Sept. 10, 1957 R. O. WEIHL 2,805,651

DEVICE TO CONTROL SMOKE

Filed Oct. 16, 1952

Fig. 1

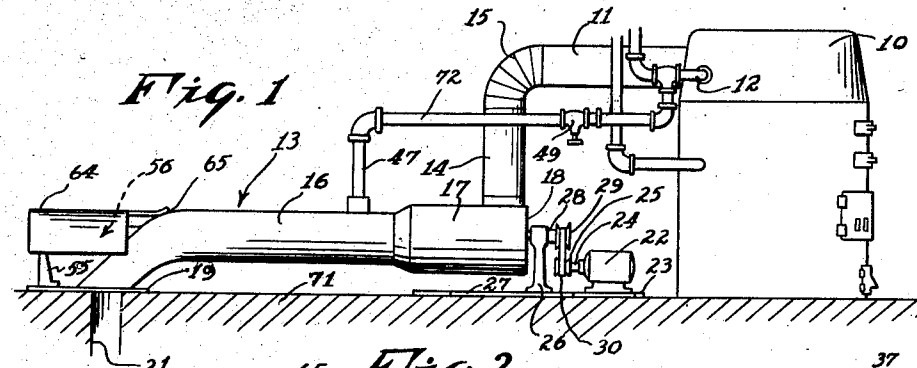


Fig. 2

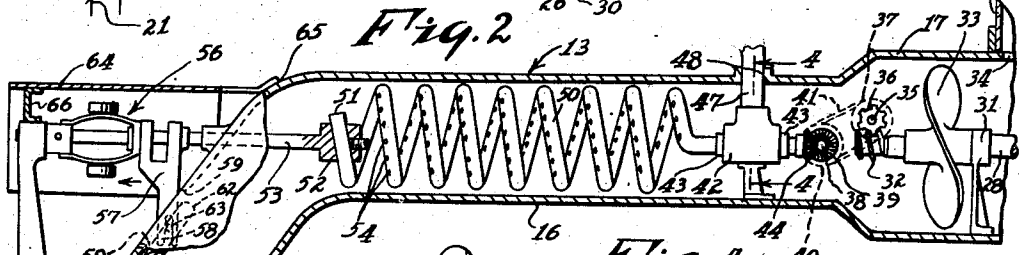


Fig. 3

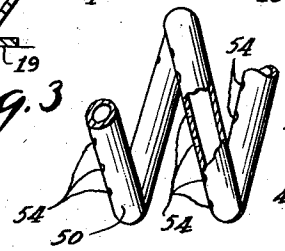


Fig. 4

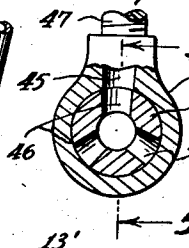


Fig. 5

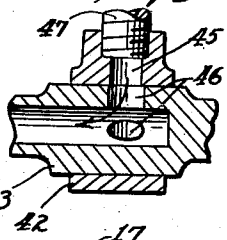


Fig. 6

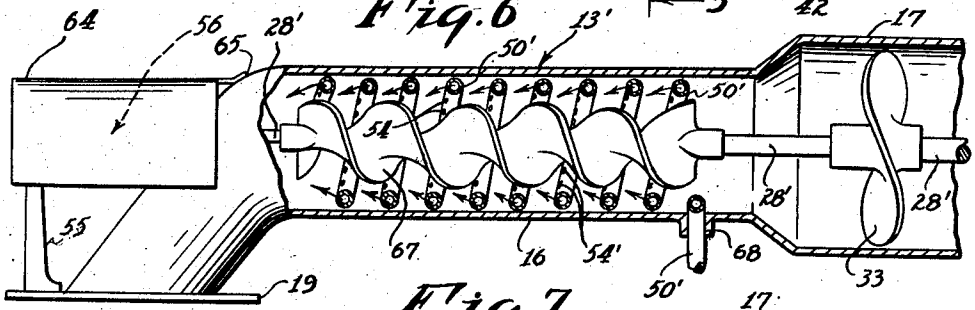
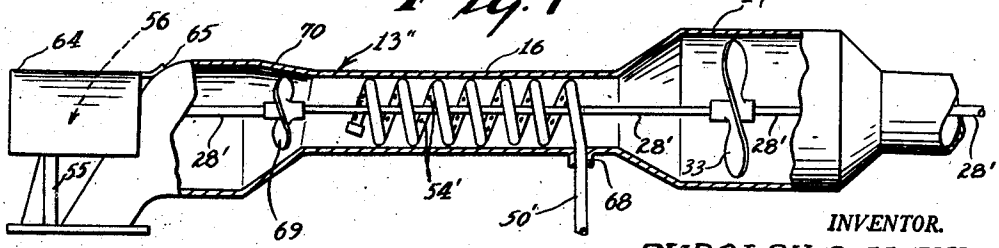


Fig. 7



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DEVICE TO CONTROL SMOKE

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9 Claims. (Cl. 122—379)

This invention relates to devices for controlling and eliminating smoke.

It is an object of the present invention to provide a device for controlling and eliminating smoke which includes means for introducing steam under high pressure into the smoke stream, the steam precipitating the soot and other coloring matter resulting from incomplete combustion of the fuel and leaving the clear gases to escape into a sewer, chimney and the like.

It is another object of the present invention to provide a device of the above type which includes means for intimately mixing the steam with the smoke stream and means for imparting a rapid movement of the resulting mixture through a smoke box to a sewer or the like.

It is still another object of the present invention to provide a device of the above type which includes automatic means for regulating the exit of the mixed smoke and steam to a sewer or the like.

It is still another object of the present invention to provide a device of the above type in which the aforesaid mixing, moving and regulating means are driven by a common source.

Other objects of the present invention are to provide a device for controlling and eliminating smoke bearing the above objects in mind which is of simple construction, has a minimum number of parts, is compact, easy to install and efficient in operation.

For other objects and for a better understanding of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a side elevational view of a device to control and eliminate smoke embodying the features of the present invention and shown in operative use with a steam furnace and utilizing a rotating steam coil;

Fig. 2 is a side elevational view of the device shown in Fig. 1 but shown partly in section to show the interior construction thereof;

Fig. 3 is an enlarged, fragmentary side elevational view of the steam coil injector shown partly in section to show the construction thereof;

Fig. 4 is a vertical sectional view of the steam coil inlet fitting and bearing support taken along line 4—4 of Fig. 2;

Fig. 5 is a vertical sectional view of said fitting and support taken along line 5—5 of Fig. 4;

Fig. 6 is a side elevational view of a modified form of the present invention where the steam coil is stationary shown partly in section to show the interior construction thereof; and

Fig. 7 is a side elevational view of a still further modified form of the present invention where a stationary steam coil is used along with a different smoke moving means, shown partly in section to show the interior construction thereof.

Referring more in detail to the drawing, in which similar reference characters designate corresponding parts

throughout the several views, there is shown in Figure 1 a steam furnace 10 having the usual smoke flue 11 and steam outlet 12.

There is also shown a smoke controlling and eliminating device, referred to collectively as 13, positioned alongside the furnace 10 and connected to the flue 11 by means of a vertically-extending flue 14 and an elbow 15, substantially as illustrated.

The device 13 includes an elongated smoke box 16 formed with an enlargement 17 at one end and extending downwardly toward concrete floor 71 at its other end, substantially as shown.

The enlargement 17 is closed at its outer end by a wall 18, while the other end of smoke box 16 is open and rests upon plate 19, the plate 19 having an opening 20 communicating with the open end of the smoke box and with a sewer conduit 21 leading to the sewer, not shown.

An electric motor 22 is mounted upon a base plate 23 intermediate the furnace 10 and smoke box 16 and includes the usual drive shaft 24 extending toward the wall 18. A pulley 25 is fixedly carried by the end of drive shaft 24.

A bearing support 26 is mounted upon a base plate 27 intermediate the end of drive shaft 24 and wall 18, the wall 18 having an opening aligned with the opening of bearing support 26.

A shaft 28 is rotatably mounted in bearing support 26, extending to smoke box 16 through the opening in wall 18 while the other end of shaft 28 rests above the end of drive shaft 24. A pulley 29 is fixedly carried by the outer end of shaft 28 in vertical alignment with motor pulley 25, and a friction belt 30 connects the two pulleys.

A second bearing support 31 is mounted within the enlargement 17 of the smoke box 16 and rotatably receives the inner end of shaft 28, as shown in Fig. 2, the shaft 28 continuing inwardly through the bearing support 31 to terminate near the inlet to the smoke box proper in a helically-threaded end 32. A blower propeller 33 is fixedly mounted upon shaft 28 intermediate the bearing support 31 and the end 32 and serves, when rotating, to draw smoke into the smoke box 16 from flue 14 through an opening 34 provided in the top of enlargement 17 and communicating with flue 14.

A transverse shaft 38 is rotatably mounted in one side of smoke box 16, extending inwardly to terminate at the central longitudinal axis of the smoke box. A bevel gear 39 is fixedly carried by the inner end of shaft 38 while the other end of shaft 38 fixedly carries a pulley 40 connected to pulley 37 by a friction belt 41.

A bearing member 42 is mounted on the bottom of the smoke box 16 alongside the gear 38, the bearing opening thereof being disposed along the central longitudinal axis of the smoke box. A hollow shaft 43 is rotatably positioned within bearing member 42, Figs. 4 and 5, extending outwardly therefrom at one end to terminate near the bevel gear 39. A seecond bevel gear 44 is fixedly carried by this end of shaft 43 and meshes with bevel gear 39.

The top of bearing member 42 is provided with a vertical opening 45 communicating with the hollow interior of shaft 43 by means of a plurality of radial openings 46 provided in shaft 43 below opening 45.

A high pressure steam pipe 47 connects with openings 45 through an opening 48 in the top of the smoke box 16, the pipe 47 being threaded into the top of bearing member 42, substantially as illustrated in Figs. 4 and 5.

The pipe 47 is suitably connected to the steam outlet pipe 12 of furnace 10 by means of a pipe 72, a valve 49 regulating the flow of steam therethrough, as shown

in Fig. 1. The steam can also be obtained from a separate source.

Referring to Fig. 2, it will be seen that a rotatable helical steam pipe **50** is suitably connected to the other end of shaft **43**, communicating with the hollow interior of the latter. The pipe **50** extends substantially the length of the smoke box proper and terminates in a closed end **51** fixedly connected to an enlargement **52** of a rotatable shaft **53** journalled in the downwardly extending end wall of smoke box **16**. The pipe **50** is provided with a plurality of spaced openings **54** extending substantially the length thereof, whereby to spray compressed steam from pipe **47** along the interior of the smoke box.

The other end of shaft **53** is rotatably mounted in a bearing member **55** of a centrifugal governor **56**, the governor **56** including a downwardly-extending arm **57** adapted to move in the direction of the arrow of Fig. 2 upon rotation of shaft **53** and operation of governor **56**. The lower end of arm **57** is provided with a slot **58** and extends into the smoke box **16** through an opening **59**, substantially as illustrated in Fig. 2, and for a purpose to be described directly.

A circular damper **60** is provided pivotally mounted and smoke tight upon a shaft **61** journalled in the sides of smoke box **16** directly above the opening **20** and is adapted to normally rest upon plate **19** whereby to close the outlet of the smoke box, as shown in Fig. 2. An upwardly-extending arm **62** is rigidly secured to damper **60** and fixedly carries a pin **63** adapted to ride the slot **58**. It will be noted that upon movement of the arm **57** in the direction of the arrow shown in Fig. 2, the pin **63** and arm **62** will be rotated outwardly whereby to open the damper **60**.

A suitable covering **64** is provided for the governor **56**, one end of which is secured to the smoke box **16** as at **65**, while the other end is mounted upon a bracket **66** secured to the top of bearing member **55**.

In operation, with the motor **22** turned on and steam valve **49** open, the drive shaft **24** of motor **22** rotates shaft **28** by means of pulleys **25** and **29** and friction belt **30**. The rotation of shaft **28** causes blower propeller **33** fixedly carried thereon to revolve, thus drawing smoke from flues **11** and **14** into the smoke box through opening **34** and blowing it toward damper **60**. Simultaneously, the rotation of shaft **28** and the helically-threaded end **32** thereof rotates reduction gear **36**, thus turning shaft **35** fixedly carrying the gear **36**, which motion rotates pulley **37** fixedly carried by the end of shaft **35**. The rotation of pulley **37** is transmitted to shaft **38** by means of pulley **40** and friction belt **41**, thus rotating bevel gear **39**. Rotation of bevel gear **39** is transmitted to hollow shaft **43** by means of bevel gear **44**.

During this operation, high pressure steam is carried from outlet **12**, through pipes **72** and **47** and discharged into opening **45**. As hollow shaft **43** rotates, this steam passes into the hollow interior thereof through openings **46**, whence it is carried along pipe **50** to be discharged therealong through outlets **54** to mix with the smoke passing through the smoke box. Simultaneously, the rotation of shaft **43** rotates the helical pipe **50** fixedly secured thereto at one end, thereby effecting a swirling motion of steam and smoke within the smoke box and bringing these two into more intimate contact with each other.

Rotation of pipe **50** causes shaft **53** to revolve, thus automatically putting the governor **56** into operation. Operation of governor **56** moves arm **57** in the direction of the arrow, thus rotating pin **63** and arm **62** outwardly to open the damper **60**, permitting the smoke and steam mixture to escape through opening **20** to a sewer, chimney or other disposal unit.

The steam precipitates the soot and other objectionable coloring matter in the smoke resulting from incomplete combustion of the fuel in furnace **10** and carries them to the sewer where they become a part of the drainage, while the clear gases escape into the atmosphere. This steam will also tend to cleanse the sewer.

It will be understood that while I have shown my device in operative use with a steam boiler furnace, it is equally applicable to all forms of combustion units where it is desired to eliminate smoke. It will also be understood that my device may be made into a unitary structure which may be inserted in chimneys and smoke stacks and as a unit without departing from the scope of the present invention.

I have found that the addition of lye to the steam line will more effectively cut the smoke and produce the best results. This lye is particularly effective with smoke resulting from the combustion of oil and keeps the steam holes clear.

When the furnace **10** is shut down, the device is turned off by closing the valve **49** and turning off the motor **22**. This causes the moving parts to become stationary, including the shaft **53**. When shaft **53** stops rotating, the operation of the governor **56** automatically ceases and arm **57** returns to its original position, thus closing damper **60**.

Referring now particularly to Fig. 6, there is shown a modified form of the present invention, referred to collectively as **13'**, and differing from the first form in the means for swirling the steam and smoke together.

In this form of the invention the shafts **53** and **28** of the first form are integrally connected in the form of an elongated shaft **28'** which fixedly carries a helical screw **67**, substantially as illustrated in Fig. 6. A stationary, helical steam pipe **50'** surrounds the screw **67** and extends substantially the length of the smoke box **16**, the pipe **50'** entering the smoke box through an opening **68** therethrough, and being suitably connected to the steam outlet **12** of furnace **10**, as in the first form. The pipe **50'** is provided with a plurality of openings **54'** which eject high pressure steam into the interior of the smoke box.

In other respects, the form of the invention shown in Fig. 6 is the same as that illustrated in Figs. 1 through 5, and like reference numerals identify like parts in each of the several views.

In operation of the form shown in Fig. 6, with the motor **22** turned on and valve **49** open, the drive shaft **24** rotates shaft **28'** causing blower propeller **33** fixedly carried thereon to revolve, thus drawing smoke from flues **11** and **14** into the smoke box through opening **34** and blowing it toward damper **60**. Simultaneously, the rotation of shaft **28'** also causes helical screw **67** fixedly carried thereon to revolve, thus intimately mixing steam escaping from openings **54'** with smoke passing through the smoke box and also shooting or forcing the mixture towards damper **60**. In other respects, the operation of this form is the same as the first form, with governor **56** being actuated upon rotation of shaft **28'** to open the damper **60**, and automatically closing the latter when shaft **28'** comes to rest.

Referring now particularly to Fig. 7, there is shown a further modified form of the present invention, referred to collectively as **13''**, and differing from the second form in the removal of helical screw **67** from shaft **28'** and in the provision of an exhaust blower propeller **69** located within a second enlargement **70** formed in the other end of smoke box **16**.

In other respects, the form of the invention shown in Fig. 7 is the same as that shown in Figs. 1 to 6 and like reference numerals identify like parts in each of the several views.

The operation of this form is the same as that shown in Fig. 6, with the exception that the smoke passing through smoke box **16** is mixed with the steam escaping from openings **54'** solely by the kinetic energy of the

latter, the resulting mixture being further propelled toward damper **60** by the rotation of the exhaust propeller **69**.

While various changes may be made in the detail construction, it shall be understood that such changes will be within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, blower means within said smoke box near said inlet, means for operating said blower means, an outlet at the other end of said smoke box, a damper adapted to close said outlet, governor means driven by the means operating said blower means for opening said damper, a steam pipe disposed longitudinally within said smoke box and extending substantially the length thereof, said pipe having a plurality of openings therealong, an inlet at the end of said pipe nearest said blower means and means for feeding steam into said pipe inlet.

2. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, blower means within said smoke box near said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, governor means driven by the means operating said blower for opening said damper, a substantially helical steam pipe rotatably mounted within said smoke box, said pipe extending longitudinally substantially the length of said smoke box, said pipe having a plurality of openings therealong, an inlet at the end of said pipe adjacent said blower means, means for feeding steam into said pipe inlet, and common means driving said blower means, damper opening governor means and rotatable pipe.

3. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, blower means within said smoke box near said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, means for opening said damper, a substantially helical screw rotatably mounted within said smoke box and connected to the blower means to be driven thereby, said screw extending longitudinally substantially the length of said smoke box, a substantially helical steam pipe surrounding said screw and freely spaced therefrom, said pipe having a plurality of openings therealong, an inlet at the end of said pipe nearest said blower means, means for feeding steam into said pipe inlet, and said damper opening means being connected to said helical screw to be operated by the same.

4. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, blower means within said smoke box near said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, means for opening said damper, second blower means within said smoke box near said outlet, a substantially helical steam pipe disposed longitudinally within said smoke box intermediate said first and second blower means and extending substantially the length of said smoke box, said pipe having a plurality of openings therealong, an inlet at the end of said pipe nearest said first blower means, means for feeding steam into said pipe inlet, and said damper opening means connected to the second blower means to be operated by the same.

5. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, a first shaft rotatably mounted in the end of said smoke box below said inlet, said shaft extending inwardly and outwardly of said end, means external of said smoke box for driving said first shaft, a blower propeller fixedly carried by said first shaft within said smoke box and

below said inlet, a bearing member within said smoke box near said inlet and propeller, a hollow shaft rotatably mounted within said bearing member, said hollow shaft being closed at its end adjacent said first shaft, means for connecting said first shaft to said hollow shaft to thereby drive the same, said bearing member having an opening therein, said hollow shaft having a plurality of radial openings adapted to register with the opening in said bearing member, means for feeding steam into said bearing member, an outlet at the other end of said smoke box, a damper adapted to close said outlet, a second shaft rotatably mounted in the other end of said smoke box above said outlet and damper, said second shaft extending inwardly and outwardly of said other end and being axially aligned with said hollow shaft and connected thereto to be driven thereby, a governor mechanism mounted upon the outer end of said second shaft and externally of said smoke box to be driven by the second shaft, means for connecting said governor mechanism with said damper to open said damper upon rotation of said second shaft, a substantially helical steam pipe extending substantially the length of said smoke box and an inlet at the end of said pipe adjacent said bearing member, said inlet being fixedly connected to the open end of said bearing member, said pipe at the other end thereof being fixedly connected to the inner end of said second shaft, said pipe having a plurality of openings therealong.

6. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, an elongated shaft rotatably mounted in the ends of said smoke box, said shaft extending outwardly of said smoke box at each end thereof, means external of said smoke box for driving said shaft, a blower propeller fixedly carried by said shaft within said smoke box and below said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, a governor mechanism mounted on the end of said shaft external of said smoke box and adjacent said outlet and damper, means for connecting said governor mechanism to said damper to open said damper upon rotation of said shaft, a substantially helical screw fixedly carried by said shaft within said smoke box, said screw extending longitudinally substantially the length of said smoke box, a substantially helical steam pipe surrounding said screw and freely spaced therefrom, said pipe having a plurality of openings therealong, an inlet at the end of said pipe adjacent said propeller and means for feeding steam to said helical pipe inlet.

7. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which smoke flue is adapted to discharge the smoke, an elongated shaft rotatably mounted in the ends of said smoke box, said shaft extending outwardly of said smoke box at each end thereof, means external of said smoke box for driving said shaft, a blower propeller fixedly carried by said shaft within said smoke box and near said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, a governor mechanism mounted on the end of said shaft external of said smoke box and adjacent said outlet and damper, means for connecting said governor mechanism to said damper to open said damper upon rotation of said shaft, an exhaust propeller fixedly carried by said shaft within said smoke box near said outlet, a substantially helical steam pipe extending substantially the length of said smoke box intermediate said propellers, said pipe having a plurality of openings therealong, an inlet at the end of said pipe nearest said blower propeller and means for feeding steam into said pipe inlet.

8. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, a shaft rotatably mounted in the end of said smoke box be-

low said inlet, said shaft extending inwardly and outwardly of said end, means external of said smoke box for driving said first shaft, a blower propeller fixedly carried by said first shaft within said smoke box and below said inlet, a bearing member within said smoke box near said inlet and propeller, a hollow shaft rotatably mounted within said bearing member, said hollow shaft being closed at its end adjacent said first shaft, means for connecting said first shaft to said hollow shaft to drive the same thereby, said bearing member having an opening therein, said hollow shaft having a plurality of radial openings adapted to register with the opening in said bearing member, means for feeding steam into said bearing member, an outlet at the other end of said smoke box, a damper adapted to close said outlet, a second shaft rotatably mounted in the other end of said smoke box above said outlet and damper, said second shaft extending inwardly and outwardly of said other end and connected with said hollow shaft to be driven thereby, a governor mechanism external of said smoke box mounted upon said second shaft, means for connecting said governor mechanism with said damper adapted to open said damper upon rotation of said second shaft, a substantially helical steam pipe extending substantially the length of said smoke box, and an inlet at the end of said pipe adjacent said bearing member, said inlet being fixedly connected to the open end of said bearing member, said pipe at the other end thereof being fixedly connected to the inner end of said second shaft, said pipe having a plurality of openings therealong, said means for connecting said governor mechanism to said damper comprising a downwardly extending arm slidably mounted upon said second shaft at its upper end and in operative engagement with said governor mechanism, said arm at its lower end having a slot, said smoke box above said damper having an opening adapted to receive said arm and slot, said damper being pivotally mounted above said outlet, an upwardly extending second arm rigidly connected to said damper, and a pin rigidly connected to said second arm and adapted to ride said slot.

9. A smoke control device comprising an elongated smoke box, an inlet at one end of said smoke box into which a smoke flue is adapted to discharge the smoke, an

elongated shaft rotatably mounted in the ends of said smoke box, said shaft extending outwardly of said smoke box at each end thereof, means external of said smoke box for driving said shaft, a blower propeller fixedly carried by said shaft within said smoke box and below said inlet, an outlet at the other end of said smoke box, a damper adapted to close said outlet, a governor mechanism mounted on the end of said shaft external of said smoke box and adjacent said outlet and damper, means for connecting said governor mechanism to said damper and adapted to open said damper upon rotation of said shaft, a substantially helical screw fixedly carried by said shaft within said smoke box, said screw extending longitudinally substantially the length of said smoke box, a substantially helical steam pipe surrounding said screw and freely spaced therefrom, said pipe having a plurality of openings therealong, an inlet at the end of said pipe adjacent said propeller and means for feeding steam into said pipe inlet, said means for connecting said governor mechanism to said damper comprising a downwardly extending arm slidably mounted upon said second shaft at its upper end and in operative engagement with said governor mechanism, said arm at its lower end having a slot, said smoke box above said damper having an opening adapted to receive said arm and slot, said damper being pivotally mounted above said outlet, an upwardly extending second arm rigidly connected to said damper, and a pin rigidly connected to said second arm and adapted to ride said slot.

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