

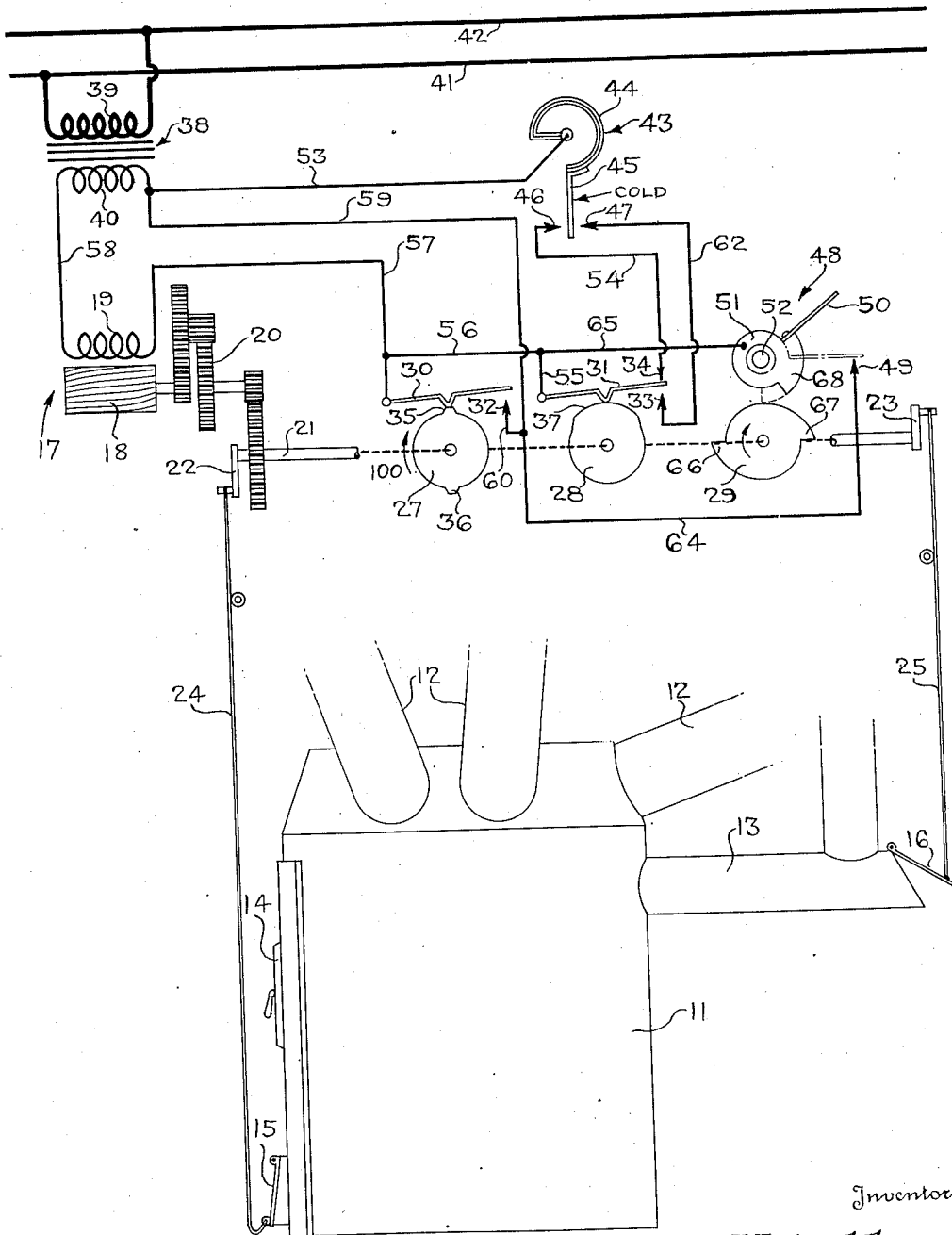
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DAMPER REGULATOR

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DAMPER REGULATOR

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Our invention relates to a new and novel damper regulator, and more particularly to one in which means are provided for moving the dampers to a firing position when desired.

5 In systems for the automatic control of furnaces it is common to employ a damper motor for actuating the dampers, which damper motor is under the control of some condition responsive device, such as a room thermostat. In
10 such systems the dampers are usually moved from a position wherein the check damper is open and the draft damper is closed to a position in which the opposite condition exists, depending upon whether the temperature or other control-
15 ling condition is above or below the desired value. In firing a furnace, it is necessary that the check damper be closed to prevent the escape of smoke from the firing door during the firing operation. In certain types of furnaces it is, furthermore,
20 necessary that both the check door and the draft door be closed during this firing operation. It, accordingly, is common to provide means in the basement for moving the dampers to a position in which either the check damper alone or both
25 dampers are closed. Such means commonly takes the form of a basement switch which causes the motor to run until the dampers are in the desired position. The objection to this arrangement is that the furnace attendant will quite
30 likely forget to move the basement switch back to the position under which the furnace is under the control of the room thermostat. Various complicated arrangements have, accordingly, been provided for returning the damper motor
35 to the control of the room thermostat a predetermined period of time after the switch has been moved to firing position. These arrangements not only greatly add to the expense of the damper motor but rely upon timing means which tend to
40 get out of order.

Another class of damper motors is provided with means for declutching the damper actuating arm from the motor so as to permit the dampers being manually moved to any desired firing position. In this class of motors, provision has
45 been made for automatically returning the motor to the control of the condition responsive device by causing the act of declutching to energize the motor and run the same to a position wherein the damper actuating device was automatically
50 redeclutched with the motor and was returned to automatic control. One difficulty with this type of device is that it involves more effort upon the part of the operator. A further and even
55 more serious objection is that the presence of the

declutching means greatly adds to the expense and complication of the damper motor.

An object of the present invention is to provide a damper motor having manual means for initiating movement of the motor with provision for
5 returning the motor to the control of the room thermostat or other controlling device after such movement has been initiated.

A further object of the present invention is to provide a damper motor having a manual
10 switching means for causing the motor to rotate the dampers through a desired firing position and to continue such rotation until the dampers have reached a position determined by the value
15 of the controlling condition.

Other objects of the invention will be apparent from the accompanying description, claims and drawing.

The single figure of the drawing schematically shows our damper motor associated with a
20 furnace and a room thermostat. Referring to said drawing, a conventional furnace is indicated by the reference numeral 11. This furnace is shown as being of the hot air type, although it is to be understood that it may be of any con-
25 ventional form. The furnace is shown as having the usual hot air pipes 12, a stack pipe 13, a fuel door 14, a draft door 15 and a check damper 16.

The damper motor comprises a motor 17 having a rotor 18 and a field winding 19. The motor is connected through reduction gearing 20 with a shaft 21. The shaft 21 is provided at its opposite
30 ends with crank arms 22 and 23. Crank arm 22 is connected through a chain or equivalent device 24 with the draft damper 15, and crank arm 23 is similarly connected through a chain 25 with the check damper 16. It will be noted that the
35 chain 24 is provided with a certain amount of slack when the crank 22 is in its downward position. This is also true of the chain 25. These chains are both of a length such that
40 when the crank arms 22 and 23 are in a horizontal position the dampers are both closed.

Mounted upon the shaft 21 are three cams 27, 28 and 29. Cams 27 and 28 are associated with
45 switch arms 30 and 31, respectively. Switch arm 30 is adapted to move into engagement with a contact 32 and switch arm 31 is adapted to be moved into engagement with either contact 33
50 or a contact 34. Switch arms 30 and 31 and their respective contacts constitute what may be termed a maintaining switch, the function of which will be apparent from the following description. The cam 27 is provided with two cam
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toes 35 and 36 spaced at points 180° apart, so that switch 30 is separated from contact 32 every 180° of rotation of shaft 21. Cam 28 is provided with an elongated cam toe 37 which is adapted to hold switch arm 31 in engagement with contact 34 during a considerable period of rotation of shaft 21. The toe 37 of cam 28 is so located that switch arm 31 is moved to the position wherein it is in engagement with contact 34 before the cam toe 35 is operative to move contact 30 out of engagement with contact 32.

Power for actuating the motor is supplied by a step-down transformer 38 having a line voltage primary 39 and a low voltage secondary 40. The primary 39 is connected to line wires 41 and 42.

The thermostat which controls the operation of the damper motor is designated generally by the reference numeral 43. This thermostat is of a conventional form and comprises a bimetallic element 44 to which is attached contact arm 45. Contact arm 45 is adapted to be engaged with either contact 46 or contact 47. The bimetallic element is so designed that upon the temperature dropping below the value desired the contact arm 45 will be moved into engagement with contact 46, while upon the temperature rising to the desired value the contact arm will be moved into engagement with contact 47. Thus, contact 46 may be referred to as the "cold contact" and contact 47 as the "hot contact". While we have shown a room thermostat as a controlling condition responsive switch, it will be understood that any other suitable form of controlling condition responsive switch may be employed. Thus a device which is responsive to the water temperature in the case of a hot water heating system, or to the steam pressure in the case of a steam heating system, may be employed.

A basement switch is generally designated by the reference numeral 48. This switch is shown as comprising a stationary contact 49 and a movable switch blade 50. The switch blade 50 is mounted on a rotatable member 51 which may be provided with a knob 52 for conveniently rotating member 51 manually to bring the switch arm 50 into engagement with contact 49, as shown in dotted lines in the drawing.

As shown in the drawing, our damper controller and the various members associated therewith are in the position assumed when the temperature in the room is at the desired value. In this position, the draft damper 15 is closed and the check damper 16 is open so that the dampers are acting to retard a draft in the furnace. With the dampers in this position, a condition will eventually be reached wherein the temperature adjacent the thermostat 43 falls below the desired value. Upon this taking place, contact arm 45 will be moved into engagement with contact 46. This will cause the following circuit to be established through the field winding 19 of the motor 17: From one end of secondary 40, through conductor 53, bimetallic element 44, contact arm 45, contact 46, conductor 54, contact 34, switch arm 31, conductors 55, 56 and 57, field winding 19 and conductor 58 to the other terminal of secondary 40. This will cause motor 17 to rotate with the result that shaft 21 is rotated in the direction of the arrow 100. After a very slight initial rotation of the shaft 21 switch arm 30 will be allowed to move into engagement with contact 32. Upon this taking place, the following maintaining circuit for field winding 19 is established: From one end of secondary 40, through conductor 59, conductor 60, contact 32,

switch arm 30, conductor 57, field winding 19 and conductor 58 back to the other terminal of secondary 40. It will be noted that the maintaining circuit just traced does not depend upon the engagement of contact arm 45 with contact 46 so that even if contact arm 45 should be separated from contact 46 after the motor has started its rotation, such rotation will continue. This rotation of motor 17 and the resultant rotation of shaft 21 will continue until switch arm 30 is moved out of engagement with contact 32 by the cam toe 36. By the time this takes place, the cam 28 will be in a position such that switch arm 31 is resting upon the heel of the cam 28 so that it is no longer in engagement with contact 34, being now in engagement with contact 33. Thus, both the initial energizing circuit and the maintaining circuit are interrupted so that rotation of shaft 21 and the resultant movement of the dampers is stopped unless in the meantime, contact blade 45 has moved into engagement with contact 47. In this new position of shaft 21 crank arm 22 is in its uppermost position and crank arm 23 is in its lowermost position so that draft damper 15 is now open and check damper 16 closed.

The new position of the dampers causes combustion to be accelerated so as to increase the temperature of the space to be heated. This will continue until the temperature of said space has risen sufficiently that contact 45 is moved into engagement with contact 47. Upon this taking place, the following energizing circuit for field winding 19 will be established: From one end of secondary 40, through conductor 53, bimetallic element 44, contact arm 45, contact 47, conductor 62, contact 33, switch arm 31, conductors 55, 56 and 57, field winding 19 and conductor 58 to the other terminal of secondary 40. The establishment of this circuit through field winding 19 will cause rotation of the motor 17 and the resultant rotation of shaft 21 with the result that cam 27 will be moved so as to allow switch arm 30 to again move into engagement with contact 32 after a very slight initial rotation of the shaft. This re-engagement of the switch arm 30 with contact 32 will result in the re-establishment of the previously traced maintaining circuit so that, as in the previous case, the motor will continue to rotate even though the arm 45 should move away from the contact 47. As in the preceding case, this rotation will continue for 180° until switch arm 30 is again moved out of engagement with contact 32, the parts then being in the position shown in the drawing. Before this separation of switch arm 30 from contact 32 takes place, switch arm 31 has been moved out of engagement with contact 33 and into engagement with contact 34 by coming into engagement with the toe 37 of cam 28.

The operation of the basement switch of our regulator will now be described. Assuming that the parts are in the position shown in the drawing, and it is desired to fire the furnace, the knob 52 is rotated so as to cause member 51 to be rotated until switch arm 50 is in engagement with contact 49 as shown in dotted lines in the drawing. Upon this engagement taking place, the following energizing circuit will be established through field winding 19: From one end of secondary 40, through conductors 59 and 64, contact 49, switch arm 50, member 51, conductors 65, 56 and 57, field winding 19 and conductor 58 to the other terminal of secondary 40. This will cause rotation of motor 17 and the resultant

rotation of the shaft 21 so that, as in the previously described cases, where the energizing circuit is established by reason of the engagement of contact arm 45 with either contact 46 or 47, a maintaining circuit will be established after a very short initial rotation of the shaft by reason of switch arm 30 being moved into engagement with contact 32. The reduction gearing 20 is so designed with respect to the speed of motor 17 that shaft 21 is rather slowly rotated. While it is to be understood that our invention is not to be limited to any particular speed of rotation, it has been found satisfactory to provide a reducing gear such that it requires two minutes for the shaft to rotate through 180°. The actuation of the basement switch will, accordingly, cause the shaft 21 to be slowly rotated with the result that damper 16 is slowly moved to a closed position and the slack in chain 24 is slowly taken up. After a comparatively short period of time, during which the operator can be preparing to fire, dampers 15 and 16 will both be closed. The operator may now proceed to fire the furnace without any danger of smoke issuing from the fire door 14. Due to the relatively slow speed of rotation of shaft 21 ample time is provided for firing the furnace before damper 15 has opened appreciably. Moreover, in the case of the majority of furnaces, no trouble is encountered with smoke issuing from the fire door even if the draft damper 16 is opened so long as the check damper is closed. Thus, assuming a two minute cycle, such as mentioned above, the operator has two minutes in which to complete his firing operation between the time that check damper 16 is first moved to a closed position until the time that it is again moved towards an open position.

As mentioned previously, shaft 21 is provided with a cam 29. This cam is provided with two cam toes 66 and 67 which are adapted to engage cam toe 68 of member 51. Thus, rotation of the shaft 21 will cause one or the other of the cam toes to move into engagement with a shoulder 68 on member 51 if the member is in the position indicated in dotted lines in the drawing, in which the basement switch 48 is closed. The engagement of these cam toes will cause rotation of member 51 about its axis and a resultant separation of switch arm 50 from contact 49. While we have shown the cam toes 66 and 67 as displaced 90° from cam toes 35 and 36 of cam 27, it is to be understood that cam toes 66 and 67 may be located at any desired point so long as they are sufficiently displaced from the cam toes 35 and 36 to permit the switch arm 30 to move into engagement with contact 32 to establish the maintaining circuit before switch arm 50 is separated from contact 49.

The result of cam 29 moving switch arm 50 out of engagement with contact 49 is that the motor 17 is returned to the control of the thermostat 43. Thus, if the parts were initially in the position shown in the drawing, rotation of the shaft and the dampers would continue for 180° until switch arm 30 would be moved out of engagement with contact 32 in which position the check damper 16 is closed and the draft damper 15 is opened. The motor 17 would then not again be energized until contact arm 45 moved into engagement with contact 47. It is to be understood, however, that the position of contact 45 indicated in the drawing is a somewhat unusual one and that ordinarily the contact arm is in engagement with either contact 46 or 47. Thus, ordinarily when the dampers are

in the position indicated in the drawing switch arm 45 would be in engagement with the "hot contact" 47. Accordingly, after the shaft has rotated 180° and switch arm 30 was separated from contact 32 by engagement with the cam toe 36, the energization of the motor would be continued by reason of an energizing circuit being established through contact 33 and switch arm 31 so that the motor would continue to rotate until the dampers are again in the position shown in the drawing. Thus, the shaft 21 would be rotated through 360° during 180° of which, as explained previously, the dampers are in a position suitable for firing.

It will be seen that we have provided an extremely simple damper regulator in which provision is made for moving the dampers to a firing position and returning the damper motor to automatic control without the use of complicated de-clutching arrangements or timing mechanisms. It will be seen that we have provided a damper motor wherein the basement switch removes the motor from control of the thermostat for only a short period and returns the same automatically to control of the thermostat during the movement of the damper actuating device to the desired position.

While we have shown a specific embodiment of our invention, it will be understood that this is for purposes of illustration and that our invention is to be limited only by the scope of the appended claims.

We claim as our invention:

1. In combination, a furnace, dampers therefor movable between draft retarding and draft producing positions, a damper actuating device, a motor, non-releasable connections between said motor and said damper actuating device to cause movement of the latter by the former, means responsive to a condition for initiating movement of said motor upon said condition assuming an undesired value, means for maintaining said motor in operation until the dampers have assumed either said draft retarding or draft producing position depending upon the value of said condition, further motor controlling means normally in a first position wherein it is inoperative to control said motor and being manually movable to a second position wherein it is operative to initiate movement of said motor independently of said condition responsive means, and means driven by said motor for moving said controlling means back to said first position after said motor is under control of said maintaining means, whereby said motor slowly operates both of said dampers through a firing range and, if the condition responsive device remains in the same controlling position, back to the position occupied prior to actuation of said further controlling means, said connections between said motor and said damper actuating device including means to cause said motor to drive said dampers sufficiently slowly that ample time is provided for firing while said dampers are passing through said firing range.

2. In combination, a furnace, dampers therefor movable between draft retarding and draft producing positions, a motor, connections between said motor and said dampers effective upon continuous movement of said motor in one direction to cause said dampers to be moved successively back and forth slowly between said draft retarding and draft producing positions, means responsive to a condition for initiating movement of said motor upon said condition assuming an

undesired value, means for maintaining said motor in operation until the dampers have assumed either said draft retarding or draft producing position depending upon the value of said condition, further motor controlling means normally in a first position wherein it is inoperative to control said motor and being manually movable to a second position wherein it is operative to initiate movement of said motor independently of said condition responsive means, and means driven by said motor for moving said further controlling means back to said first position after

said motor is under control of said maintaining means whereby said motor slowly operates both of said dampers through a firing range and, if the condition responsive device remains in the same controlling position, back to the position occupied prior to actuation of said further controlling means, the speed of movement of said dampers by said motor being sufficiently slow that ample time is provided for firing while said dampers are passing through said firing range.

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