Aug. 22, 1944. J. H. JACOBSEN 2,356,590

ELECTROMOTOR-DRIVEN MECHANICAL STOKERS

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Fig. 1.

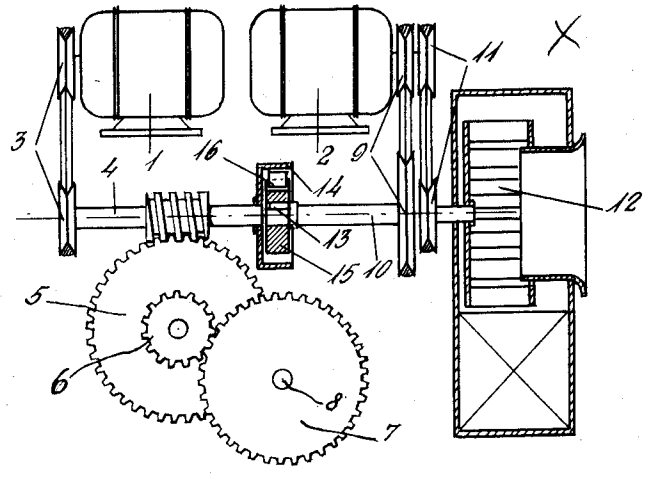


Fig. 2.

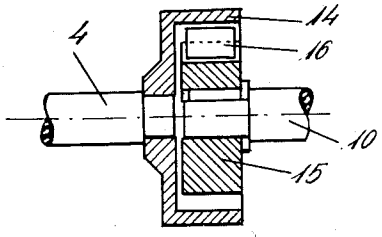


Fig. 3.

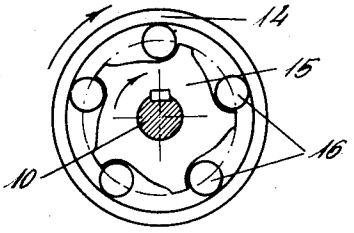
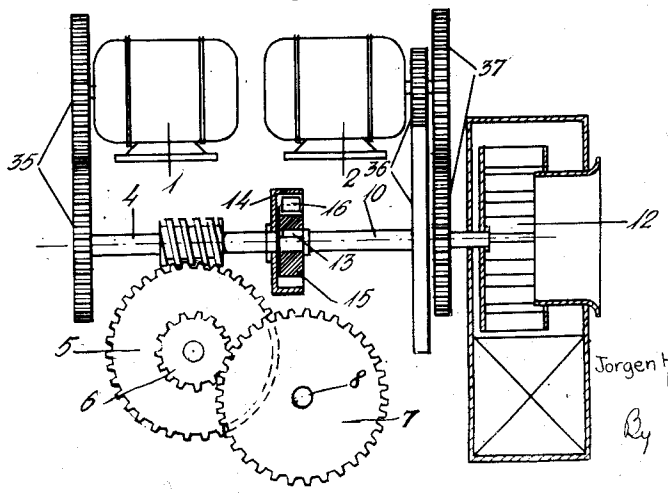


Fig. 4.



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Filed July 16, 1940 2 Sheets-Sheet 2

Fig. 5.

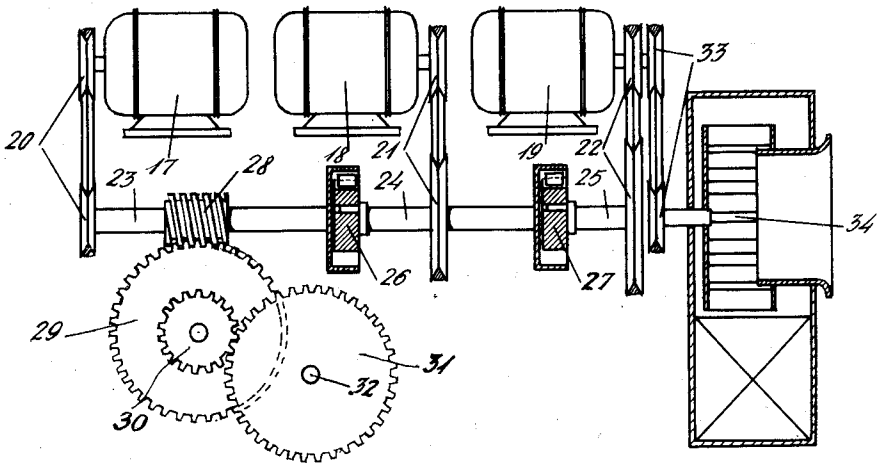


Fig. 6.

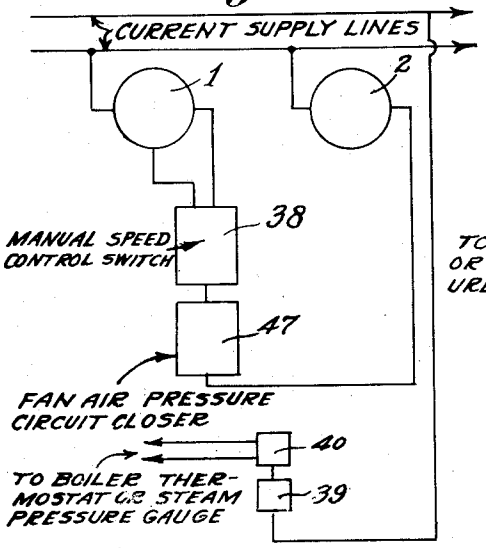


Fig. 7.

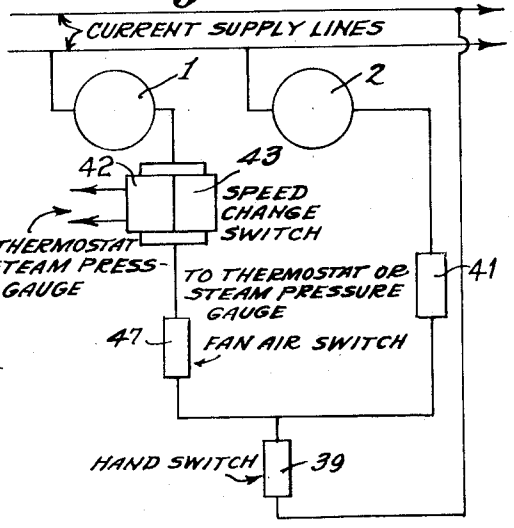
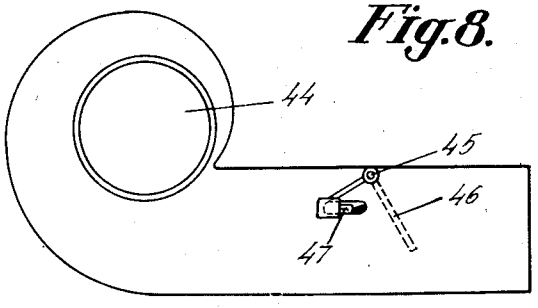


Fig. 8.



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Patented Aug. 22, 1944 2,356,590

UNITED STATES PATENT OFFICE

2,356,590

ELECTROMOTOR-DRIVEN MECHANICAL STOKER

Jörgen Helge Jacobsen, Hellerup, Denmark; vested in the Alien Property Custodian

Application July 16, 1940, Serial No. 345,866
In Denmark July 25, 1939

1 Claim. (Cl. 110—101)

This invention relates to improvements in mechanical stokers, particularly of the electric motor-driven type.

It is common practice for steam boilers and hot water boilers in apartment houses, schools, cottages and the like, and for industrial boilers to be fired by mechanical stokers, in which the fuel is charged into the furnace by means of a feeding device, and in which the combustion air is supplied under pressure from one or more fans to an air chamber located below or around, or both below and around the furnace grate.

The consumption of heat in most heating plants is subject to many variations while in operation, and for this reason adjustments of the fuel feeding member of the mechanical stoker are required during the day and/or night. For this purpose a manually operable gear operatively connected between the driving parts and the fuel feeding device of the stoker is generally employed. However, adjustments made by this means cannot in practice follow accurately the relatively large and frequent variations in the amount of heat required.

Further, in prior stoker installations, should the driving element, such as the electric motor, fail the stoker is rendered inoperative and the production of heat is stopped. Heretofore the only available relief from this stoppage was to provide the installation with one or more spare stokers which could be brought into operation when others failed. This is, of course, an extremely expensive and cumbersome arrangement.

The foregoing drawbacks are eliminated in the present invention by the provision in each installation of at least two electric driving motors, under the control of means such that the supply of fuel to the furnace may be adjusted either manually by electromagnetically operated equipment connected in the supply circuits of the motors, or automatically by electrically operated means responsive to the rise and fall of the temperature of the water and/or the rise and fall of the steam pressure in the boiler. Through the operation of the automatic means the stoker installation operates without any attention so as to provide the amount of heat required at any given moment. In addition, the automatic arrangement includes means whereby upon the failure of one of at least two electric driving motors, another one of the motors will be automatically and instantly brought into effective operation. While such an arrangement requires the provision of one or more additional driving motors, the expenditure for additional complete spare stokers is eliminated, together with the additional space and equipment which they require.

Figure 1 is an elevational view of a stoker driving arrangement employing two motors; Figures 2 and 3 illustrate detailed views of the free-wheeling device shown in Figure 1; Figure 4 illustrates an arrangement similar to that illustrated in Figure 1, but employing gear wheel drives instead of belts and pulleys; Figure 5 is a view similar to Figure 1, but with three instead of two motors; Figures 6 and 7 illustrate diagrammatically switches and circuits employed with the two-motor arrangement; and Figure 8 illustrates a switch arranged in the air duct leading from the fan to the stoker.

Referring to the accompanying drawings, Figure 1 is a diagrammatic and elevational view partly in section showing a stoker driving arrangement having two electric motors coupled singly and independently of each other to the stoker in a manner to act as the driving medium for the fuel feeding device and for at least one fan.

The numerals 1 and 2 designate the electric motors, with the motor 1 driving a worm shaft 4 through a pair of pulleys and a wedge belt 3. The worm shaft 4 drives one or more sets of gear wheels 6 and 7 by means of the worm wheel 5. The shaft 8 of the gear wheel 7 is connected to the fuel feeding device (not shown).

The electric motor 2 drives the shaft 10 by means of pulleys and a wedge belt 9, and the fan 12, by means of the belt 11 and pulleys shown. A known type of free wheeling device 13 is connected between the worm shaft 4 and the shaft 10. The free wheeling device consists of an external rim 14 fixed to the worm shaft 4, and a core 15 fixed to the shaft 10, with rollers 16 interposed therebetween to effect the transmission of power from the core to the rim.

When the motor 2 is driving the stoker and the motor 1 is deenergized, the shaft 10 drives the worm shaft 4 and thereby the fuel feeding device (not shown). This takes place because, as the motor 2 starts, the rollers 16 are pressed outwardly against the rim 14 by the core 15 and the corresponding shafts thereby become operatively connected.

If, instead of the motor 2, the motor 1 is started, the rate of revolution of the worm shaft 4 is higher because the gear ratio between motor 1 and the worm shaft 4 is greater than that between the motor 2 and the worm shaft 4. As the rim 14 thereby attains a higher rate of revolution than the core 15, the rollers 16 recede from the rim 14. This action of the free-wheeling de-

vice disconnects motor 2 and motor 1 alone is operatively connected to, and drives the fuel feeding device, while motor 2 alone drives the fan. It is evident, therefore, that the amount of fuel supplied to the furnace is dependent upon which of the motors is coupled to the fuel feeding device (not shown).

Figures 2 and 3 illustrate in detail the construction of the free-wheeling device 13. The numeral 14 designates the outer rim which is fixed to the worm shaft 4, the core 15 being fixed on the shaft 10, the rollers 16 being interposed between the rim and the core. When the core 15 is rotated in the direction of the arrow relative to the rim 14, the rollers 16 are driven along the oblique surfaces in the recesses of the core and become pressed against the rim so that the latter is turned along with the core, so that the two shafts become operatively connected and turn in the direction originated by the shaft 10. Whenever the rim 14 is rotated in the direction of the arrow at a higher speed than the core 15, the rollers 16 recede along the said oblique surfaces in a direction away from the rim 14, and the shafts 4 and 10 are disconnected and can rotate independently of each other. Free-wheeling couplings of the type described are well known in the art, and that described herein forms, per se, no part of the present invention.

Referring to Figure 4 of the drawings, the arrangement therein shown, involving two motors 1 and 2, corresponds in every essential respect with the arrangement of Figure 1, with the exception that gear wheel drives 35, 36 and 37 are used instead of the belts 3, 9 and 11 and attendant pulleys.

Figure 5 of the drawings shows an arrangement involving three electric motors designated 17, 18 and 19, respectively, which are operatively connected to corresponding shafts 23, 24 and 25 by means of wedge belts 20, 21 and 22, respectively, with free-wheeling devices 26 and 27 coupled between each two adjacent shafts.

The shaft 23 drives the worm wheel 29 by means of the worm 28, the worm wheel being connected through gear wheels 30 and 31 to the fuel feeding device (not shown) through shaft 32.

The motor 19 drives the combustion air fan 34 through the belt 33 and attendant pulleys. When only motor 19 is started it drives the fan 34 as well as the shaft 25, and through the free-wheeling devices 27 and 26, also the shafts 24 and 23, whereby the fuel feeding device is driven at low speed.

From the foregoing it is evident that by reason of the presence of the free wheeling devices 26 and 27, any of the three motors can, independently of each other, drive the fuel feeding device, at correspondingly different speeds depending upon the ratio of their operative connections to the corresponding shafts. In addition, the three motors can each have several speeds, thereby in effect providing the stoker with several additional selective speeds.

If it be desired to use more than three motors, the construction and manner of operation corresponds to that shown in Figure 5, with the exception that an additional free-wheeling device must be used for each extra motor.

In Figure 6, the numerals 1 and 2 designate the electromotors of which motor 1 may have two or more speeds. The device 38 can be an ordinary multiple point switch having several contacts enabling initially closing the circuit to the motor 1 and then changing over to the two or more different speeds of the motor 1. The device 38 is an ordinary switch by means of which the current supply to the motors 1 and 2 can be closed or opened, and the device 40 is ar automatic switch of conventional type reacting either to rising and falling water temperatures or to rising and falling steam pressures in the boiler fired by the stoker.

When the current supply is closed by manual operation of the switch 39, and the automatic switch 40 is closed, then the motor 2 is the first to start, and it drives the fuel feeding device at lowest gear ratio as well as the fan. If now the circuit to motor 1 is closed by means of the switch 38, then this motor, which drives the fuel feeding device at a higher speed than motor 2, will take care of the operation of the feeding apparatus, while motor 2 is automatically uncoupled from shaft 4 by means of the free wheeling device 13 (Figure 1), but continues to drive the fan. By adjusting the position of the switch 38, the speed of motor 1 may be increased to give to the fuel feeding device a still higher speed, while motor 2 continues to drive the fan. The switches 38 and 39 may be located remote from the fuel feeding device, in such a manner that stopping and starting as well as the gear changing of the fuel feeding device can be done by remote control.

Figure 7 shows an arrangement involving two motors 1 and 2, the first having two or more speeds. The numerals 41, 42 and 43 designate automatic switches of conventional type which react either to rising and falling water temperatures or to rising and falling steam pressures in the boiler fired by the stoker. When the stoker is started by manual closing of the switch 39, and the switch 41 is closed, the motor 2 will start, and drive the fuel feeding device at lowest gear ratio as well as the fan. By means of the switch 42 current is subsequently supplied to motor 1 which then by itself drives the feeding device at a higher speed, since the motor 2 is uncoupled automatically from the feeding device by means of the free wheeling device 13, but continues to drive the fan. By means of the switch 43 motor 1 may be run at one of its higher speeds, whereby the feeding device will run at a higher speed, while motor 2 continues to drive the fan.

The number of different speeds available for the stoker depends upon the number of motors provided in the driving arrangement and upon the number of speeds possessed by each motor. In the drawings, motor 1 is assumed to have two speeds and motor 2 one speed.

When the switch 43 is opened automatically, as at too high a water temperature for the heat requirements or at too high a steam pressure, then the higher speed circuit of motor 1 will be broken, while the low speed circuit of motor 1 is held closed by the switch 42, so that the stoker is operated at low speed. Upon any further rise of the water temperature or the steam pressure in the boiler, the switch 42 will break the connection to the lowest speed circuit of motor 1, and motor 1 will stop, after which motor 2 becomes coupled by means of the free wheeling device 13 to the fuel feeding device at the lowest gear ratio, whereat the motor 2 acts to drive the fuel feeding device as well as the fan. If then the water temperature or the steam pressure rises still higher, the switch 41 will automatically break the circuit to motor 2, whereupon the stoker stops entirely. Upon the falling of the water temperature or steam pressure responsive to rising con-

sumption of heat, the stoker is started in the lowest gear ratio by automatic switch **41**, and then automatic adjustments of the stoker will be produced successively, from a lower to a higher, and thence to a still higher gear ratio, as the switches **42** and **43** are closed successively.

If the stoker has three motors, as shown in Figure 5, the above described automatic switching arrangement will correspondingly close or break the circuits of the motors **17** and **18**, which drive only the fuel feeding device and not the fan. In all other respects the manner of operation with three or more motors is similar to that described above for two motors. The automatic switches **41**, **42** and **43** per se do not form parts of the present invention.

In the arrangement shown in Figure 1 involving two motors acting independently of each other through the free wheeling device **13**, the operation of the motors may be controlled by the automatic switches **41**, **42** and **43**, whereby there is obtained the advantage, not only that the stoker starts and stops automatically, but that the stoker automatically changes gear in such a manner that the speed of the fuel feeding device, and hence the rate of fuel supply, closely follows the variations in the heat requirements.

In the described arrangement, should motor **1** fail for any reason, the supply of fuel to the furnace will not stop, since in that case motor **2** automatically couples to the fuel feeding device through the free wheeling device **13** at lowest gear ratio, so that operation of the stoker continues in this gear ratio. Therefore, cessations in operation of the stoker occur less frequently so that the need for spare stokers is greatly reduced or eliminated.

In the arrangement of Figure 8 of the drawings, a switch is arranged in the air duct **44** leading from the fan of the stoker, consisting of a tilting or swinging device, for example a plate **46** which is fixed on a rotatable shaft **45** projecting into the air duct **44** and carrying on its outer end an electric contact **47** to close or break the circuit of the motor **1** exclusively driving the fuel feeding device but not the fan. In Figure 8 the switch **47** is shown as a mercury switch. In the position of rest, the plate **46** is in vertical position and the switch **47** is open. If, with the switch in this position, motor **2** is started, fan **12** will be operated, and the resultant air pressure in the air duct **44** will tilt the plate **46**, and thereby close the mercury switch **47**, so that current can reach the motor **1**.

By means of this arrangement cooperation is established between the operation of the fan and the operation of the fuel feeding device, since the motor **1** cannot drive the fuel feeding device unless the fan is running. Should the fan stop, when, for example, the fuses of the motor **2** blow out, the switch **47** breaks the circuit to motor **1**, and motor **1** is automatically stopped. Thus, by means of the switch **47** the supply of fuel to the furnace is halted whenever the amount of air required for combustion of the fuel is not supplied by the fan.

I claim:

In a driving arrangement for a mechanical stoker having fuel feed means and a fan, a first driving shaft, means for driving the fuel feed means from said first driving shaft, a first electromotor, permanent coupling means between said first electro-motor and said first driving shaft to drive said shaft at a predetermined minimum speed when said motor is running, a second driving shaft, a second electro-motor, permanent coupling means between said second electromotor and second driving shaft to drive the latter at a speed less than said minimum speed of said first driving shaft, a permanent coupling between said second electro-motor and said fan to drive the fan at a constant speed, and a free wheel coupling between said second driving shaft and said first driving shaft to drive the latter from the former when said first motor is not running.

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