

Jan. 25, 1966

J. R. SALTZ

3,230,568

VARIABLE SPEED SOOT BLOWER

Filed April 20, 1964

3 Sheets-Sheet 1

FIG. 1.

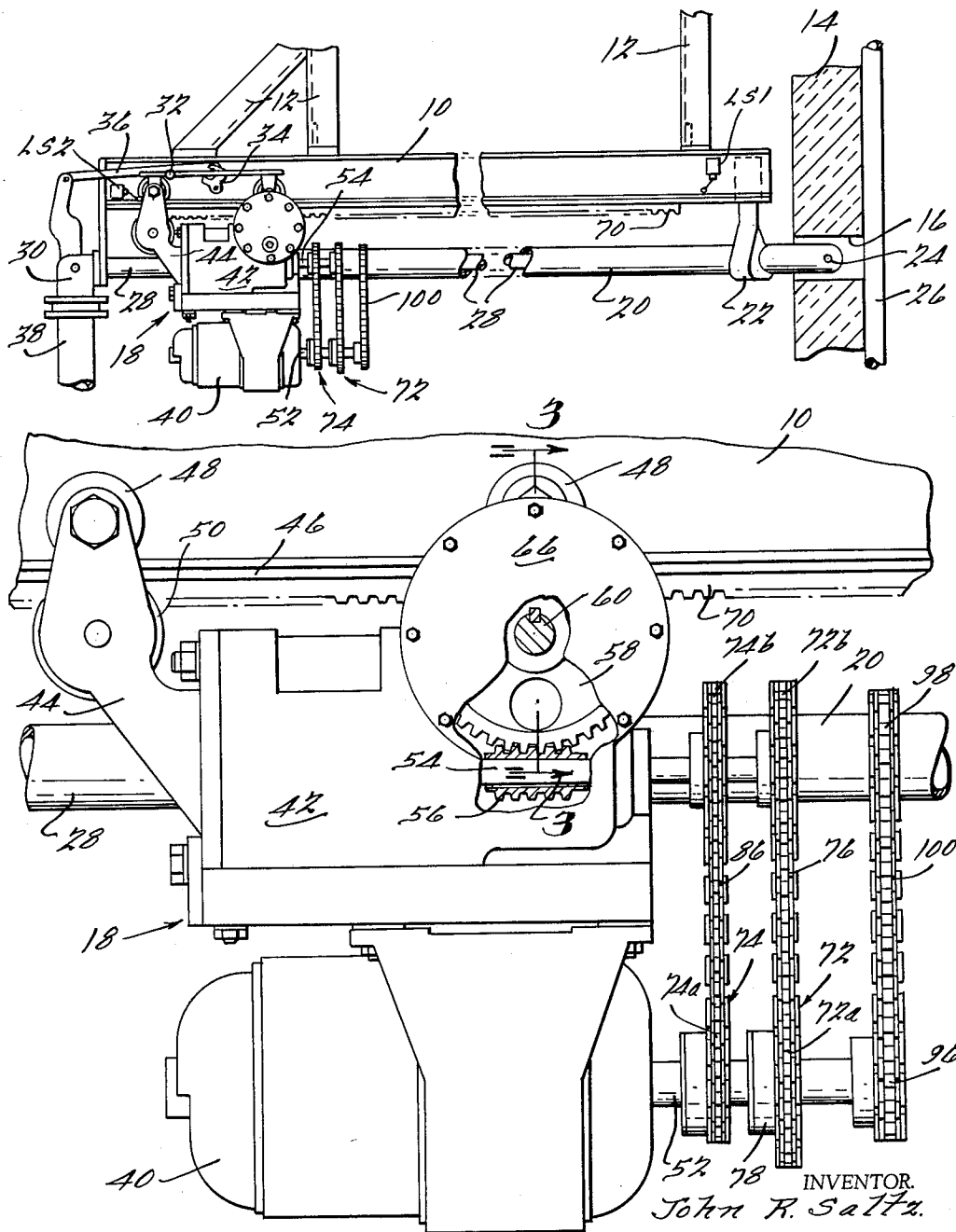


FIG. 2.

INVENTOR.
John R. Saltz.

BY

Harness, Decker & Peier,
ATTORNEYS.

Jan. 25, 1966

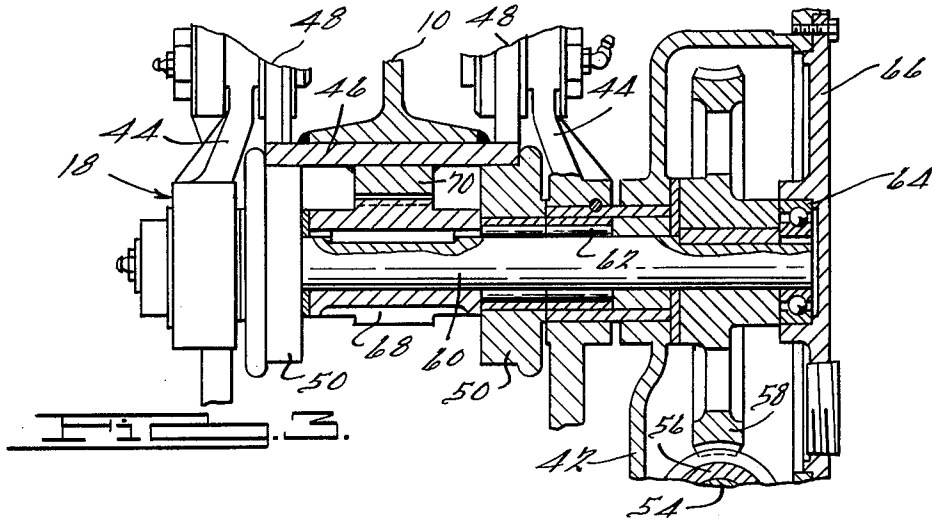
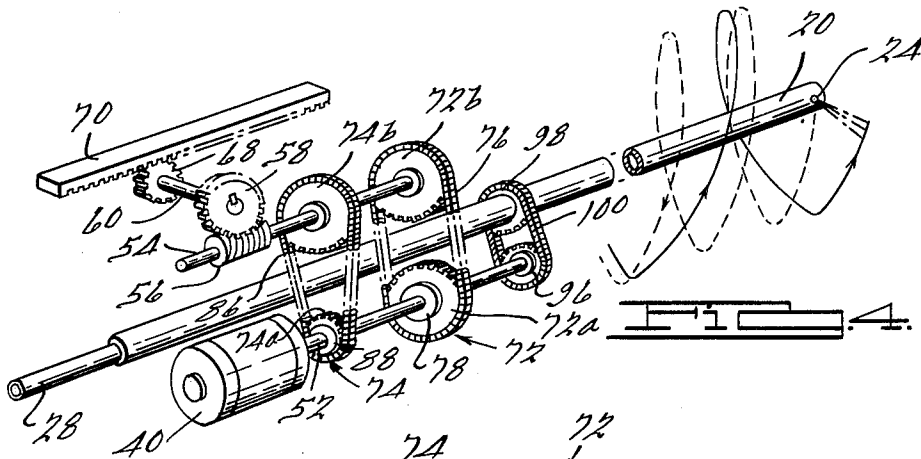
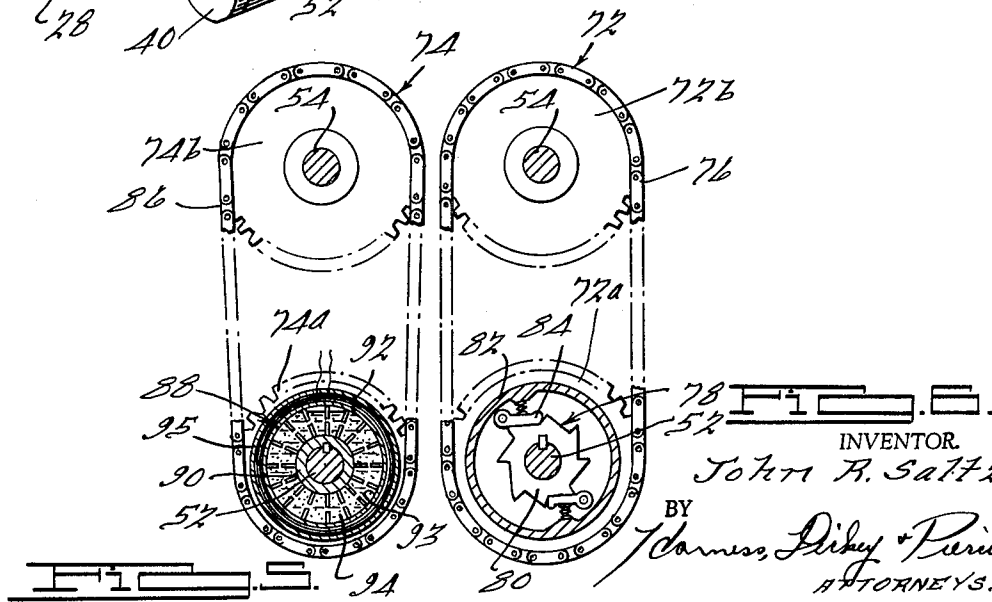
J. R. SALTZ

3,230,568

VARIABLE SPEED SOOT BLOWER

Filed April 20, 1964

3 Sheets-Sheet 2



INVENTOR
John H. Saltz.
BY
James D. P. P.
ATTORNEYS.

Jan. 25, 1966

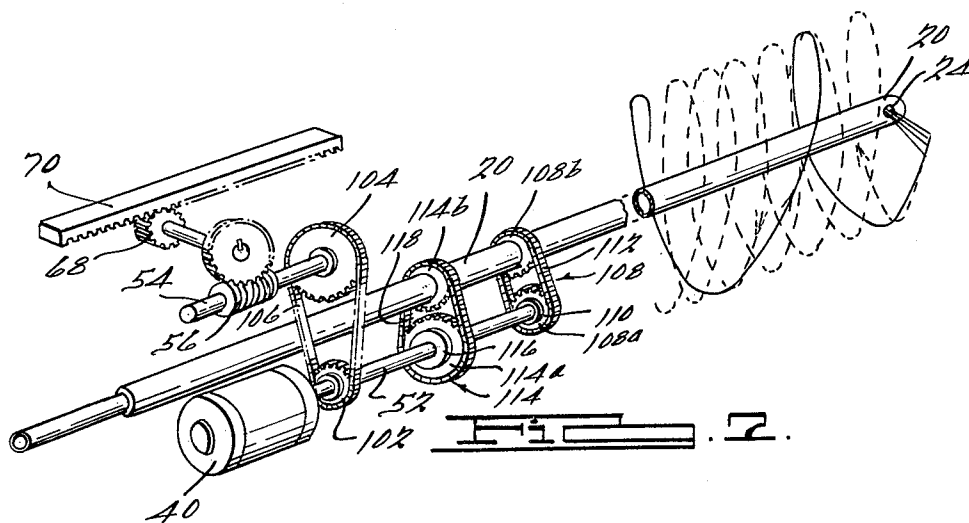
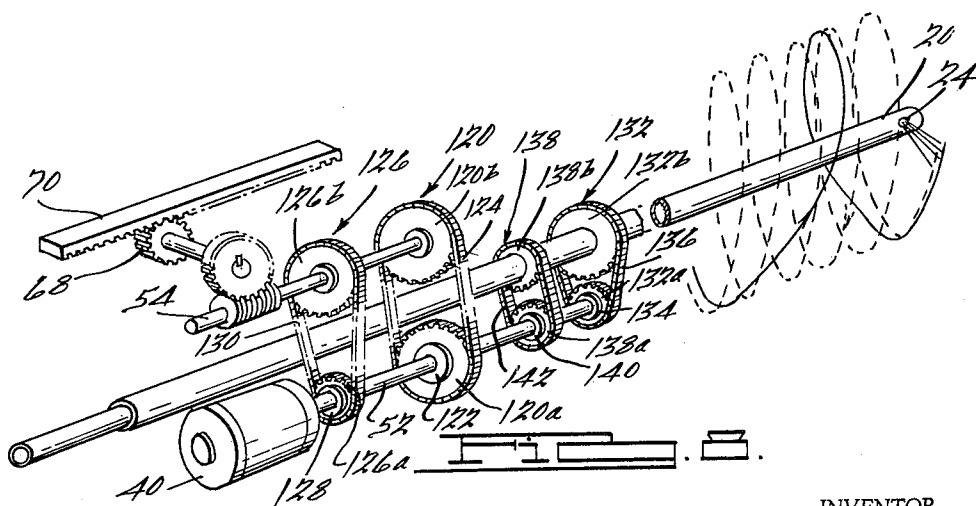
J. R. SALTZ

3,230,568

VARIABLE SPEED SOOT BLOWER

Filed April 20, 1964

3 Sheets-Sheet 3



INVENTOR.

John R. Saltz.

BY

Harness, Dickey & Perie.
ATTORNEYS.

1

3,230,568

VARIABLE SPEED SOOT BLOWER

John R. Saltz, Lancaster, Ohio, assignor to Diamond Power Specialty Corporation, Lancaster, Ohio, a corporation of Ohio

Filed Apr. 20, 1964, Ser. No. 363,330

6 Claims. (Cl. 15—317)

The present application is a continuation-in-part of my prior copending United States patent application Serial No. 222,369, filed September 10, 1962, now abandoned, for "Variable Speed Soot Blower," and assigned to the same assignee as the present invention.

The present invention broadly relates to heat exchanger apparatus, and more particularly to improvements in apparatus for cleaning the heat exchanger surfaces of high pressure steam boilers and the like. More specifically, the present invention is applicable to an improved cleaning mechanism commonly referred to as a "soot blower" of the long travel type which incorporates means therein for effecting a controlled variation in the relative speed of translation and rotation of a lance tube incorporating nozzles therein for discharging a pressurized blowing medium against the heat exchanger surfaces to be cleaned.

Soot blowers of the long travel or long retracting type, to which the present invention is applicable, are in widespread use in various types of heat exchanger apparatus for providing periodic cleaning of slag and soot deposits from the heat exchanger surfaces maintaining optimum thermal efficiency thereof. Conventionally, a plurality of soot blowers are employed which are disposed at preselected intervals along the heat exchanger apparatus and are operated singly or in multiples for providing an automatic sequentially phased cleaning operation.

Soot blowers of the so-called long travel type are adapted to be mounted exteriorly of the heat exchanger apparatus and are provided with a lance tube incorporating nozzles in the forward end portion thereof which is movable to and from a retracted position wherein the forward end portion of the lance tube is positioned in a wall port and out of contact with the hot combustion gases to a projected position disposed within the heat exchanger apparatus. Conventionally, the lance tube is rotated during its projecting and retracting travel and a pressurized blowing medium such as steam or air, for example, is discharged through the nozzles and impinges against the heat exchanger surfaces effecting the removal of deposits therefrom. The efficiency of the cleaning action achieved is determined to a large extent by the uniformity of coverage of the heat exchanger surfaces by the blasting of cleaning medium discharged through the nozzles. At the same time, it is desirable to minimize the length of time that the lance tube is projected into the furnace in which position it is subjected to the hot combustion gases which promote deterioration and wear thereof effecting a shortening of its useful life.

In order to provide substantially uniform coverage of heat exchanger surfaces, it has heretofore been proposed to employ a lost motion device in a long retracting type soot blower effecting a displacement in the phase of the helical blowing pattern discharged from the nozzles in the lance tube during its projecting and retracting travel. In view of the outward pressure exerted against the lance tube by the pressurized cleaning fluid and the frictional resistance in the soot blower, the use of such lost motion provisions have, in some instances, failed to provide a phase displacement in the blowing pattern or have provided erratic operation resulting in inadequate cleaning of some portions of the heat exchanger surfaces traversed thereby.

The increased size of modern high pressure steam boilers has also necessitated a corresponding increase in the

2

length of the lance tube and the length of travel thereof to provide the necessary cleaning coverage of the heat exchanging surfaces within the boiler. The increased length of the lance tube has imposed restrictions on the speed of rotation thereof to prevent lance tube whip necessitating a corresponding reduction in the speed of translation thereof and the necessity of subjecting the lance tube to increased periods within the furnace chamber. The necessity of reducing the speed of rotation of the lance tube with a corresponding reduction in the speed of translation thereof in order to achieve a uniform cleaning pattern, also, has increased the length of the operating cycle and decreased the efficiency and flexibility of the cleaning operation.

It is, accordingly, a principal object of the present invention to provide an improved variable speed long travel type soot blower which is more flexible and versatile and which overcomes the disadvantages and problems associated with soot blowers of similar type heretofore known.

Another object of the present invention is to provide an improved variable speed soot blower which provides for a controlled positive change in the pitch of the helical blowing pattern achieved during the projecting travel and the blowing pattern achieved during the retracting travel of the lance tube during a cleaning operation.

Still another object of the present invention is to provide an improved variable speed soot blower which enables a controlled regulation of the speed of the projecting movement of the lance tube in comparison to the retracting speed thereof in combination with the speed of rotation of the lance tube enabling optimum cleaning of the heat exchanger surfaces within a shorter time period providing thereby greater efficiency and versatility of the cleaning operation and enhancing the useful life of the soot blower.

A further object of the present invention is to provide an improved variable speed long travel type soot blower which incorporates power transmission means therein providing a preselected variation in the relative speed of rotation and translation of the lance tube during its projecting and retracting travel into and out of the heat exchanger apparatus.

A still further object of the present invention is to provide an improved variable speed soot blower of the long travel type which is of simple design, durable operation, economical manufacture, and which requires minimal service and maintenance.

The foregoing and other objects and advantages of the present invention are achieved by employing a single reversible power source operatively connected to the lance tube of a long travel type soot blower which upon reversal in the direction of driving rotation is effective through power transmission means for effecting a positive controlled variation in the relative speed of translation and rotation of the lance tube overcoming the problem of lance whip and providing for a positive change in the pitch of the helical cleaning pattern assuring uniform deslagging of the heat exchanger surfaces within a minimal time period.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary side elevation view of a long travel type soot blower mounted exteriorly of a heat exchanger apparatus and incorporating therein a variable speed power transmission constructed in accordance with one of the embodiments of the present invention;

FIGURE 2 is an enlarged fragmentary side elevation view partly in section of the carriage of the soot blower shown in FIGURE 1;

3

FIGURE 3 is a transverse vertical sectional view of the carriage drive mechanism of the soot blower shown in FIGURE 2 and taken along the line 3—3 thereof;

FIGURE 4 is a schematic perspective view of the relationship of the components of the variable speed power transmission incorporated in the soot blower shown in FIGURES 1-3;

FIGURES 5 and 6 are side elevation views partly in section of the variable speed power transmission and the arrangement of typical overrunning clutches for effecting a change in the relative speed of rotation and translation of the lance tube of the soot blower shown in FIGURE 1;

FIGURE 7 is a schematic perspective view of an alternate satisfactory embodiment of the present invention providing for variations in the speed of rotation of the lance tube between its projecting and retracting travel at a constant speed of translation; and

FIGURE 8 is a schematic perspective view of still another alternate satisfactory embodiment of the present invention illustrating a variable speed power transmission providing for both a change in the speed of rotation and translation of the lance tube between its projecting and retracting travel.

Referring now in detail to the drawings and as may be best seen in FIGURE 1, a typical long travel type soot blower is illustrated to which the present invention is applicable. As shown in FIGURE 1, the soot blower comprises a longitudinally extending beam 10 which is supported by a suitable framework 12 in a position exteriorly of a wall 14 of a heat exchanger apparatus provided with a wall port 16 therethrough. A carriage 18 is movably mounted on the beam 10 and is movable therealong to and from a retracted position as shown in FIGURE 1 to an advanced or projected position in which the carriage is disposed on the right end portion of the beam as viewed in FIGURE 1. A lance tube 20 is rotatably mounted on the carriage 18 and extends longitudinally of the beam 10 having the forward end portion thereof rotatably and movably supported in a front support or roller bracket 22 connected to the forward end of the beam 10. The lance tube 20 is shown in FIGURE 1 in the fully retracted position wherein the forward end thereof incorporating one or more nozzles 24 therein is disposed within the wall port 16 and shielded from the hot combustion gases within the interior of the boiler. Suitable seals (not shown) are conventionally provided for sealing the lance tube 20 within the wall port 16 preventing the escape of any combustion gases from the interior of the boiler.

The lance tube 20 is movable by the carriage 18 during the projecting and retracting travel thereof from the retracted position as shown in FIGURE 1 to a projected position wherein the nozzle end portion thereof is disposed within the interior of the heat exchanger apparatus. During the lance tube's projecting and retracting travel, the lance tube is rotated and a pressurized blowing medium is discharged from the nozzles 24 in the front end thereof in the form of a helix which traverses and impinges on the heat exchanger surfaces within the boiler effecting the removal of slag and other extraneous deposits therefrom. Conventionally, the blowing medium is introduced into the lance tube 20 after the carriage has advanced a predetermined distance from the fully retracted position so that the nozzles 24 are disposed beyond the wall port 16 and a series of water wall tubes 26 positioned along the interior surface of the boiler wall 14 to prevent direct impingement of the pressurized blowing medium at close range against these surfaces which might otherwise cause erosion and damage thereto. Similarly, the discharge of the pressurized blowing medium is stopped during the latter portion of the retracting travel of the lance tube at a preselected point before the fully retracted position is attained.

The supply of the pressurized blowing medium to the lance tube 20 is conveniently achieved by means of a

4

feed tube 28 stationarily mounted at its rearward or left hand end as viewed in FIGURE 1 to a supply valve 30. The feed tube 28 extends therefrom forwardly and is disposed in telescopic relationship within the interior of the lance tube 20. The feed tube 28 extends forwardly from the supply valve 30 to a point adjacent to the forward end of the beam 10 maintaining continuous communication with the interior of the lance tube 20 as the carriage 18 moves from the fully retracted to the fully advanced position. Suitable seals (not shown) are incorporated within the carriage 18 for preventing the escape of any of the pressurized blowing medium from between the feed tube 28 and the lance tube 20.

The actuation of the supply valve 30 can be satisfactorily achieved in any one of a number of conventional techniques and is preferably mechanically actuated through an actuator 32 adjustably positioned on the carriage 18 which is operative to engage and pivot a cam 34 pivotally mounted on the beam 10 to which linkage 36 is connected for selectively opening and closing the supply valve 30 when the carriage moves a preselected distance from the fully retracted position or returns to a preselected position during its retracting movement from the fully retracted position. The supply valve 30 is connected to a suitable supply pipe 38 which in turn is connected to a header (not shown) to which each of the remaining soot blowers is similarly connected. The supply valve 30 can also be electrically or remotely actuated either in response to the travel of the carriage 18 or by an operator in the central control room.

The advancement of the carriage 18 and the translation of the lance tube 20 to and from the retracted position to a projected position and the simultaneous rotation of the lance tube can be achieved by suitable reversible motor means such as a fluid actuated motor or an electric motor 40 as specifically shown in the drawings. The reversible motor means may be mounted directly on the carriage 18, as shown in the drawings, and electrical energy or a pressurized driving fluid supplied thereto by a suitable flexible conductor or conduit as the case may be. Alternatively, the reversible motor means can be stationarily mounted either at the forward end or at the rearward end of the soot blower and provided with an elongated power transmission shaft of an irregular configuration such as a square shaft, for example, which is slidably coupled to a driven member for rotating a shaft on the carriage. In either case, the reversible motor means is driven in one direction during the projecting movement of the carriage and lance tube and is driven in the opposite direction during the retracting movement thereof.

In the specific embodiment shown in FIGURE 1, the electric motor 40 is energized either manually or remotely by the operator or in accordance with an automatic sequentially phased control system which provides for automatic operation of each of the soot blowers in a preselected operating sequence to provide optimum cleaning of the heat exchanger surfaces consistent with the accumulation of slag deposits thereon. In the arrangement shown in FIGURE 1, energization of the electric motor 40 effects forward movement of the carriage toward the projected position. When the fully projected position is attained, the carriage 18 or a suitable actuator thereon, trips a forward travel limit switch LS1 mounted on the forward end of the beam 10 which signals the control circuit effecting a reversal in the direction of rotation of the electric motor whereby the carriage 18 commences its retracting movement. When the carriage 18 attains the fully retracted position, a rearward travel limit switch LS2 is tripped by the carriage or an actuator thereon de-energizing the electric motor 40 whereby the carriage stops and is in position for the next operating cycle.

The mode of driving the carriage along the beam 10 can be suitably achieved by a sprocket drivingly mounted on the carriage engageable with a longitudinally extend-

ing chain; by a rotatably driven lead screw extending the length of the beam 10; and the like; and preferably by a rack and pinion driving arrangement as illustrated in the exemplary embodiment shown in the drawings. As will be best seen in FIGURES 2 and 3, the carriage 18 comprises a gear box or housing 42 incorporating a pair of trolley brackets 44 along each side thereof for movably and guidably mounting the carriage 18 on the beam 10. As shown in FIGURE 3, a track plate 46 is rigidly affixed to the lower flange of the beam 10 and projects laterally of the side edges thereof against which an upper roller 48 rotatably mounted on each of the trolley brackets 44 is disposed in rolling bearing contact. A flanged roller 50 rotatably mounted on each of the trolley brackets 44 is disposed in rolling bearing contact along the underside of the edges of the track plate 46 with the flanged rims thereof disposed in overlying bearing contact with the side edges of the track plate providing lateral guidance of the carriage during its movement therealong.

The motor 40 is securely fastened to the underside of the housing 42 and is provided with an elongated output shaft 52 on which suitable pulleys or sprockets are mounted. A driven shaft 54 is rotatably mounted and supported within the housing 42 on which a worm 56 is rotatably fixed such as by suitable keys or splines. The worm 56, as shown in FIGURES 2 and 3, is disposed in constant meshing relationship with a worm wheel 58 which is keyed or splined to a cross shaft 60 which is rotatably supported in roller bearings 62 in the trolley brackets 44 and a ball bearing 64 supported by a gear box cover 66.

A pinion gear 68 is keyed or splined to the cross shaft 60 in a position between the flanged rollers 50 and is disposed in constant meshing relationship with a rack 70 affixed to the underside of the track plate 46. The rack 70 extends centrally and longitudinally of the beam 10 and for substantially the entire length thereof. Accordingly, the rotation of the worm 56 in one direction will effect movement of the carriage 18 in one direction and upon reversal of the direction of rotation of the worm 56, the carriage correspondingly will reverse direction.

Rotation of the driven shaft 54 and the worm 56 thereon is achieved in the specific embodiment illustrated in FIGURES 1-6 by a pair of chain and sprocket transmissions 72, 74 coupled between the output shaft 52 and the driven shaft 54. The chain and sprocket transmission 72 is operative to drive the driven shaft 54 when the electric motor 40 is rotated in one direction and the chain and sprocket transmission 74 is operative to drive the driven shaft 54 when the electric motor is driven in the opposite direction. Alternate suitable transmission means such as gears, belts and pulleys, friction drives, and the like, can be satisfactorily employed in lieu of the specific chain and sprocket transmission shown in the drawings.

The chain and sprocket transmission 72 comprises a driving sprocket 72a coupled to the output shaft 52 and a driven sprocket 72b coupled to the driven shaft 54. A chain 76 is trained around the sprockets 72a, 72b drivingly connecting the sprockets together. The sprocket 72a is drivingly coupled to the output shaft 52 through a suitable clutch 78 of the exemplary type shown in FIGURE 6 which is adapted to engage the output shaft when it is driven in one direction and to disengage the output shaft when it is driven in the opposite direction. The clutch 78 as shown comprises a ratchet wheel 80 keyed to the output shaft 52 of the motor which is enclosed within an annular housing 82 connected to the sprocket 72a on which a pair of sprags or pawls 84 are mounted and biased toward an engaging position with the ratchet wheel 80. Accordingly, when the output shaft 52 is driven in a counterclockwise direction as viewed in FIGURE 6, the pawls 84 engage the ratchet wheel 80 driving the housing 82 and the sprocket 72a in a counterclockwise direction whereupon the worm 56 is driven so as to effect advance-

ment of the carriage from the retracted position to the projected position.

Similarly, the chain and sprocket transmission 74 comprises a sprocket 74a and a sprocket 74b which are drivingly coupled together by a chain 86 trained therearound. The sprocket 74b is keyed to the driven shaft 54 and the sprocket 74a is drivingly coupled to the output shaft 52 through a clutch 88 which is operable to engage the output shaft 52 and the sprocket 74a when the output shaft 52 is driven in a clockwise direction as viewed in FIGURE 5. The clutch 88 may be of any of the types well known in the art which enables a relative overrunning of the sprocket 74a, and the output shaft 52 when the output shaft 52 is driven in a counterclockwise direction as occasioned during the projecting travel of the lance tube. In the exemplary arrangement as diagrammatically illustrated in FIGURE 5, the clutch 88 is of the fluid magnetic type well known in the art and comprises a driving impeller 90 coupled to the output shaft 52 and a driven impeller 92 which is connected to the sprocket 74a. An annular chamber 93 formed between the vaned driving impeller 90 and vaned driven impeller 92 is filled with a suitable magnetic fluid indicated at 94 which conventionally contains magnetic particles and which is of a viscosity to enable relative rotative movement between the two impellers when in a non-magnetized state. A magnetic coil 95 is positioned around the annular chamber 93 and upon energization thereof effects substantial solidification of the magnetic fluid 94 in a corresponding driving connection or lockup between the drive impeller 90 and the driven impeller 92.

In lieu of the magnetic fluid clutch illustrated in FIGURE 5, alternative satisfactory magnetic disk type clutches can be employed of the types well known in the art such as the types illustrated in "Kent's Mechanical Engineers' Handbook," 12th edition, published by John Wiley & Sons, Inc., of New York, New York, and disclosed in chapter 15, pages 34 and 35. In the exemplary fluid-type magnetic clutch illustrated in FIGURE 5, electrical energy can be conveniently supplied to the magnetic coil through the electrical connection provided by a pair of brush contacts positioned in electrical contact with a pair of collector rings (not shown) on the output shaft 52 in a manner well known in the art. The energization of the magnetic coil 95 can be achieved in response to the tripping of forward travel limit switch LS1 which through the central control circuit as hereinbefore described is operative to effect a reversal in the direction of rotation of the drive motor 40. Deenergization of the magnetic coil 95 can be achieved in response to the tripping of rearward travel limit switch LS2 when the carriage and lance tube attain the fully retracted position which concurrently effects the deenergization of the reversible drive motor 40 in a manner previously described. In accordance with this arrangement, when the output shaft is driven in a counterclockwise direction, the driven shaft 54 and the worm 56 thereon is driven by the transmission 72, during which time the magnetic clutch 88 of the transmission 74 overruns and subsequently upon reversal of the direction of rotation of the output shaft to a clockwise direction in response to the tripping of limit switch LS1, the transmission 74 drives the driven shaft 54 during which time the transmission 72 overruns. It will also be appreciated that both the clutch 78 and clutch 88 may be of the magnetic type which are suitably controlled by the respective tripping of forward and rearward travel limit switch LS1 and LS2, respectively.

It will also be understood that the clutches 78 and 88 can be mounted on the driven shaft 54 and the sprockets 72b, 74b thereon to provide the same action as achieved through the arrangement shown in the drawings. Additionally, alternate suitable clutch mechanisms which are operative to engage in one direction and to be disengaged upon reversal of the direction of rotation can be employed in lieu of the exemplary clutches shown.

The speed of rotation of the driven shaft 54 is established by the ratios of the transmissions 72, 74 at a constant motor speed. In accordance with the preferred form of the present invention and as best shown in FIGURES 5 and 6, the ratio between the diameters of the sprockets 72a, 72b of the transmission 72 is substantially unity whereby the lance tube is rapidly advanced from the retracted position to the projected position. On the other hand, the ratio between the sprockets 74a and 74b is less than unity whereby the lance tube is retracted more slowly during its movement from the projected position to the fully retracted position. In accordance with this arrangement, the lance tube is rapidly advanced into the interior of the heat exchanger apparatus, effecting partial cleaning during this movement and thereafter is withdrawn slowly providing a more extensive cleaning. This arrangement minimizes the duration of time during which the lance tube is exposed to the hot combustion gases.

The lance tube 20 is rotated simultaneously with its translatory movement and this can be conveniently achieved by the driving relationship between a sprocket 96 mounted on the output shaft 52 of the reversible electric motor 40 as shown in FIGURES 1, 2 and 4 and a driven sprocket 98 affixed to the lance tube 20 about which a drive chain 100 is trained. The lance tube 20 will, accordingly, rotate at the same speed during its projecting and retracting travel. In view, however, of the differences in the speed of the advancing and retracting movement of the lance tube, a positive predetermined change in the pitch of the helical blowing pattern of the blowing medium occurs as it is discharged from the nozzles 24 in the forward end of the lance tube 20. As shown in FIGURE 4, the helical pattern of the blowing medium discharged through the nozzle 24 during the projecting travel of the lance tube as shown in solid lines is of a greater pitch than the helical blowing pattern indicated in dotted lines obtained during the retracting travel of the lance tube. This change in pitch in the helical blowing pattern assures that uniform coverage of the heat exchanger surfaces is obtained during the traversing movement of the lance tube during a blowing operation.

Alternate satisfactory arrangements for providing a positive change in pitch between the helical blowing patterns during the projecting and retracting travel of the lance tube are illustrated in FIGURES 7 and 8. Corresponding components of the apparatus shown in FIGURES 7 and 8 are designated by the same numerals hereinbefore employed. In the soot blower arrangement shown in FIGURE 7, a variation in the relative speed of rotation and translation of the lance tube and a positive change in pitch of the helical blowing pattern is achieved by providing transmission means which varies the speed of rotation of the lance tube between its projecting travel and its retracting travel at a constant projecting and retracting speed of translation. In FIGURE 8, on the other hand, a change in pitch is achieved by a change in both the speed of translation and rotation of the lance tube between its retracting travel and projecting travel.

In the arrangement shown in FIGURE 7, the output shaft 52 of the electric motor 40 is drivingly connected to the driven shaft 54 incorporating the worm 56 thereon by means of a sprocket 102 affixed to the output shaft and a sprocket 104 affixed to the driven shaft around which a drive chain 106 is trained. The speed of rotation of the driven shaft 54 will be the same in both directions of rotation of the output shaft 52.

The rotation of the lance tube 20, as shown in FIGURE 7 during the projecting travel thereof, is achieved through a chain and sprocket transmission 108 including a sprocket 108a coupled by an overrunning clutch 110 to the output shaft of the motor and a driven sprocket 108b affixed to the lance tube about which a chain 112 is trained. Rotation of the lance tube during the retracting

travel thereof is achieved by a chain and sprocket transmission 114 comprising a driving sprocket 114a coupled by an overrunning clutch 116 to the output shaft 52 and a driven sprocket 114b connected to the lance tube 20 about which a drive chain 118 is trained. In the specific arrangement shown, the ratios of the transmissions 114 and 108 are such that the lance tube rotates more rapidly during the retracting stroke than during the projecting travel providing a helical blowing pattern during the projecting travel as shown in solid lines and during the retracting travel as shown in dotted lines which are of different pitch.

The arrangement shown in FIGURE 8 comprises a combination of the transmission mechanism as shown in FIGURES 4 and 7. Rapid outward movement of the lance tube is achieved by a chain and sprocket transmission 120 including a sprocket 120a coupled to the output shaft 52 of the electric motor 40 by a clutch 122 and a sprocket 120b connected to the driven shaft 54 and around which a drive chain 124 extends. A slower retracting travel of the lance tube 20 is achieved by a transmission 126 comprising a sprocket 126a coupled to the output shaft 52 by a clutch 128 and a sprocket 126b connected to the driven shaft 54 and around which a drive chain 124 extends. A slower retracting travel of the lance tube 20 is achieved by a transmission 126 comprising a sprocket 126a coupled to the output shaft 52 by a clutch 128 and a sprocket 126b connected to the driven shaft 54 and around which a drive chain 130 is trained.

Similarly, rotation of the lance tube at a relatively slow speed during its projecting travel is achieved through a transmission 132 including a sprocket 132a coupled to the output shaft 52 by a clutch 134 and a sprocket 132b connected to the lance tube 20 around which a chain 136 is trained. Rotation of the lance tube during its retracting travel at a relatively higher speed is achieved through a transmission 138 including a sprocket 138a coupled to the output shaft 52 by a clutch 140 and a sprocket 138b connected to the lance tube around which a chain 142 is trained.

By controlling the relative ratios of the transmissions 120 and 126 for advancing and retracting the lance tube and the relative ratios of the transmissions 132 and 138 for rotating the lance tube, the optimum combination of lance tube travel and rotation can be achieved providing for a positive pitch change in the helical blowing pattern between the projecting travel as shown in solid lines in FIGURE 8 and the retracting travel as shown in dotted lines consistent with the specific nature and disposition of the heat exchanger surfaces to be cleaned.

While it will be apparent that the preferred embodiments of the invention disclosed 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 soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including nozzles in the forward end portion thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, means drivingly connected to said motor for rotation of said lance tube in one direction and in an opposite direction in response to rotation of said motor in one direction and in an opposite direction, first transmission means engageable with said motor in response to rotation thereof in one direction for moving said carriage and said lance tube toward said projected position, second transmission means engageable with said motor in response to rotation thereof in the opposite direction for moving said carriage and said lance tube toward said retracted position at a

speed of translation different from the speed of translation during the projecting travel providing a positive change in the pitch of the helical blowing pattern discharged from said nozzles.

2. A soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including nozzles in the forward end portion thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, means drivingly connected to said motor for rotation of said lance tube in opposite directions at the same speed in response to rotation of said motor in one direction and in an opposite direction, first transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in one direction for moving said carriage and said lance tube toward said projected position, second transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in the opposite direction for moving said carriage and said lance tube toward said retracted position at a speed of translation different than the speed of translation during the projecting travel providing a positive change in the pitch of the helical blowing pattern discharged from said nozzles.

3. A soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including nozzles in the forward end portion thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, means drivingly connected to said motor for moving said carriage and said lance tube to said projected position in response to rotation of said motor in one direction and to said retracted position in response to rotation of said motor in the opposite direction, first transmission means engageable with said motor in response to rotation thereof in said one direction for rotating said lance tube in one direction during its projecting travel, second transmission means engageable with said motor in response to rotation thereof in said opposite direction for rotating said lance tube in the opposite direction during the retracting travel thereof at a speed of rotation different from the speed of rotation during its projecting travel providing a positive change in the pitch of the helical blowing pattern discharged from said nozzles.

4. A soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including nozzles in the forward end portion thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, means drivingly connected to said motor for movement of said carriage and said lance tube toward said projected position in response to rotation of said motor in one direction and for movement of said carriage and said lance tube toward said retracted position in response to rotation of said motor in the opposite direction and at substantially the same speed of translation, first transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in said one direction for rotating said lance tube in one direction during its projecting travel, and second transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in said opposite direction for rotating said lance tube in the opposite direction during its retracting travel at a speed of rotation different from the speed

of rotation thereof during its projecting travel providing a positive change in the pitch of the helical blowing pattern discharged from said nozzles.

5. A soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including a nozzle in the forward end portion thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, first transmission means engageable with said motor in response to rotation thereof in one direction for moving said carriage and said lance tube toward said projected position, second transmission means engageable with said motor in response to rotation thereof in the opposite direction for moving said carriage and said lance tube toward said retracted position at a different speed of translation from the speed of translation during the projecting travel thereof, third transmission means engageable with said motor in response to rotation thereof in said one direction for rotating said lance tube, and fourth transmission means engageable with said motor in response to rotation thereof in said opposite direction for rotating said lance tube at a speed different from the speed of rotation thereof during its projecting travel providing a combined relative speed of rotation and translation of said lance tube which is different during its projecting and retracting travel and effecting a positive change in the pitch of the helical blowing pattern discharged from said nozzles.

6. A soot blower comprising guide means, a carriage movably mounted on said guide means, a lance tube including nozzles in the forward end thereof rotatably mounted on said carriage and movable thereby to and from a projected position and a retracted position, means for supplying a pressurized blowing medium to said lance tube for discharge through said nozzles, a reversible motor, first transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in one direction for moving said carriage and said lance tube toward said projected position, second transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in the opposite direction for moving said carriage and said lance tube toward said retracted position at a speed of translation different from the speed of translation during the projecting travel thereof, third transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in said one direction for rotating said lance tube during its projecting travel, and fourth transmission means including an overrunning clutch engageable with said motor in response to rotation thereof in said opposite direction for rotating said lance tube during its retracting travel at a speed of rotation different from the speed of rotation during its projecting travel providing thereby a combined relative speed of translation and rotation which is different during the projecting and retracting travel of said lance tube effecting a positive change in the pitch of the helical blowing pattern discharged from said nozzle.

References Cited by the Examiner

UNITED STATES PATENTS

2,441,112	5/1948	Hibner et al.	15—317
2,760,222	8/1956	Anderson	15—317
2,883,694	4/1959	Hibner et al.	15—317
2,932,053	4/1960	McColl	15—317

ROBERT W. MICHELL, *Primary Examiner*.

WALTER A. SCHEEL, *Examiner*.