov. 10, 1937 3 Sheets-Sheet 1

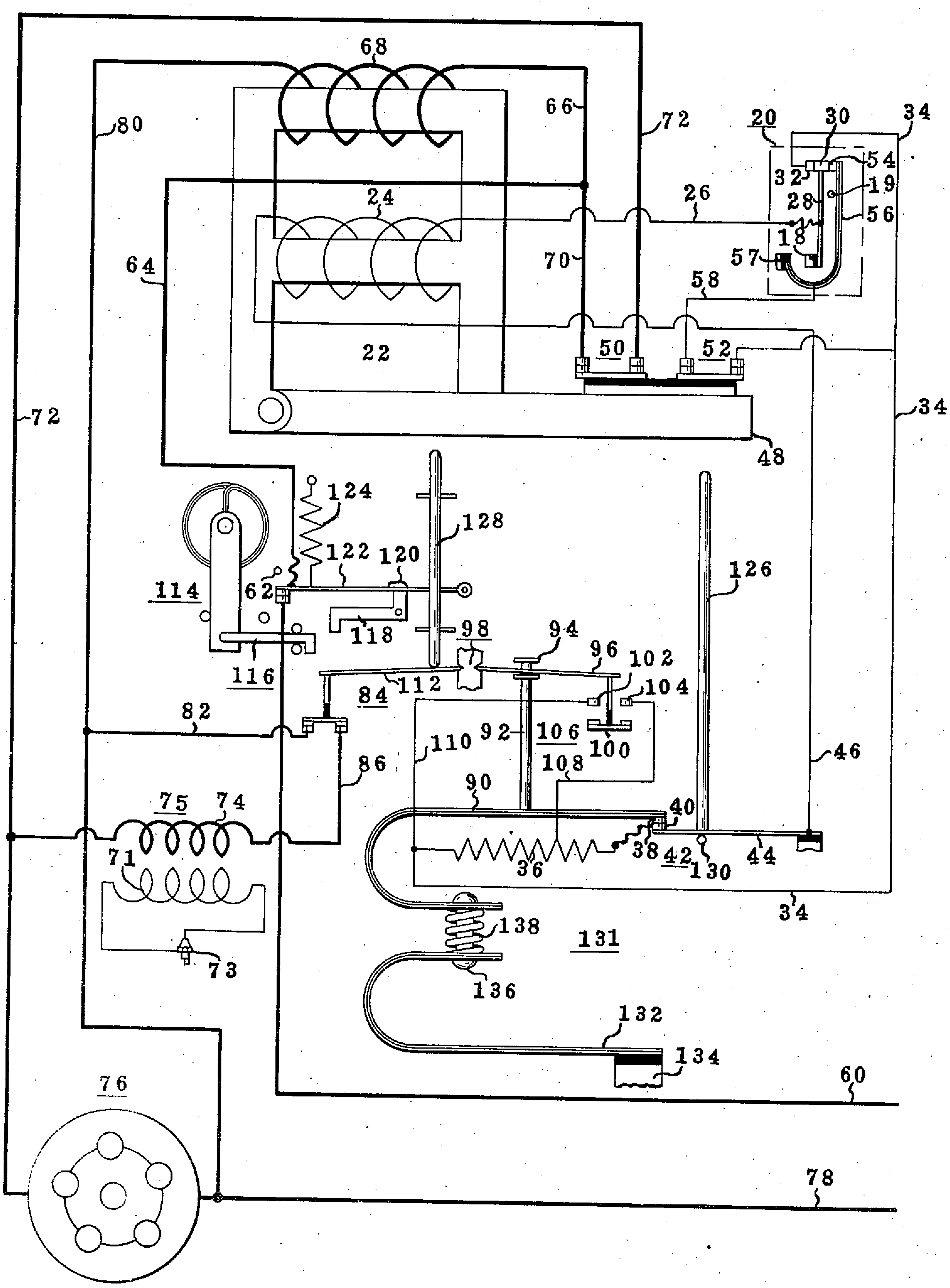

FIG 1

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CONTROL APPARATUS

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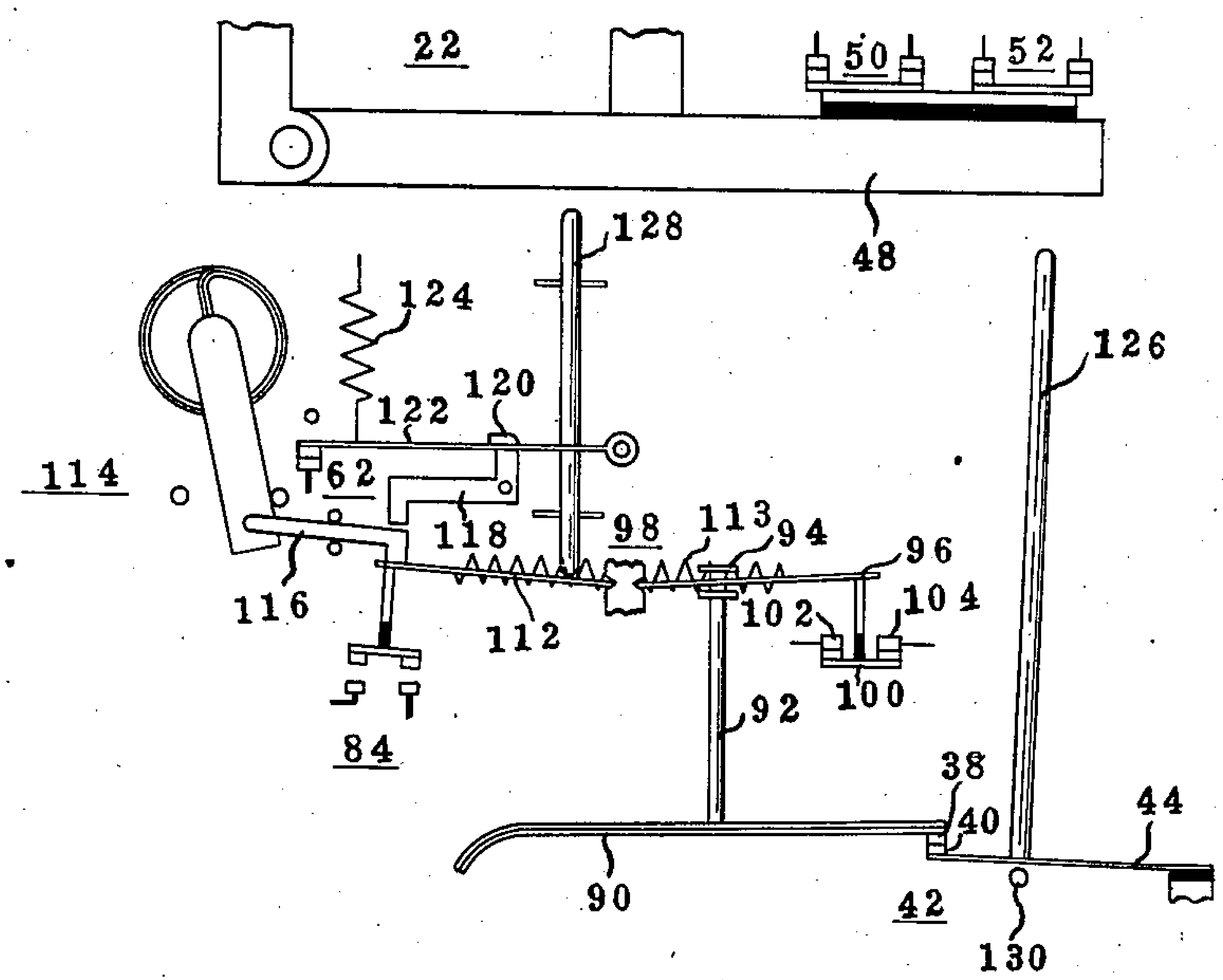

Fig 2

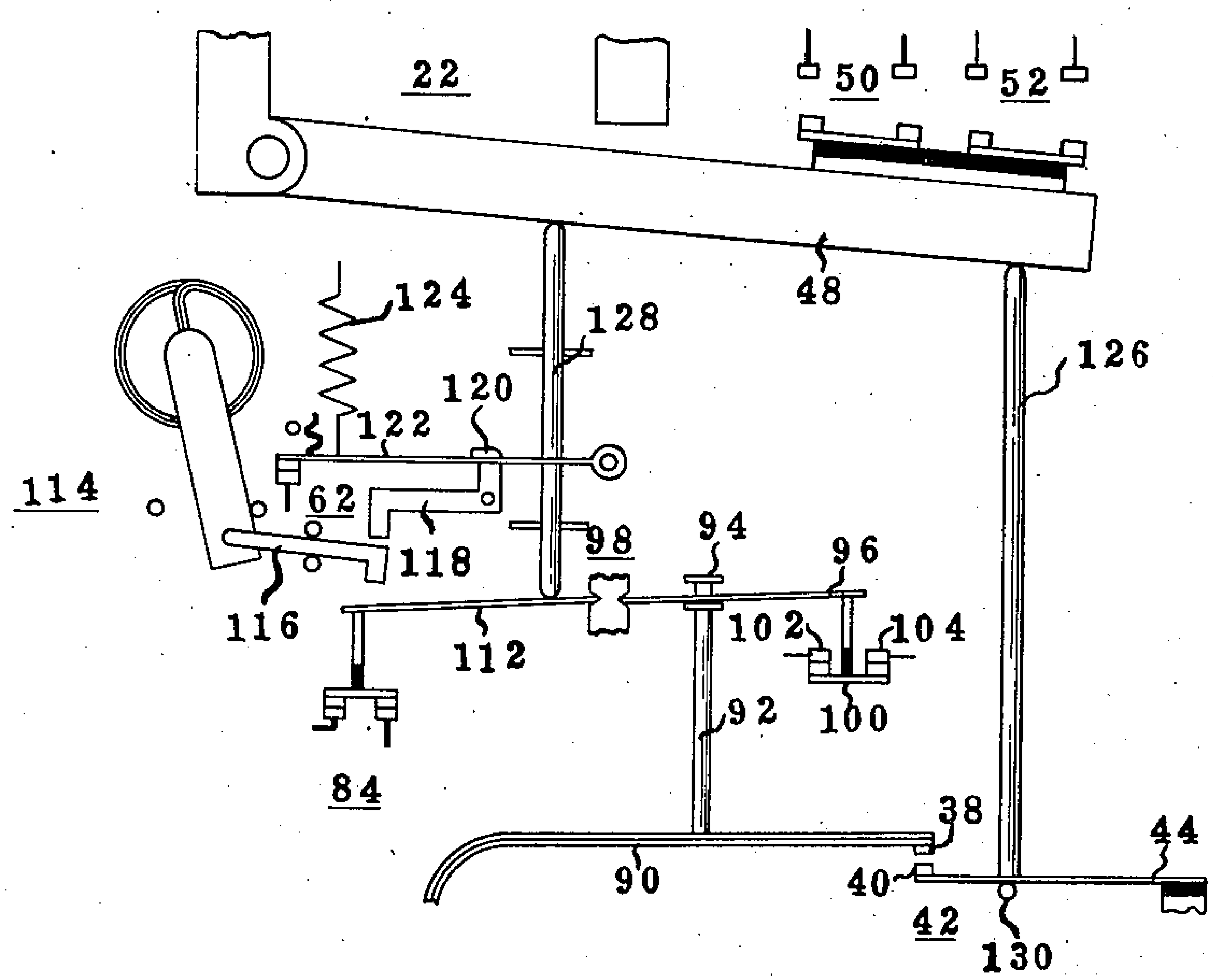

Fig 3

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CONTROL APPARATUS

Filed Nov. 10, 1937 3 Sheets-Sheet 3

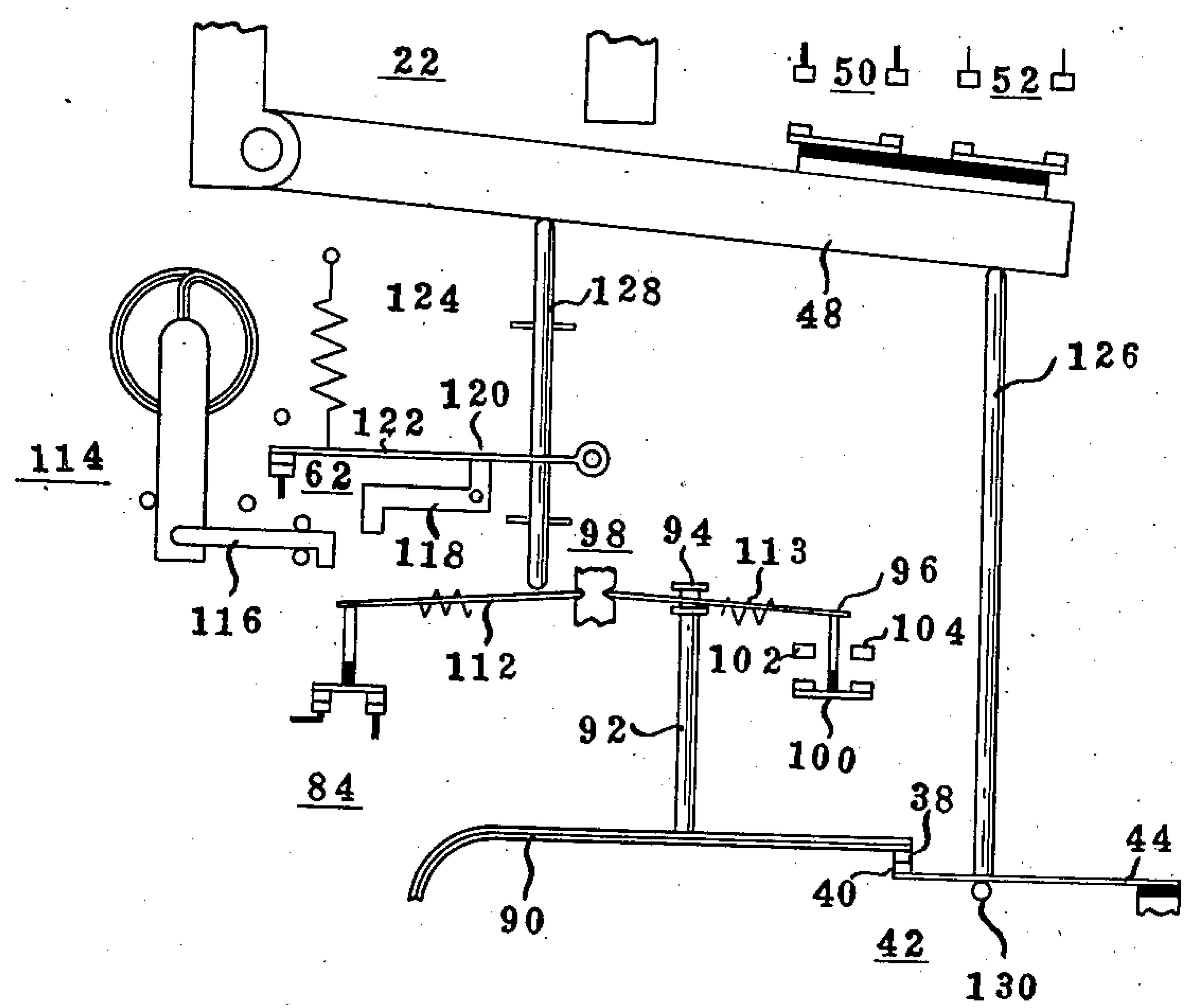

Fig 4

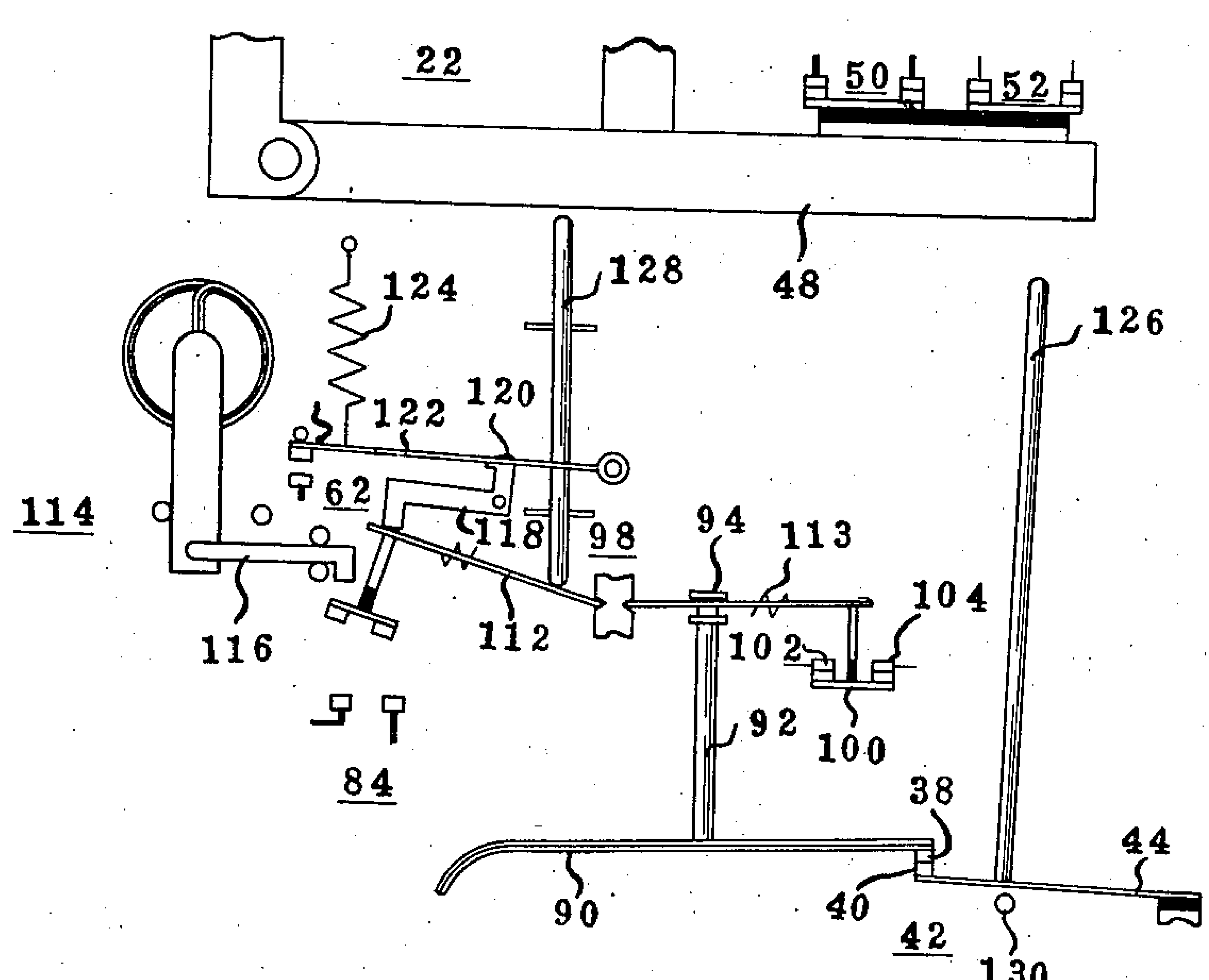

Fig 5

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CONTROL APPARATUS

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Application November 10, 1937, Serial No. 173,882

6 Claims. (Cl. 158—28)

The present invention relates to control systems and more particularly to electrical control systems for controlling fuel burning apparatus.

One of the objects of the present invention is to provide a control system, such as a control system for a fuel burner which utilizes an ignition device, and in which the ignition device is rendered inoperative after a timed period after starting of the burner and is reset upon denergization of the system, so as to insure ignition upon the restarting of the system.

Another object of the invention is to provide a control system with an electrically heated timing device which is heated continuously during the operating period of the fuel burning device and which controls the period of operation of ignition and, also, to provide for modifying the heating effect of the device after a predetermined period of operation thereof.

Other and further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view of a control system in position immediately after energization of the system;

Fig. 2 is a diagrammatic view of a control apparatus and switches, in the operating position, during an operating period of the fuel burning device;

Fig. 3 is a view similar to Fig. 2 with the apparatus and the switches in position immediately after deenergization of the system;

Fig. 4 is a view similar to Fig. 2 with the apparatus in position prior to energization of the system, and,

Fig. 5 is a view similar to Fig. 2, with the apparatus in the deenergized position due to flame failure, a similar action occurring upon failure to initially establish combustion.

Referring to Fig. 1 the present invention is shown in connection with an oil burning device. The system is operatively responsive to the action of a room thermostat **20**, which closes the secondary circuit of the system, when there is a demand for heat, and which opens the same when the demand has been satisfied. A transformer relay **22** is utilized to supply low voltage current to the secondary or starting circuit of the system and also to actuate various associated control switches.

The room thermostat **20** includes a bimetallic member **56** having one end thereof suitably anchored at **57**, and a contact **54** located on its free end. A spring member **28** having one end fixedly mounted at **18**, is provided with a contact **30** on its free end, and is arranged so that the contact **54** will engage contact **30** when the member **56** is moved to the left. The spring member **28** is biased normally against the stop **19**. A fixed contact **32** is suitably mounted for contact with the contact **30**. The bimetal member **56**, the member **28** and contact **32** are connected in the secondary circuit by the wires **58**, **26** and **34** respectively.

When the bimetallic member **56** cools its free end moves to the left, as viewed in Fig. 1, and brings the contact **54** against the contact **30**. The secondary circuit is not energized at this point, however, due to the fact that the contacts **30** and **54** are in series with the switch **52**, which switch is not closed until the secondary circuit is energized. As the bimetallic member **56** continues to move to the left it moves the free end of the spring member **28** away from the stop **19** against the bias of the member **28**, until the contact **30** connects with the contact **32**. At this point the secondary circuit will be energized due to the completion of the circuit, which may be traced as follows: secondary coil **24** of relay **22**, wire **26**, member **28**, contacts **30** and **32**, wire **34**, heating coil **36**, contacts **38** and **40** of time delay switch **42**, resilient contact member **44**, and wire **46**.

Completion of the secondary circuit causes the transformer relay **22** to draw its armature **48** upwardly to close the associated switches **50** and **52** (as shown in Fig. 1). Closure of switch **52** completes a holding circuit around the contact **32** of the thermostat **20**. This circuit may be traced as follows: secondary **24**, wire **26**, member **28**, contacts **30** and **54** and bimetal **56** of thermostat **20**, wire **58**, switch **52**, wire **34**, heating coil **36**, time delay switch **42**, contact member **44** and wire **46**. Thus the secondary circuit will be maintained operative after it has been energized and after contacts **30** and **32** of thermostat **20** have been separated.

As the bimetal member **56** becomes warmer, the free end thereof moves to the right. The member **28** will follow the movement of the bimetal member, due to its spring bias, and thereby maintain the secondary circuit through the contacts **30** and **54** until the member **28** is arrested by the stop **19**. When the member **28** rests against the stop **19**, the contact **54** will be moved away from the contact **30** by further movement of the bimetallic member and the secondary circuit will then be opened and deenergized.

The high voltage primary circuit, includes the primary coil 68 of transformer relay 22 and may be traced as follows: wires 78 and 80, primary coil 68, wires 66 and 64, safety switch 62 and wire 60. Wires 60 and 78 connect directly to the high voltage line. Thus the primary coil 68 is continuously energized when safety switch 62 is closed.

Closure of switch 50, by the armature 48 energizes the motor and ignition circuits. The motor circuit may be traced as follows: wire 78, motor 76, wire 72, switch 50, wire 70, wire 64, safety switch 62 and wire 60. The primary 74 of the ignition transformer 75 is preferably placed in parallel with the motor through the ignition switch 84; such circuit includes wires 78, 80 and 82, ignition switch 84, wire 86, ignition primary 74, wire 72, switch 50, wires 70 and 64, safety switch 62 and wire 60. Thus it is apparent that closure of switch 50 energizes the motor 76 and ignition primary 74 substantially simultaneously.

The motor 76 is utilized to propel pump means for supplying oil and air to the fuel burning device or to operate a fuel valve. A suitable ignition device 73 is also provided and is connected with the secondary 71 of the ignition transformer to ignite the fuel.

The heating coil 36 is disposed in intimate heat transfer relation with a U-shaped bimetallic element or thermostat 90. Upon energization of the secondary circuit of the system, the heating coil 36 is rendered effective and heats the bimetal 90 to cause the same to deflect upwardly. The bimetal 90 carries a push rod 92 on its upper blade, which rod 92 has a lost motion connection 94 at the upper end thereof which engages a flipper 96 of a snap acting toggle mechanism 98. The free end of flipper 96 carries a bridging member 100 disposed to bridge contacts 102 and 104 when the flipper is in its upper, or snapped position. Thus, as the bimetal 90 moves the push rod 92 upwardly, due to the continuous heating by the coil 36, the flipper 96 snaps upwardly to cause the bridging member 100 to engage contacts 102 and 104 of switch 106. Closure of the switch 106 shunts out a part of the heating coil 36 thereby rendering the shunted part substantially ineffective. In this position current from the time delay switch 42 traverses part of the heating coil 36, wire 108, switch 106, wire 110, back to wire 34. When the heating coil 36 is partly shunted it still has sufficient heating effect to maintain the bimetal 90 in its upper position wherein the flipper 96 has been snapped to close switch 106. Simultaneously with the snapping of flipper 96, the associated flipper 112 of the toggle mechanism 98 is snapped upwardly since the flippers 96 and 112 are connected by a spring 113 (see Fig. 2). Upward snap movement of flipper 112 causes the associated ignition switch 84 to be open circuited, thereby rendering the ignition device inoperative. A definite time period elapses, prior to the snap action of toggle mechanism 98, which period assures that the ignition device has been operative for a sufficient period to ignite the fuel.

When combustion has been established, a combustion responsive control 114 causes an associated lever 116 to be moved to the right so that the end thereof is in a position to engage the outer end of flipper 112 when the same is snapped upwardly, so that the flipper remains in the upper position. In this manner the upward movement of the flipper 112 is limited by the controller 114 (as shown in Fig. 2).

The combustion control 114 is associated with lever 116 by a conventional slip clutch which provides for substantially immediate movement of lever 116 upon a change in temperature of the controller 114.

In the event of failure to establish combustion, the controller 114 is not moved and the lever 116 remains in the position shown in Fig. 1. In this case, the flipper 112 snaps upwardly until it engages the end of a downwardly extending, pivotally mounted latch lever 118, the other end 120, of the lever 118 being utilized to latch a pivotally mounted spring biased lever 122, to maintain the associated safety switch 62 in circuit closing position. Engagement of the downwardly extending end of latch lever 118 by the flipper 112 causes the lever 118 to release the latch 120 from lever 122 which allows a spring 124 to separate the contacts of the safety switch 62 to deenergize the system (as shown in Fig. 5). When this action occurs the system remains deenergized until the safety switch 62 is reset manually.

A similar condition arises in the event of flame failure during an operating period of the fuel feeding device. In this event the combustion control 114 cools, and withdraws the lever 116 from engagement with flipper 112, which permits the flipper 112 to move immediately upwardly to cause the safety switch 62 to be opened. The time period between failure of combustion and operation of the safety switch 62 depends only on the time required for the control 114 to withdraw lever 116.

When the system is deenergized, either normally, that is, by the opening of thermostat 20, or due to a power failure, the armature 48 drops downwardly to simultaneously bear upon two vertically extending push rods 126 and 128. This action, due to the weight of the armature 48 on rod 126, causes the resilient contact member 44 to drop downwardly until the same engages the fixed stop 130, in which position the time delay switch 42 is open circuited. Obviously the system cannot be reenergized until the bimetal 90 has cooled sufficiently to close the time delay switch 42. The action of the armature on push rod 128 closes the ignition switch 84. The rod 128 is slidably journalled in suitable bearings, and when acted upon by the armature causes the flipper 112 to be depressed sufficiently to close the ignition switch 84 (as shown in Fig. 3). It is apparent that during this action the flipper 96 is still in the upper position. Upon deenergization of heating coil 36 the bimetal 90 cools and draws the rod 92 downwardly to cause the connection 94 to engage the flipper 96 and draw it downwardly until it passes the dead center position of the toggle mechanism 98, at which instant the flipper 96 snaps downwardly through the lost motion connection 94 (as shown in Fig. 4).

From the foregoing it will be observed that whenever the transformer relay 22 is deenergized, the ignition switch 84 is immediately closed by the action of the armature through the rod 128 and therefore the ignition device is in readiness to operate whenever the secondary or starting circuit is reenergized.

In the embodiment shown in Fig. 1, the bimetal 90 is provided with a compensator 131 which compensator comprises a bimetal 132, of similar shape to the bimetal 90, fixedly mounted at 134. Bimetal 132 is resiliently connected to the bimetal 90 by a double headed rivet 136, which passes loosely through both bimetals, and a spring 138 disposed around the rivet 136 and compressed between the bimetals. The bimetal 132 is so formed, that upon application of heat thereto, it deflects in the opposite direction to the bimetal 90. Thus when the room temperature rises, bimetal 90 deflects upwardly while bimetal 130 deflects downwardly a like distance. This maintains the operative connection between rod 92 and toggle mechanism 98 substantially in the same position throughout changes in atmospheric temperature, which assures that the period of operation of the ignition device will be substantially constant and likewise assures that the safety switch 62 will always be operative within a set time interval.

The present invention can be very satisfactorily operated with a conventional two wire thermostat in place of thermostat 20, in which case the switch 52, and the wiring necessitated thereby, can be eliminated. It is likewise possible to utilize the disclosed principle of closing the ignition switch upon deenergization of the system, with other types of control systems without departing from the scope of the invention.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted, all coming within the scope of the claims which follow:

We claim:

1. A control system for a fuel burning device comprising electrically operated means for starting said device; a normally closed time delay switch in circuit with the said means; electrically heated thermal means adapted to control the operation of said swtich, said thermal means being energized simultaneously with the starting of said fuel burning device; means operated by the electrically heated thermal means, after a predetermined period of heating thereof, for modifying the heating effect of said thermal means; and means operated by the electrically operated means when the same is deenergized, for opening the time delay switch for causing a delay between successive energizations of the electrically operated means, the duration of said delay being governed by the cooling of said thermal means to cause said switch to close.

2. A control system for a fuel burning device comprising, electrically operated means for starting the device; an electrically operated safety mechanism in circuit with said means capable of rendering the circuit inoperative, said mechanism including an electric heater, said heater being energized by said means upon the starting of the fuel burning device and maintained energized during the operation of said device; means rendered effective by the safety mechanism for reducing the heating effect of the heater; and means responsive to the establishment of combustion for preventing said safety mechanism from rendering said electrically operated means inoperative.

3. In a control system for a fuel burning apparatus, an electrically operated device for controlling starting of the apparatus; a normally closed safety switch for controlling said apparatus; an ignition means including a switch; an electrically heated timing means for actuating the safety and ignition switches to their open positions, said timing means being continually energized during operation of the apparatus; means responsive to combustion for preventing movement of the safety switch to its open position; and means independent of said timing means actuated by said device for biasing and maintaining the ignition switch in its closed position when the apparatus is deenergized.

4. In a control system for a fuel burning apparatus, an electrically operated device for controlling operation of the apparatus; a normally closed safety switch in circuit with the said device; means for igniting the fuel, said means including an ignition switch; thermal responsive means adapted to move in one direction when heated for causing successive opening of the ignition switch and the safety switch respectively; electric heating means for said thermal responsive means; a circuit for the heating means, said circuit being connected with the electrically operated device and energized continually during operation of the apparatus; means for arresting movement of said thermal responsive means in response to the presence of combustion following opening of the ignition switch and prior to opening of the safety switch by the thermal means; and means independent of said thermal responsive means actuated by said electrically operated device for biasing the ignition switch in its closed position on stopping of the burner apparatus.

5. A control system for a fuel burning device comprising in combination, an igniter; a circuit for the igniter including two switches; electrically operated means having a running position and a stopping position, said means when moved to the running position closing one of the igniter circuit switches and adapted to render the fuel burning device operative and, when moved to stopping position, opening said one switch and closing and maintaining the other of said igniter switches closed; means for actuating the electrically operated means; and an electrically operated timing device operable after the electrically operated means is moved to the running position, for causing the electrically operated means to be moved to the stopping position and for opening said other igniter switch; and means responsive to the establishment of combustion for preventing said timing device from causing the electrically operated means to be moved to the stopping position.

6. A control system for a fuel burning device comprising in combination, an igniter; a circuit for the igniter including two switches; electrically operated means having a running position and a stopping position, said means when moved to the running position closing one of the igniter circuit switches and adapted to render the fuel burning device operative and, when moved to stopping position, opening said one switch and closing and maintaining the other of said ignition switches closed; means for actuating the electrically operated means; and an electrically operated timing device, continuously energized while the electrically operated means is in the running position, said timing device being operable, after the electrically operated means is moved to the running position, for causing the electrically operated means to be moved to the stopping position and for opening said other igniter switch; and means responsive to the establishment of combustion for preventing said timing device from causing the electrically operated means to be moved to the stopping position.

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