Nov. 9, 1965 R. E. CHAPPELL 3,216,046

LONG TRAVEL SOOT BLOWER WITH TELESCOPIC FEED TUBE

Filed June 5, 1963 3 Sheets-Sheet 1

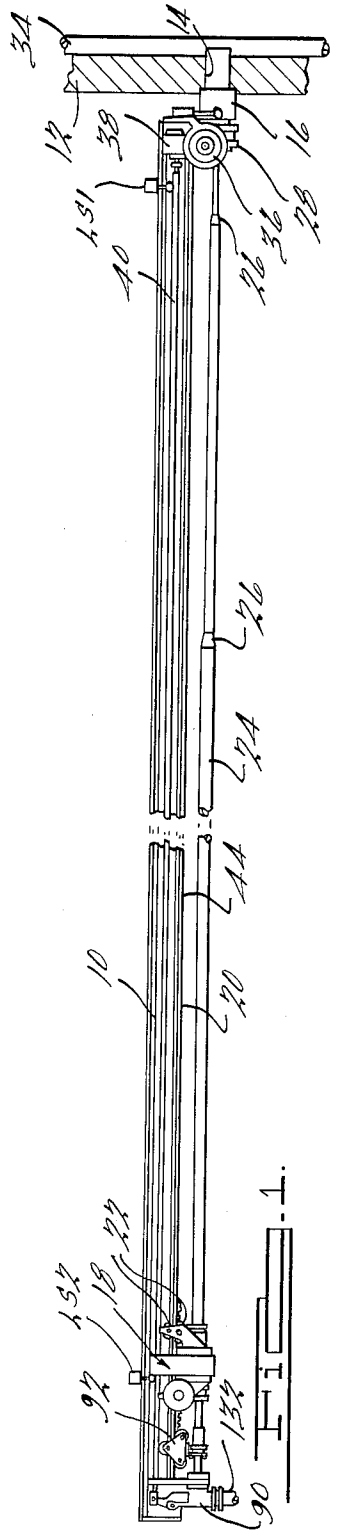

Fig. 1.

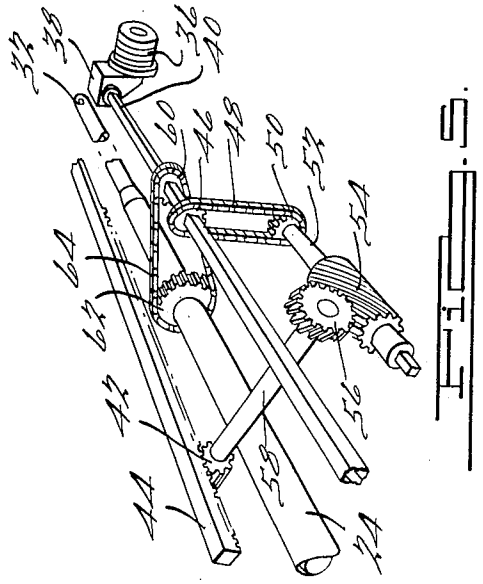

Fig. 5

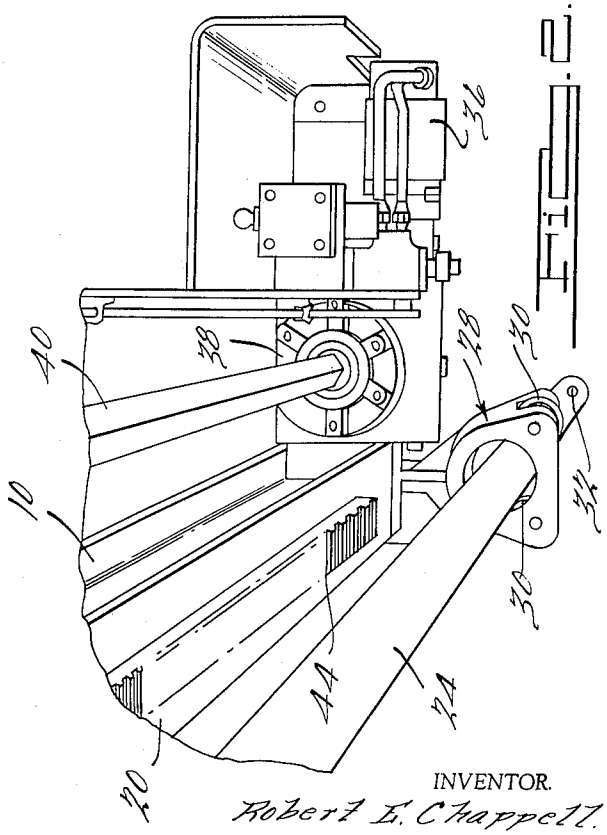

Fig. 2

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LONG TRAVEL SOOT BLOWER WITH TELESCOPIC FEED TUBE

Filed June 5, 1963 3 Sheets-Sheet 2

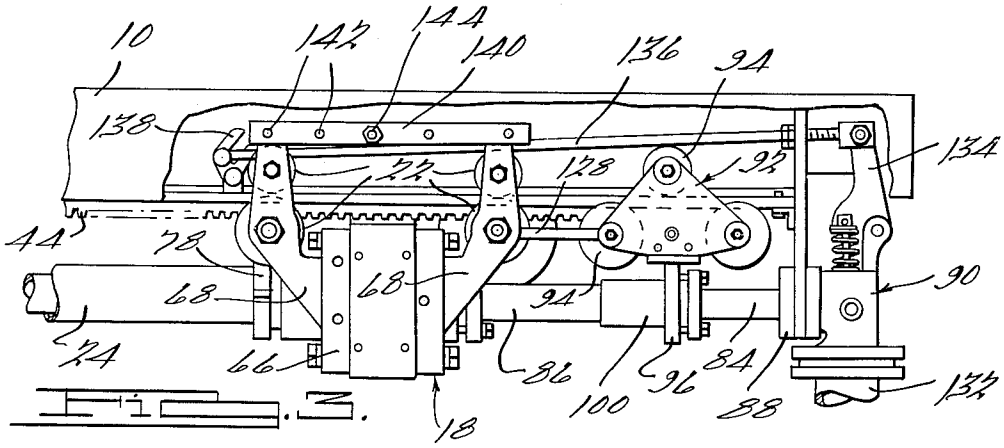

Fig. 3.

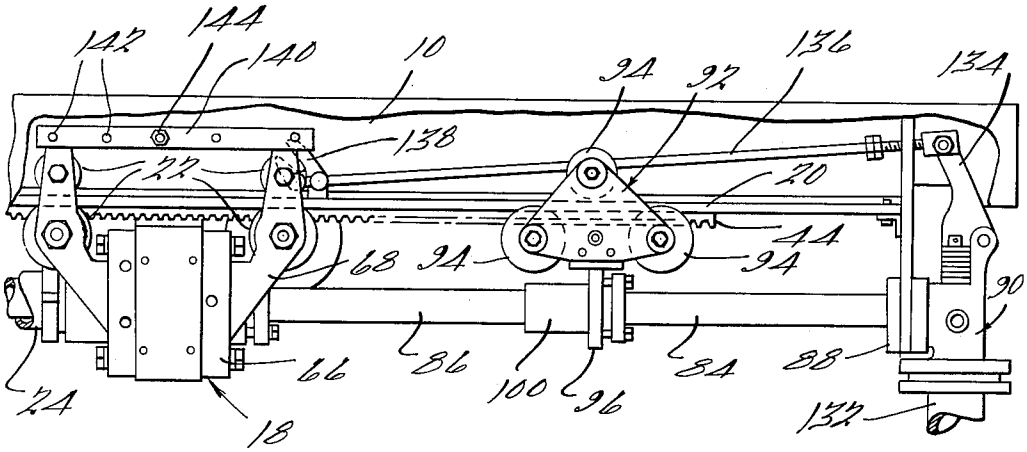

Fig. 4.

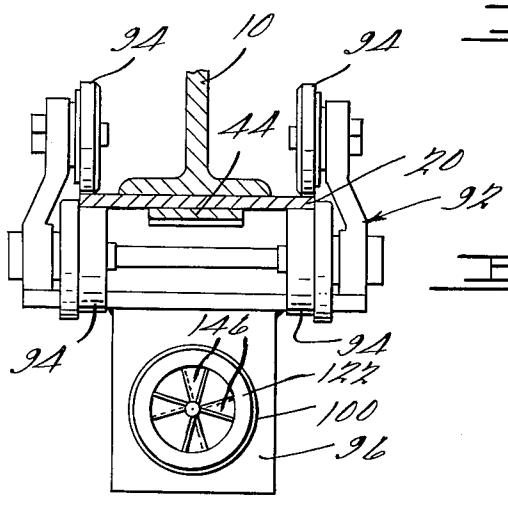

Fig. 2.

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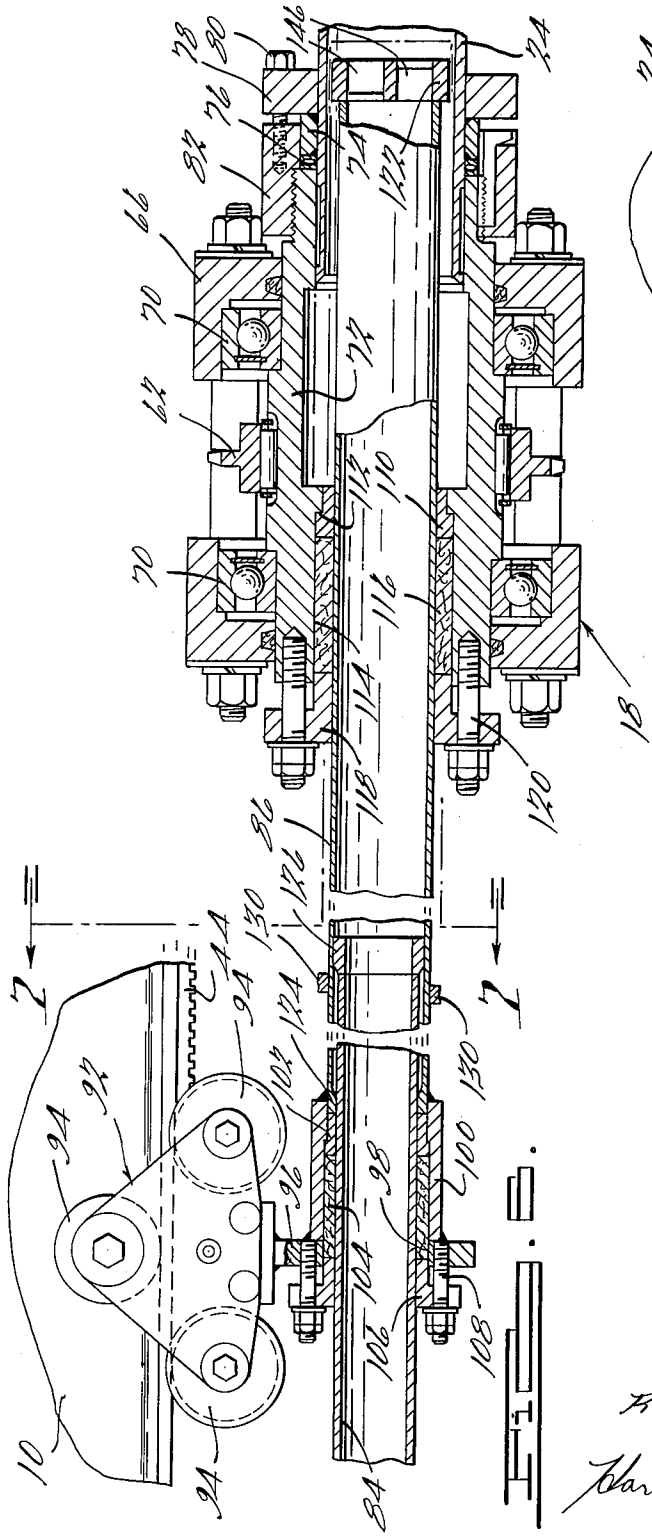
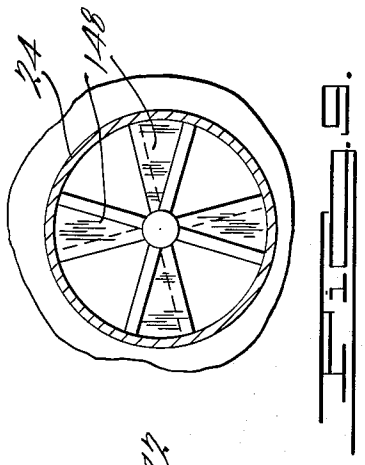
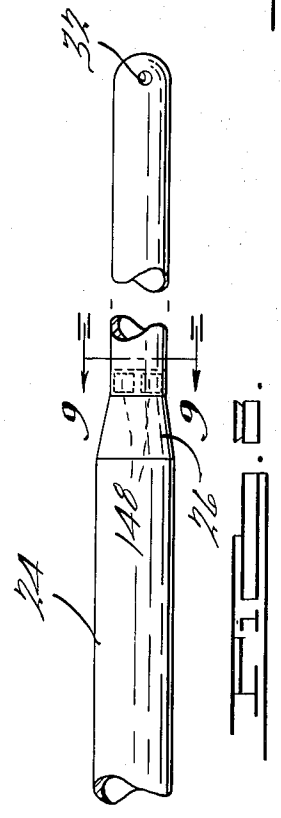
LONG TRAVEL SOOT BLOWER WITH TELESCOPIC FEED TUBE

Filed June 5, 1963 3 Sheets-Sheet 3







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United States Patent Office 3,216,046 Patented Nov. 9, 1965

3,216,046

LONG TRAVEL SOOT BLOWER WITH TELESCOPIC FEED TUBE

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Filed June 5, 1963, Ser. No. 285,793
11 Claims. (Cl. 15—317)

The present invention broadly relates to apparatuses for cleaning the surfaces of heat exchangers and more particularly to an improved cleaning apparatus or soot blower of the long retracting type for use in high capacity power boilers and the like which incorporates therein a telescopic feed tube for supplying a high pressure blowing medium to a lance tube formed with nozzles in the forward end portion thereof through which the blowing medium is discharged against the heat exchanger surfaces to be cleaned.

Cleaning apparatuses or soot blowers, as they are conventionally referred to, are in widespread use in industry for effecting a removal of soot, slag, and other extraneous deposits from the surfaces of heat exchanger apparatuses of various types. Soot blowers of the so-called long-retracting or long-travel type comprise an elongated cleaning or lance tube which is adapted to be disposed exteriorly of and in alignment with a wall port in the wall of a heat exchanger apparatus and is movable from a retracted inoperative position wherein the forward or the nozzle end of the lance tube is disposed within the wall port to a projected cleaning position within the interior of the boiler during which time a high pressure blowing medium such as steam or air, for example, is discharged from one or a plurality of nozzles formed in the forward end portion of the lance tube. The lance tube conventionally is rotated during its projecting and retracting travel whereby the blowing medium is discharged in the form of a helical blowing pattern. The impingement of the blowing medium against the heat exchanger surfaces effects a dislodgement and removal of the soot, slag and other deposits therefrom thereby maintaining a high level of thermal efficiency of the boiler.

Increases in the size and capacity of modern high pressure power boilers have necessitated corresponding in the length of long-retracting type soot blowers in order to obtain adequate cleaning coverage of the tube banks including the pendant-type superheater and reheater bundles disposed within the interior of the boiler. The increases in the size and length of the lance tubes employed in such soot blowers have caused increasing problems as a result of increased heat absorption of the lance tubes when projected in the cleaning position as well as increases in their gravitational deflection or bending increasing their tendency to buckle. The increased gravitational deflection of the lance tube is further undesirable due to the arcuate path of travel of the nozzle end portion of the lance tube resulting in a lack of uniformity in the cleaning action thereof and in some instances producing actual physical interference with the heat exchanger surfaces. Various techniques have heretofore been used or proposed for use to overcome one or more of these problems which have not found widespread acceptance due to the creation of other problems attending their use.

It has been found that by employing a stepped lance tube comprising a series of integrally connected tubular sections of progressively smaller diameter on moving toward the nozzle end of the lance tube, significant improvements are achieved in the strength and rigidity of the lance tube and a reduction in the weight thereof, particularly at the outermost end thereof. The use of a stepped lance tube further decreases the total peripheral

surface area of the lance tube resulting in a proportional reduction in the quantity of heat absorbed thereby during a cleaning operation which enables a corresponding reduction in the quantity of blowing medium employed above that is necessary for the cleaning function to effect a cooling of the lance tube and maintain it within reasonable operating temperature levels.

The maximum benefits however derived from employing a stepped lance tube have heretofore been unattainable due to the necessity of having the smallest section thereof of a size greater than desirable to provide adequate internal clearance for a stationary feed tube telescopically disposed therein for supplying a pressurized blowing medium to the interior of the lance tube. Corresponding reductions in the diameter of the fixed feed tube to accommodate the use of a stepped lance tube has resulted in an excessively high pressure drop of the blowing medium supplied therefrom. A high pressure drop in the blowing medium is particularly objectionable when air is employed as the blowing medium due to the necessity of using relatively costly and complex compressor apparatus for supplying the requisite quantity of pressurized air at the increased pressure level to compensate for the pressure loss incurred.

In long-retracting type soot blowers of considerable length, the gravitational deflection of the feed tube within the lance tube has further aggravated the tendency of the feed tube to seize and bind within the lance tube during the relative translatory and rotary movement of the lance tube around the feed tube. This has required the use of still greater clearances between the peripheral surface of the feed tube and the inner surfaces of the lance tube to avoid seizure and galling. In some instances, it has been found necessary to apply a hard surface coating such as a chromium plating on the peripheral surface of the feed tube and/or the inner surface of the lance tube to minimize seizure therebetween.

It is accordingly a principal object of the present invention to provide an improved soot blower of the long-retracting type which overcomes the problems and disadvantages of soot blowers of similar type heretofore known.

Another object of the present invention is to provide an improved long-retracting type soot blower incorporating a stepped lance tube which minimizes gravitational deflection of the lance tube and increases its strength and resistance to buckling while simultaneously incorporating means for supplying a pressurized blowing medium thereto without encountering any mechanical interference therebetween.

Still another object of the present invention is to provide an improved long-retracting type soot blower incorporating a stepped lance tube in which a telescopic feed tube is telescopically mounted providing for a continuous supply of a high pressure blowing medium to the interior of the lance tube without sustaining an objectionable degree of pressure drop in the supply of the blowing medium to the interior of the lance tube.

A further object of the present invention is to provide an improved soot blower of the long-retracting type including a telescopic feed tube which is formed with means therein for imparting a controlled degree of turbulence to the blowing medium on discharge into the lance tube increasing the removal of heat therefrom and maintaining the lance tube at a lower operating temperature.

A still further object of the present invention is to provide an improved soot blower of the long-retracting type comprising a stepped lance tube and a telescopically mounted telescopic feed tube and wherein means are provided in the forward end portion of the lance tube for imparting increased turbulence to the blowing medi-

um effecting a significant reduction in the operating temperature of the lance tube.

Yet still another object of the present invention is to provide an improved soot blower of the long-retracting type which is of simple design, of durable operation, of versatile use, and of economical manufacture and operation.

The foregoing and other objects and advantages of the present invention are achieved by employing a longitudinally stepped lance tube comprising a plurality of sections of progressively decreasing diameter and wherein the outermost or forward section is formed with one or a plurality of nozzles therein for discharging a pressurized blowing medium such as steam or air against the heat exchanger surfaces traversed by the lance tube. The pressurized blowing medium is supplied to the interior of the stepped lance tube by a telescopic feed tube comprising a plurality of sections telescopically disposed within the lance tube and with the outlet thereof disposed in constant communication with the interior of the lance tube. In the preferred form of the present invention, means are provided adjacent to the outlet of the telescopic feed tube and/or within the interior of the lance tube for imparting turbulence to the blowing medium discharged into the lance tube effecting a substantial improvement in the removal of heat therefrom with corresponding lower lance tube operating temperatures.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a side elevationl view of a long-retracting type soot blower constructed in accordance with the preferred embodiments of the present invention and mounted in longitudinal alignment with a wall port in the wall of a boiler;

FIGURE 2 is a fragmentary perspective view of the forward end portion of the soot blower shown in FIGURE 1;

FIGURE 3 is a fragmentary side elevational view of the outer end portion of the soot blower with the carriage and lance tube in the fully retracted position;

FIGURE 4 is a fragmentary side elevational view of the outer end portion of the soot blower wherein the carriage and lance tube have been advanced toward the projected position and during which movement the supply valve has been actuated;

FIGURE 5 is a schematic perspective view partly in section, illustrating the drive means for effecting translatory and rotative movement of the lance tube;

FIGURE 6 is a fragmentary side elevational view partly in section illustrating the mounting of the telescopic feed tube and the rotary supporting means for the lance tube;

FIGURE 7 is a transverse vertical sectional view through the supporting rail and elevation view of the end of the feed tube of the soot blower shown in FIGURE 6 and taken substantially along the line 7—7 thereof;

FIGURE 8 is a fragmentary side elevational view of the forward end portion of the stepped lance tube; and

FIGURE 9 is a transverse sectional view through the forward end portion of the lance tube shown in FIGURE 8 and taken along the line 9—9 thereof.

Referring now in detail to the drawings and as may be best seen in FIGURES 1 and 2, a long-travel or long-retracting type soot blower to which the present invention is applicable, comprises guide means such as a rail **10** which is of an I-shaped cross section and which is positioned exteriorly of a wall **12** of a heat exchanger apparatus or boiler. The wall **12** is provided with an opening indicated at **14** in which a wall box **16** is installed. A track plate **20** is affixed to the underside of the rail **10** on which a carriage **18** is movably and guidably supported such as by means of rollers **22**, which are disposed in rolling bearing contact on the longitudinal edges of the track plate. A lance tube **24** is rotatably supported at the rearward end thereof by the carriage **18** and extends therefrom in a direction in alignment with the wall box **16**.

As best seen in FIGURES 1 and 8, the lance tube **24** comprises a plurality of sections of progressively decreasing diameter on moving from the carriage to the forward or nozzle end thereof which are rigidly interconnected by conical tapered joints indicated at **26**. The forward end portion of the lance tube **24** is rotatably and movably supported by suitable supporting means such as a roller bracket **28** as best seen in FIGURE 2 which is connected to and depends from the forward end of the rail **10**. The roller bracket **28** incorporates a pair of rollers **30** which are disposed in rolling sliding engagement with the periphery of the lance tube enabling translatory and rotary movement of the lance tube during its movement to and from the retracted position as shown in solid lines in FIGURE 1 to a fully projected position in which the carriage **18** is positioned at the forward end portion of the rail **10** adjacent to the wall **12** of the boiler. When lance tubes of a substantial length are employed, it is also contemplated within the scope of the present invention that intermediate supports similar to the roller bracket **28** can be movably supported from the track plate **20** to support the lance tube at points intermediate the ends thereof.

The forward end of the lance tube **24** is slidably disposed within the wall box **16** as shown in FIGURE 1 which conventionally incorporates suitable sealing means (not shown) for preventing the escape of the hot combustion gases from within the interior of the boiler out through the wall port. When in the fully retracted position, the forward or nozzle end of the lance tube **24** which is formed with one or a plurality of nozzles **32** as shown in FIGURES 2 and 8, is retracted within the wall box **16** and shielded from the direct radiant heat present in the interior of the boiler. At the initiation of the operation of the soot blower, the lance tube commences to rotate and is advanced from the fully retracted position shown in FIGURE 1 outwardly toward the projected position. The discharge of the blowing medium from the nozzle **32** in the forward end of the lance tube is delayed until the lance tube has traveled to a position slightly beyond the water wall tubes **34** as indicated in FIGURE 1, which are positioned along the inner surface of the walls **12** of the boiler. Similarly, the discharge of the blowing medium from the nozzles is halted prior to the completion of the retracting movement of the lance tube when the nozzles approach a position spaced from the water wall tubes **34** to avoid direct close range impingement of the blowing medium thereagainst which may result in excessive erosion thereof. The controlled supply of blowing medium to the interior of the lance tube will subsequently be described in detail.

The movement of the carriage **18** and the lance tube **24** to and from the retracted and projected positions as well as the rotation of the lance tube during its translatory movement is achieved in accordance with the drive means as exemplarily shown in FIGURES 2, 5 and 6. As shown in these drawings, a suitable reversible motor **36** is mounted adjacent to the forward end of the rail **10** and is drivingly connected to a gear box **38** to the output shaft of which a suitable elongated drive shaft **40** is coupled, which is of an irregularly shaped cross section such as a square cross section, for example. The drive shaft **40** extends for substantially the entire length of the rail **10** and is coupled to a driven member on the carriage **18** which is formed with a correspondingly contoured irregular bore therethrough for slidably receiving and rotatably engaging the drive shaft. The reversible motor **36** may be either of a fluid actuable type such as an air or hydraulic motor or alternatively may comprise a reversible electric motor. It is also contemplated within

the scope of the present invention that in lieu of employing a stationarily mounted motor coupled to a drive shaft **40**, the reversible motor can be directly mounted on the carriage **18** and supplied with the pressurized actuating fluid through suitable flexible conduits or with electricity through flexible conductors, as desired.

In the exemplary embodiment as illustrated in FIGURES 2, 5 and 6, the translatory movement of the carriage **18** and the lance tube rotatably supported thereby is achieved through the coaction of a pinion **42** on the carriage disposed in constant meshing relationship with a rack **44** affixed to the underside of the track plate **20** and extending centrally thereof for substantially the entire length of the rail. In accordance with the schematic arrangement shown in FIGURE 5, driving rotation of the pinion **42** is achieved by a sprocket **46** slidingly coupled to the drive shaft **40** which is drivingly coupled by means of a chain **48** to a driven sprocket **50** on a shaft **52** formed with a worm **54**. The worm **54** in turn is disposed in constant meshing relationship with a worm wheel **56** affixed to the end of a cross shaft **58** to which the pinion **46** is secured.

Rotation of the lance tube during its translatory movement is achieved by a drive sprocket **60** disposed in sliding engagement on the drive shaft **40** which is drivingly connected to a driven sprocket **62** on the lance tube by means of a continuous chain **64**. In accordance with the arrangement as schematically shown in FIGURE 5, energization and rotation of the reversible drive motor **36** in one direction effects movment of the lance tube outwardly and rotation thereof in one direction which, upon attaining the fully projected position, actautes a suitable forward limit switch LS1 (FIG. 1) which in turn effects a reversal in the direction of rotation of the drive motor producing a corresponding reversal in the direction of rotation of the lance tube and initiating its retracting movement toward the fully retracted position. When the carriage and lance tube attain the fully retracted position, a second limit switch LS2 (FIG. 1) signals the control circuit and deenergizes the drive motor halting the soot blower in the fully retracted position preparatory to its next operating cycle.

The structural components of the carriage **18** by which the outer end of the lance tube **24** is rotatably mounted in the carriage is best shown in FIGURE 6. As shown in this figure, the carriage **18** comprises a housing **66** to which the roller arms **68** (FIGURES 3 and 4) are rigidly secured for supporting the carriage on the track plate. The housing incorporates a pair of thrust roller bearings **70** for rotatably supporting a cylindrical tubular hub **72** to the forward end of which the lance tube **24** is securely fastened. The lance tube **24** is formed with a collar **74** securely affixed to the peripheral surface thereof, which is maintained in clamped relationship against a seal **76** disposed along the forward edge of the hub **72** by means of a collar **78** connected by means such as bolts **80** to a nut **82** threadably fastened to the forward end of the hub. The driven sprocket **62** as previously described in connection with FIGURE 5 is affixed to the mid point of the cylindrical hub **72** as shown in FIGURE 6 for effecting rotation of the lance tube during its projecting and retracting travel.

The interior of the lance tube **24** is disposed in constant communication with supply means for supplying the pressurized blowing medium for discharge out through the nozzles **32** in the forward end of the lance tube. In the preferred construction of the supply means comprising the present invention as shown in the drawings, a pair of feed tubes are employed comprising a stationarily mounted fixed inner tube **84** and a movable outer feed tube **86** disposed in overlying sliding telescopic relationship around the inner fixed feed tube. The length of the inner and outer feed tubes **84**, **86** when in their fully extended position project forwardly to a point adjacent to the wall of the boiler with the end of the movable feed tube **86** disposed within the end of the lance tube to assure a continuous supply of blowing medium when the carriage is in the fully projected position.

Conventionally, the feed tube sections are of substantially equal length such that when the carriage and lance tube are in the fully retracted position, the forwardmost extension of the feed tubes in the contracted condition corresponds to a point about midway along the length of the lance tube. Accordingly, the stepped sections of the lance tube forwardly of about the midpoint thereof may be of a reduced inner diameter without any concern as to any binding or seizure of the feed tube therein. The fact that the outermost projection of the feed tube never extends greater than about half way along the length of the lance tube provides for substantially increased flexibility in the manner in which the lance tube is stepped enabling optimum benefits to be achieved without encountering any adverse pressure drop in the blowing medium supplied thereto. It is also contemplated within the scope of the present invention that three or more sections can be employed in lieu of the two sections as shown to further limit the outermost extent of projection of the end of the feed tube within the lance tube.

The inner fixed feed tube **84**, as shown in FIGURES 3 and 4, is formed with a flange **88** at its rearward end which is securely connected to the outlet flange of a supply valve **90** mounted on the outer end of the rail **10**. The fixed inner feed tube **84** extends forwardly therefrom and is disposed in sliding telescopic relationship within the movable outer feed tube **86**. The rearward or outer end of the outer feed tube **86** is movably supported on a trolley **92** including three sets of rollers **94** which are disposed in rolling bearing contact with each of the projecting portions of the track plate **20** as best seen in FIGURE 7. The trolley **92** is formed with a downwardly depending flange **96** which is formed with a bore **98** therethrough as best seen in FIGURE 6. A sleeve **100** is welded or otherwise securely fastened to the forward face of the flange **96** and in axial alignment with the bore **98**. The forward end of the sleeve **100** is in turn securely connected such as by welding to the rearward end portion of the outer movable feed tube **86**.

A fluid-tight slidable seal is formed between the fixed inner feed tube **84** and movable outer feed tube **86** by means of a stepped spaced ring **102** disposed within the annular region formed between the overlying sleeve **100** and the periphery of the inner feed tube **84** against which a cylindrical packing indicated at **104** is clamped by means of a packing gland **106**. The packing gland **106** is adjustably tightened by means of studs **108** to allow for sliding movement of the outer feed tube **86** relative to the inner fixed feed tube **84** while maintaining a substantially tight seal to prevent the escape of any blowing medium therebetween.

The outer movable feed tube **86** is sealed within the cylindrical hub **72** of the carriage **18** as shown in FIGURE 6 by means of a stepped spacer ring **110** seated against an annular shoulder **112** within a bore **114** extending through the rearward end of the hub **72** and disposed in axial alignment with the lance tube. A tubular cylindrical packing sleeve **116** is disposed with its forward end in abutting relationship against the spacer ring **110** and is compressed in sealing relationship within the bore **114** by means of a packing gland **118** adjustably mounted on a plurality of studs **120**.

The manner in which the outer movable feed tube **86** moves relative to the inner feed tube **84** during the expansion and contraction thereof in response to the outward and inward movement respectively, of the carriage **18**, depends on the relative magnitude of frictional resistance imposed by the packing **104** in comparison to the packing **116**. If, for example, the packing **104** provides the greater frictional resistance to movement, on forward movement of the carriage **18** and the lance tube

24 carried thereby, the outer feed tube 86 will remain stationary and the packing 116 will slide along the periphery thereof as the carriage moves toward the projected position. To prevent the end of the outer feed tube 86 from being withdrawn from the bore 114 of the cylindrical hub 72, a positive mechanical stop such as an annular ring 122 which may be slotted if desired, is securely fastened around the periphery at the outermost end of the movable feed tube 86 and is adapted to abut against the spacer ring 110 in accordance with the arrangement shown in FIGURE 6, effecting thereby a positive forward movement of the outer feed tube 86 relative to the fixed inner feed tube 84 in response to the further outward movement of the carriage. On the other hand, if the packing 116 imposes the greater frictional resistance to relative slippage, the outer feed tube 86 will advance concurrenly with the carriage during the first half of its projecting movement until the forward surface of an annular shoulder 124 projecting inwardly from the rear end portion of the outer feed tube 86 as shown in FIGURE 6, contacts the outwardly projecting rearward surface of an annular hub 126 affixed to the forward end of the inner feed tube 84. The coaction between the annular shoulder 124 and the annular hub 126 provides a positive mechanical stop preventing disengagement of the outer and inner feed tubes and restrains further outward movement of the outer feed tube 86 whereby during the remainder of the projecting travel of the carriage 18 the packing 116 slides over the peripheral surface of the outer feed tube 86.

The manner in which the telescopic feed tube is contracted similarly is determined by the relative frictional resistance imposed by the packing 104 and packing 116. Under the condition wherein the packing 104 imposes the greater frictional resistance to relative movement, the telescopic feed tubes 84, 86 will remain in the extended position during approximately the first half of the retracting travel of the carriage 18 at which time the rearward rollers 22 of the carriage contact the forward rollers 94 of the trolley 92 effecting positive retraction of the outer feed tube 86 over the peripheral surface of the fixed inner feed tube 84. In lieu of relying on the abutting contact between the rollers 22 of the carriage and the rollers 94 of the trolley, a rearwardly extending arm 128 as shown in FIGURE 3, can be provided for engaging the side brackets of the trolley or alternatively a stop collar 130 as shown in FIGURE 6 can be adjustably affixed to the periphery of the outer feed tube 86 at a point spaced forwardly of the trolley which is adapted to abut and coact with the rearward surface of the packing gland 118 during the retracting movement of the carriage effecting positive rearward movement of the outer feed tube 86. In the situation where the packing 116 in the carriage imposes the greater frictional resistance to relative movement, the outer feed tube 86 commences to telescope over the inner feed tube 84 at the commencement of the retracting movement of the carriage which continues until the trolley 92 attains the fully retracted position after which the packing 116 of the carriage slides over the peripheral surface of the outer feed tube 86 until the fully retracted position is attained as illustrated in FIGURES 1 and 3. The manner in which the telescopic feed tube extends and contracts in response to the projecting and retracting travel of the carriage is immaterial to the attainment of the benefits of the present invention since in each case positive communication between the interior of the lance tube and the outlet of the feed tube is maintained in all positions of the carriage.

The pressurized blowing medium is supplied to the inner fixed feed tube 84 through the supply valve 90 which in turn is connected to a main supply header 132 as best shown in FIGURES 1, 3 and 4. Actuation of the supply valve can be achieved remotely and preferably mechanically as illustrated in FIGURES 3 and 4 in response to the movement of the carriage 18 to and from the fully retracted and projected positions. In the exemplary embodiment shown in FIGURES 3 and 4, a resiliently biased actuating lever 134 of the supply valve 90 is connected by means of a link rob 136 to a slotted cam 138 pivotally mounted on the side of the rail 10. An actuator rod 140 is securely mounted to the upper ends of the roller arms 68 of the carriage and is provided with a plurality of apertures 142 therealong for selectively positioning an actuator pin 144 therealong.

The actuator pin 144 is located for the purpose hereinbefore described to effect actuation of the supply valve after the nozzle end portion of the lance tube has been advanced beyond the water wall tubes adjacent to the wall of the boiler and to deactuate the valve halting the discharge of blowing medium when the nozzle end portion of the lance tube is retracted to a point adjacent to the wall tubes during the retracting movement. In the specific arrangement shown in FIGURE 3 the actuator valve is shown in the deactuated position with the carriage 18 in the fully retracted position. FIGURE 4 illustrates the valve in the actuated position wherein the slotted cam 138 has been rotated forwardly in response to coaction with the actuator pin 144 during the advancing movement of the carriage. The over-center pivotable mounting of the slotted cam 138 causes it to remain in the actuated position until tripped during the retracting movement of the carriage. On subsequent retraction of the carriage, the slotted cam 138 is again rotated from the position as shown in FIGURE 4 to the position as shown in FIGURE 3 effecting a closing of the supply valve and the cessation of the discharge blowing medium through the nozzle 32 in the nozzle end of the lance tube.

In accordance with one preferred embodiment of the present invention means are provided at the outlet end of the movable outer feed tube 86 such as a plurality of vanes 146 as best seen in FIGURES 6 and 7 for imparting a swirl or turbulence to the blowing medium supplied to the interior of the lance tube effecting thereby an increase in the transfer of heat from the lance tube to the blowing medium resulting in a reduction in the operating tempearture of the lance tube. In the exemplary embodiment as shown in FIGURES 6 and 7, the radially disposed angularly positioned vanes 146 are integrally formed with the annular ring 122.

In an alternative preferred embodiment of the present invention, a plurality of vanes 148 as shown in FIGURES 8 and 9 are affixed to the interior of the lance tube 24 at a position forwardly of the forward-most extension of the front end of the outer feed tube 86 which imparts a swirl or turbulence to the blowing medium passing therethrough effecting an increased cooling of the forward end portion of the lance tube substantially reducing its operating temperature level. It is also contemplated that two or more sets of vanes 148 can be employed at longitudinally spaced increments in the lance tube. The increased effectiveness in the cooling of the lance tube as the result of the inclusion of the vanes 146 in the feed tube and/or the vanes 148 in the lance tube provides for lower lance operating temperatures enhancing the strength and useful life thereof. This feature also enables a reduction in the quantity of blowing medium discharged in excess of that required for cleaning purposes while maintaining lower or substantially the same lance tube operating temperatures present in soot blowers not so equipped effecting further economy in the conservation of blowing medium.

In operation, the soot blower is energized either remotely, manually, or in response to an automatic control system for providing sequentially phased operation of each of a plurality of soot blowers disposed at spaced intervals along the boiler wall. Actuation of the soot blower is achieved by the energization of the reversible motor 36 which through the gear box 38 and drive shaft 40, effects rotation of the pinion 42 whereupon the carriage 18 and the lance 24 commence their projecting

movement. As the carriage advances from the fully retracted position, the actuator pin **144** (FIGURES 3 and 4) actuates the slotted cam **138** which in turn opens the supply valve **90**, effecting a discharge of blowing medium into the interior of the inner feed tube **84** and the lance tube. The carriage continues in its projecting movement during which time the lance tube is rotated and the blowing medium is discharged in the form of a helical pattern from the nozzles **32** in the forward end of the lance tube. As the carriage advances the telescopically mounted feed tubes **84**, **86** extend to maintain a continuous supply of blowing medium into the interior of the lance tube. On reaching the fully projected position, the carriage **18** contacts the forward limit switch **LS1** as shown in FIGURE 1 which signals the control circuit effecting a reversal in the direction of rotation of the reversible motor **36** whereupon the carriage commences its retracting movement. The carriage continues in its retracting movement during which time the telescopically mounted feed tubes **84**, **86** contract in a manner as hereinbefore described during the continued discharge of blowing medium from the nozzles in the lance tube. As the carriage approaches the retracted position, the actuator pin **144** (FIGURES 3 and 4) contacts the slotted cam **138** effecting a closing of the supply valve **90** whereupon the supply of pressurized blowing medium is halted. The carriage continues in its retracting movement until rearward limit switch **LS2** as shown in FIGURE 1, is tripped by the carriage **18** which signals the control circuit and which de-energizes the reversible drive motor **36**. The soot blower on attaining the fully retracted position is in a stand-by condition preparatory to the next operating cycle.

While it will be apparent that the preferred embodiments herein illustrated are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A long-retracting type soot blower comprising a frame, a carriage movably mounted on said frame, a lance tube formed with a nozzle in the forward end thereof supported on said carriage and movable thereby to and from a retracted inoperative position and a projected cleaning position, a telescopic feed tube on said frame comprising a plurality of sealed telescopically mounted sections disposed in sealed telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, and supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube.

2. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a lance tube formed with a nozzle in the forward end thereof supported on said carriage and movable thereby to and from a retracted inoperative position and a projected cleaning position, a telescopic feed tube on said frame comprising a plurality of sealed telescopically mounted sections disposed in sealed telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube, and means in the forward end portion of said feed tube for imparting turbulence to said blowing medium discharged into the interior of said lance tube.

3. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a lance tube formed with a nozzle in the forward end thereof supported on said carriage and movable thereby to and from a retracted inoperative position and a projected cleaning position, a telescopic feed tube on said frame comprising a plurality of telescopically mounted sections disposed in mutual sealing relationship to each other and in telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube, and means in said lance tube disposed forwardly of the forwardmost extension of said feed tube for imparting turbulence to the blowing medium passing forwardly toward said nozzle.

4. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a stepped lance tube formed with a nozzle in the forward end thereof supported at its rearward end on said carriage and movable thereby to and from a retracted inoperative position and a projected cleaning position, said stepped lance tube comprising a plurality of sections of progressively decreasing diameter on moving from said rearward end towards said forward end, a telescopic feed tube on said frame comprising a plurality of telescopically mounted sections disposed in telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, and supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube.

5. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a stepped lance tube formed with a nozzle in the forward end thereof supported at its rearward end on said carriage and movable thereby to and from a

retracted inoperative position and a projected cleaning position, said stepped lance tube comprising a plurality of sections of progressively decreasing diameter on moving from said rearward end toward said forward end, a telescopic feed tube on said frame comprising a plurality of sealed telescopically mounted sections disposed in sealed telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube, and means in the forward end portion of said feed tube for imparting turbulence to the blowing medium discharged into the interior of said lance tube.

6. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a stepped lance tube formed with a nozzle in the forward end thereof supported at its rearward end on said carriage and movable thereby to and from a retracted inoperative position and a projected cleaning position, said stepped lance tube comprising a plurality of sections of progressively decreasing diameter on moving from said rearward end toward said forward end, a telescopic feed tube on said frame comprising a plurality of sealed telescopically mounted sections disposed in sealed telescopic sliding relationship with the outermost section thereof disposed in communication with the interior of said lance tube in all moved positions thereof and extensible and contractible in response to movement of said carriage between said retracted and said projected position, said sections disposed in longitudinally stationary relationship relative to each other during a portion of the travel of said lance tube between the retracted and projected positions, sealing means on said carriage disposed in frictional sealing relationship around said outermost section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supply means for supplying a pressurized blowing medium to said feed tube for discharge through said nozzle in said lance tube, and means in said lance tube disposed forwardly of the forwardmost extension of said feed tube for imparting turbulence to the blowing medium passing forwardly therefrom toward said nozzle.

7. A long-retracting type soot blower comprising a frame, a carriage movably and guidably mounted on said frame, a lance tube formed with a nozzle in the forward end thereof rotatably supported at its rearward end on said carriage and movable thereby to and from a retracted position and a projected position, drive means for moving said carriage between the positions and for concurrently rotating said lance tube, a telescopic feed tube comprising a first section stationarily mounted on said frame and a second section disposed in overlying sealed telescopic sliding relationship around said first section and positioned in sealed telescopic sliding relationship within and in communication with the interior of said lance tube in all moved positions thereof, said second section movable to and from a contracted position to an extended position in response to movement of said carriage between said retracted and said projected positions, said first section disposed in longitudinally stationary relationship relative to said second section during a portion of the movement of said carriage between said positions, sealing means on said carriage disposed in frictional sealing relationship around said second section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, and supply means connected to said first section for supplying a pressurized blowing medium to the interior of said lance tube for discharge through said nozzle therein.

8. A long-retracting type soot blower comprising a frame, a rail on said frame, a carriage movably mounted on said rail, a lance tube formed with a nozzle in the forward end thereof rotatably supported at its rearward end by said carriage and movable thereby to and from a retracted position and a projected position, drive means for moving said carriage between said positions and for rotating said lance tube, a telescopic feed tube comprising a first section stationarily mounted on said frame and a second section disposed in overlying sealed telescopic sliding relationship around said first section and disposed in sealed telescopic sliding relationship within and in communication with the interior of said lance tube, said second section telescopically extensible and contractible relative to said first section in response to the projecting and retracting travel of said carriage, sealing means on said carriage disposed in frictional sealing relationship around said second section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carirage, supporting means movably mounted on said rail for supporting said first and said second sections during the extension and contraction thereof, and supply means for supplying a pressurized blowing medium to said first section for discharge through said nozzle and said lance tube.

9. A long-retracting type soot blower comprising a frame, a rail on said frame, a carriage movably mounted on said rail, a stepped lance tube formed with a nozzle in the forward end thereof rotatably supported at its rearward end by said carriage and movable thereby to and from a retracted position and a projected position, said stepped lance tube comprising a plurality of sections of progressively decreasng diameter on moving from said rearward end toward said forward end thereof, drive means for moving said carriage between said positions and for rotating said lance tube, a telescopic feed tube comprising a first section stationarily mounted on said frame and a second section disposed in overlying sealed telescopic sliding relationship around said first section and disposed in sealed telescopic sliding relationship within and in communication with the interior of said lance tube, said second section telescopically extensible and contractible relative to said first section in response to the projecting and retracting travel of said carriage, sealing means on said carriage disposed in frictional sealing relationship around said second section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supporting means movably mounted on said rail for supporting said first and said second sections during the extension and contraction thereof, and supply means for supplying a pressurized blowing medium to said first section for discharge through said nozzle and said lance tube.

10. A long-retracting type soot blower comprising a frame, a rail on said frame, a carriage movably mounted on said rail, a stepped lance tube formed with a nozzle in the forward end thereof rotatably supported at its rearward end by said carriage and movable thereby to and from a retracted position and a projected position, said stepped lance tube comprising a plurality of sections of progressively decreasing diameter on moving from said rearward end toward said forward end thereof, drive means for moving said carriage between said positions

and for rotating said lance tube, a telescopic feed tube comprising a first section stationarily mounted on said frame and a second section disposed in overlying sealed telescopic sliding relationship around said first section and disposed in sealed telescopic sliding relationship within and in communication with the interior of said lance tube, said second section telescopically extensible and contractible relative to said first section in response to the projecting and retracting travel of said carriage, sealing means on said carriage disposed in frictional sealing relationship around said second section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supporting means movably mounted on said rail for supporting said first and said second sections during the extension and contraction thereof, supply means for supplying a pressurized blowing medium to the rearward end of said first section, and means including a plurality of angularly disposed vanes positioned in the outlet end portion of said second section for imparting turbulence to said blowing medium discharged into the interior of said lance tube.

11. A long-retracting type soot blower comprising a frame, a rail on said frame, a carriage movably mounted on said rail, a stepped lance tube formed with a nozzle in the forward end thereof rotatably supported at its rearward end by said carriage and movable thereby to and from a retracted position and a projected position, said stepped lance tube comprising a plurality of sections of progressively decreasing diameter on moving from said rearward end toward said forward end thereof, drive means for moving said carriage between said positions and for rotating said lance tube, a telescopic feed tube comprising a first section stationarily mounted on said frame and a second section disposed in overlying sealed telescopic sliding relationship around said first section and disposed in sealed telescopic sliding relationship within and in communication with the interior of said lance tube, said second section telescopically extensible and contractible relative to said first section in response to the projecting and retracting travel of said carriage, sealing means on said carriage disposed in frictional sealing relationship around said second section of said feed tube permitting independent longitudinal sliding movement thereof relative to said carriage and said lance tube during a portion of the longitudinal travel of said carriage, supporting means movably mounted on said rail for supporting said first and said second sections during the extension and contraction thereof, supply means for supplying a pressurized blowing medium to the rearward end of said first section, and means including a plurality of radially extending angularly disposed vanes positioned in said lance tube forwardly of the forwardmost extension of said first and said second sections for imparting turbulence to the blowing medium discharged from said second section toward the nozzle in said lance tube.

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