Nov. 9, 1954 EL ROY L. PAYNE 2,693,914

HOT AIR FURNACE CONTROL

Filed April 11, 1951 3 Sheets-Sheet 1

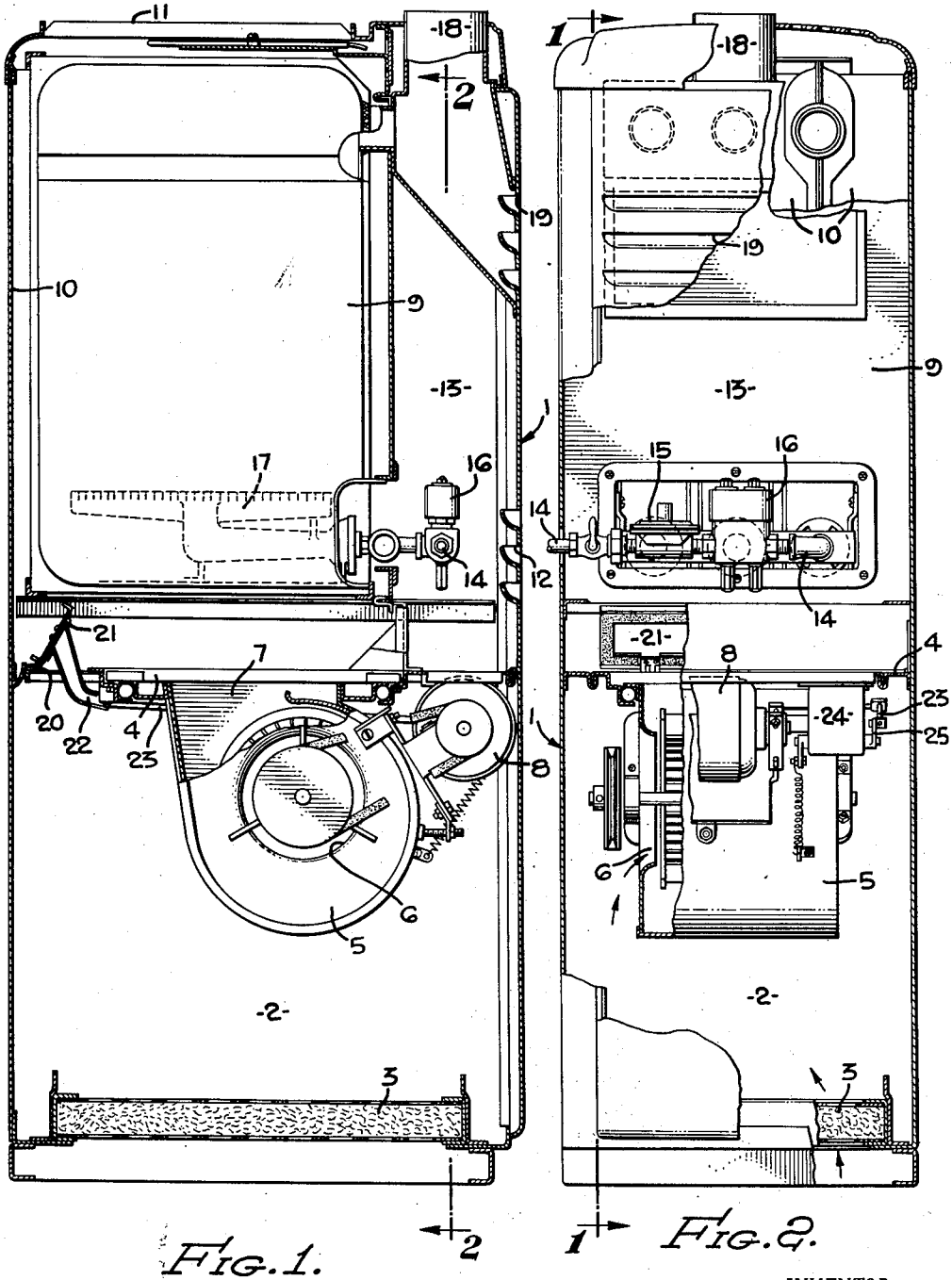


FIG. 1. FIG. 2.

INVENTOR.
ELROY L. PAYNE
BY Lyon & Lyon
ATTORNEYS

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FIG. 3.

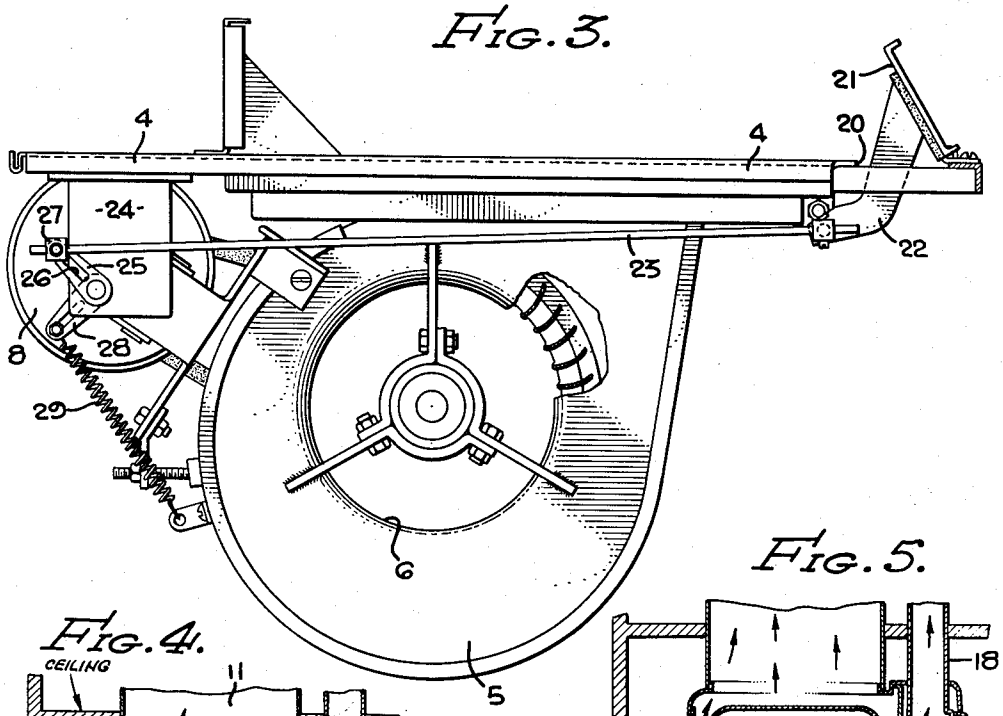


FIG. 4.

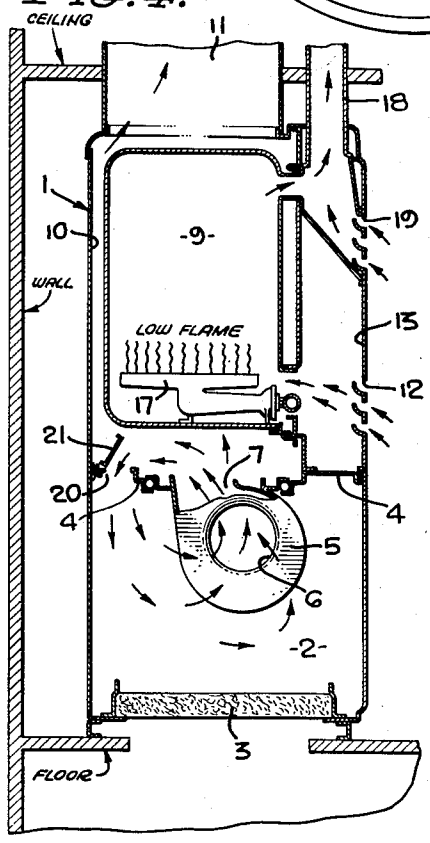
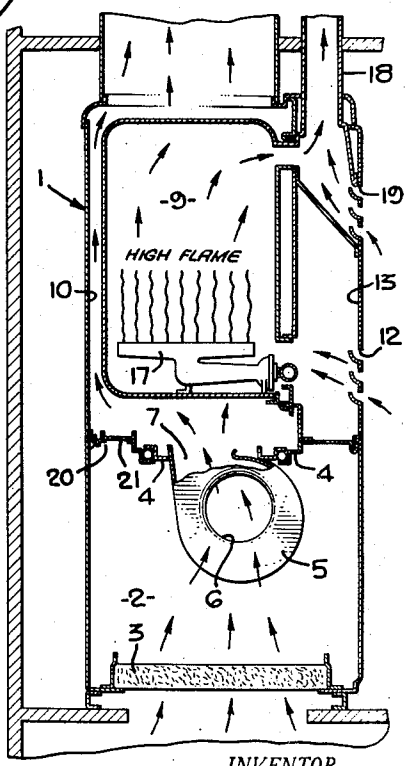


FIG. 5.



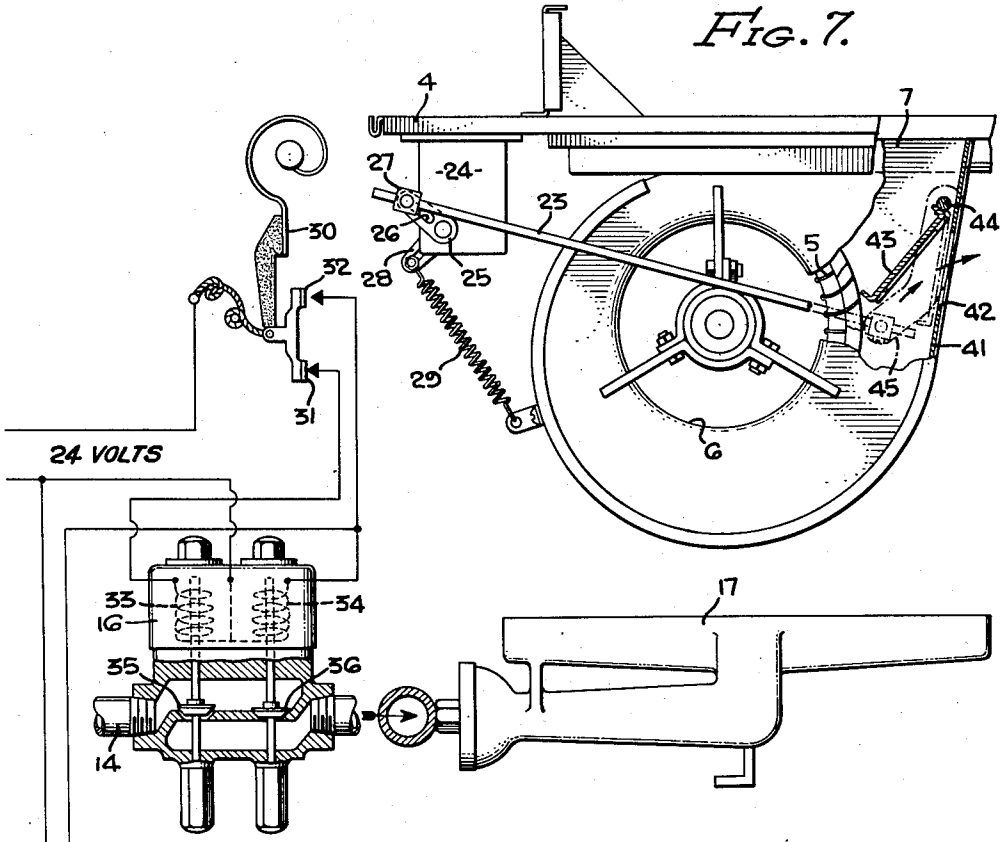
INVENTOR.
ELROY L. PAYNE
BY Lyon & Lyon
ATTORNEYS

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FIG. 7.



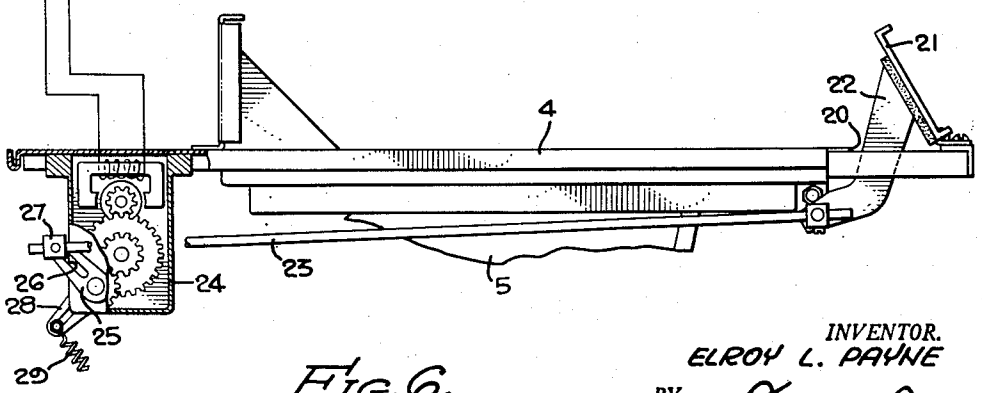


FIG. 6.

INVENTOR.
ELROY L. PAYNE
BY Lyon & Lyon
ATTORNEYS

United States Patent Office

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HOT AIR FURNACE CONTROL

El Roy L. Payne, Beverly Hills, Calif.

Application April 11, 1951, Serial No. 220,447

3 Claims. (Cl. 236—11)

My invention relates to furnaces, more particularly to warm air furnaces. Conventional warm air furnaces, such as those which are thermostatically controlled, often fail to maintain the desired air temperature. One type of such conventional furnace is caused to shut off when the thermostat reaches its preset temperature. The air conduits cool off much more rapidly than the areas being heated. Then upon subsequent operation of the furnace, the initial air is chilled by its conduits and enters at a temperature substantially below normal and produces an uncomfortably cold draft which is repeated with each cycle of operation.

Attempts have been made to overcome this by use of a two-stage thermostat which first reduces the fuel supply so that the furnace does not shut off but goes on low heat. This is reasonably satisfactory if natural draft is used, however, natural draft is seldom sufficient. Thus, if in conjunction with a two-stage control furnace a blower is used, the air supply under conditions of reduced fuel supply greatly lowers the temperature of the air supplied. The obvious expedient is to reduce the speed of the blower so that it supplies a correspondingly less volume of air. This is, however, impractical as the cost of variable speed electric motors, both as to installation cost and maintenance cost, is substantially higher than the cost of conventional blower motors of the induction type. Furthermore, it is an inherent characteristic of blowers that their efficiency drops materially if they are operated at any speed other than their design speed. In any case, adjustment by this means to meet different conditions would be virtually impossible.

Another expedient is to place a damper in the main discharge conduit, but again, disadvantages occur. The blower builds up a pressure in the system preceding the damper, correspondingly reducing the volume of air passing the blower. This has the effect of reducing the blower load, causing it to speed up and increasing the noise factor. Also, under this condition, there is a tendency for the supply ratio to the various registers to change, causing some areas to be deprived of heat while other areas to receive too much. Still further, the main outlet conduits are large, difficult to throttle and often so close to the point of discharge that any increased air noise around the damper would be heard.

Accordingly then, included in the objects of my invention are:

First, to provide a warm air furnace utilizing a two-stage burner control and blower, wherein air drawn through the blower is caused to follow in part a bypass so that the blower load remains substantially constant, although the volume supplied to the air ducts may be varied.

Second, to provide a warm air furnace of this class wherein the reduced volume of air supplied to the air ducts under low flame setting of the furnace may be readily, quickly and accurately varied to meet the unique conditions of each installation.

Third, to provide for a furnace of this class a control wherein the temperature of the fire chamber of the furnace and the flue may be maintained at an efficient level above that wherein condensation may take place so as to reduce the fuel consumption and minimize repairs.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings in which:

Figure 1 is a sectional view of a warm air furnace, incorporating my invention, the section being substantially along the line 1—1 of Figure 2.

Figure 2 is a partial elevational, partial sectional view thereof, taken substantially along the line 2—2 of Figure 1.

Figure 3 is an enlarged fragmentary view showing the blower, its drive unit and the bypass valve with its control motor.

Figure 4 is a diagrammatical view showing the flow of air when the furnace is adjusted for low flame operation.

Figure 5 is a similar diagrammatical view showing the flow of air when the furnace is adjusted for high flame operation.

Figure 6 is a diagrammatical view showing the manner in which the burner valves and bypass valve motor are connected in circuit with a thermostat.

Figure 7 is a fragmentary view, similar to Figure 3, showing a modified arrangement of blower and bypass valve.

My invention may be adapted to various warm air furnace constructions. For purposes of illustration, one type is shown: the furnace includes an outer shell structure 1, having an intake compartment 2 which, in this case, is shown as located at the bottom of the shell structure. The intake compartment is provided with an air intake opening, preferably covered by a filter 3. A partition 4 forms the upper wall of the compartment. Mounted within the compartment, is a blower 5 having an intake port 6 communicating with the compartment and a discharge port 7 communicating through the partition 4. The blower is driven by a suitable motor 8, preferably a constant speed induction motor, mounted within the compartment.

Above the partition 4, there is provided within the shell structure a fire box 9 or chamber or a series of such chambers. Air discharged from the blower 5 passes around, but is isolated from the interior of the fire box or chambers, that is, the air flows through passages 10 defined by exterior walls of the fire chambers and the walls of the shell structure 1. The air passages 10 communicate with a discharge duct 11, extending from the shell structure 1 and communicating with the area or areas to be heated, not shown.

One side of the shell structure 1 is provided with fuel air intake ports 12. Air required for combustion enters through the intake ports 12, flows across a control compartment 13 into the fire chambers 9. The control compartment receives a fuel supply line 14 and contains a pressure regulator valve 15 and a dual feed control valve 16 and, if desired, other control devices, not shown. Fuel lines extend from the valve 16 to one or more burners 17, located in the fire chambers 9.

The fire chambers 9 communicate with a flue 18, preferably through an intermediate compartment having flashback ports 19.

The structure, as so far described, may be considered as conventional. In the exercise of my invention, in conjunction with the type of furnace shown, I provide a bypass port 20 of substantial area in the partition 4. Other furnace constructions may require a different location of the bypass port, but in any case, it is so located as to afford communication between the discharge side and the intake side of the blower.

The port is controlled by a valve 21 in the form of a reinforced and marginally padded plate, hinged at one side. The valve opens into the air passages above partition 4 and is provided with an arm 22 which extends downwardly into the intake compartment 2. The arm 22 is pivotally joined to a connecting rod 23 which is operated by a control motor 24. The control motor is preferably a low-powdered synchronous motor which operates through a gear train to turn an operating arm 25. The operating arm is provided with a longitudinally extending adjustment slot 26, and is joined to the connecting rod 23 by an adjustable fitting 27 so that the effective length of the operating arm may be varied. The control motor is a type which may be stalled without harm so that it may move the connecting rod and, in the construction shown, close the bypass valve 21, and by reason of the torque applied when the motor is

stalled, hold the bypass valve in its closed position.

A second arm **28**, secured to the same shaft as the operating arm **25**, is attached to a spring **29**, suitably anchored so that when the control motor is deenergized, the valve may be moved to its other extreme position, in this case, its open position.

The control motor **24** is joined in a control circuit to a thermostat **30**, having contacts **31** and **32** and solenoids **33** and **34**, incorporated in the dual feed controlled valve **16**. The dual control valve includes a pair of solenoid operated valve members **35** and **36**, controlling ports forming parallel communication between the fuel supply line and the burners. The valve members **35** and **36** are individually adjustable as to position when open. By this arrangement, when both solenoids are energized, a predetermined maximum supply of fuel may be maintained, and when one of the solenoids is energized, a predetermined minimum supply of fuel may be supplied.

The thermostat **30** is so arranged that below a predetermined temperature value, both contacts **31** and **32** which control, respectively, solenoids **33** and **34** are closed. The furnace then operates under the conditions shown in Figure 5 with the preset maximum amount of fuel being supplied. When the temperature rises above a critical point, the contact **32**, controlling solenoid **34**, opens so that a predetermined minimum amount of fuel is supplied and the conditions shown in Figure 4, obtain.

The bypass valve control motor **24** is connected in parallel with the solenoid **34** so that under the conditions shown in Figure 5, the control motor is energized and the bypass valve **21** is held closed. Thus, all of the air passing through the blower **5** is delivered to the discharge ducts **11**. When solenoid **33** only is energized, the control motor **24** is deenergized so that the spring **29** causes the bypass valve to open as shown in Figure 4. Under these conditions, a portion of the air passing through the blower is returned to the intake compartment and recirculated through the blower so that the amount of air supplied to the discharge duct **11** is reduced. By simple adjustment of the operating arm **25** and connecting rod **23** the amount of air bypassed can be easily regulated and thus be adjusted to the conditions existing for the corresponding low flame setting of the control valve **16**.

A low flame setting is chosen which is normally insufficient to maintain the temperature of the area being heated so that under normal conditions of operation, the thermostat will operate only contact **32**, causing the furnace to move from a high flame to a low flame condition, and the areas to be heated are supplied with high and low volumes of air at substantially the same temperature for both conditions. Thus, no cold air drafts are created, and a change from a low operation to a high operation and vice versa may occur without detection by persons in the area being heated.

A further important advantage is obtained in that the fire chambers and flue are not cooled under conditions of low flame operation, the draft is not impaired, and condensation conditions are avoided. It should be pointed out that repeated condensation of moisture present in the flue gases is a major factor in shortening the life of a furnace of this type.

If conditions are such that the supply of heat is more than that required even under low setting of the furnace, the thermostat will open both contacts, shutting off the furnace completely. If later, the temperature drops, the furnace is first operated at low heat and if this is not sufficient, a continued temperature drop causes the furnace to operate at high heat.

Reference is now directed to Figure 7. In this arrangement, the blower **5** is provided with a shell **41** in which is cut a port **42** near the blower discharge end **7**. The port **42** is closed by a plate valve **43**, similar to the valve **21**. The plate valve is secured by its upper margin to a shaft **44** located above the opening or port **42** within the shell so that the end of the plate valve projects into the air passage between the blower rotor and the shell and serves, when open, as a deflector.

The shaft **44** is provided with an external lever **45** connected to a rod **23** and operating motor **24** as in the first described structure.

When the plate valve is closed, all the air output of the blower is delivered to the furnace. When the valve **43** is open, a corresponding proportion of the air is bypassed or returned to the air intake chamber **2**.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. A warm air furnace, comprising in combination: a heating unit including burners and valve means adapted to operate said burners at a high and low setting; means defining upwardly extending air passages in heat transfer relation to said heating unit and an air duct communicating with the upper ends thereof; a partition below said heating unit and air passages and define in part by a casing for a centrifugal blower; means, including said partition, defining an air intake compartment; a centrifugal blower in said casing having an inlet communicating with said intake compartment and arranged to move air therefrom through said partition; means for directing air from said blower to the lower ends of said passages; a bypass opening through said partition adjacent the outlet of said blower; a bypass valve controlling said bypass opening; and means operative when said burners are at high setting to close said bypass valve and operative when said burners are at low setting to open said bypass valve to recirculate, within said intake compartment, a portion of the air moved by said blower.

2. A warm air furnace as set forth in claim 1, wherein: said bypass opening is located in said casing for said centrifugal blower.

3. A warm air furnace as set forth in claim 1, wherein: said bypass opening is disposed in said partition at one side of said blower casing.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,539,717	Coppus	May 26, 1925
1,546,450	Meaker	July 21, 1925
1,862,289	Anderson	June 7, 1932
2,120,803	Grant	June 14, 1938
2,154,051	Martenis	Apr. 11, 1939
2,226,510	Grant	Dec. 24, 1940
2,327,841	Hagen	Aug. 24, 1943
2,396,000	Findley	Mar. 5, 1946
2,402,177	Miller	June 18, 1946
2,569,877	Woodruff	Oct. 2, 1951