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C. F. LUMB ET AL

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TUBE CLEANING APPARATUS FOR BOILERS AND THE LIKE

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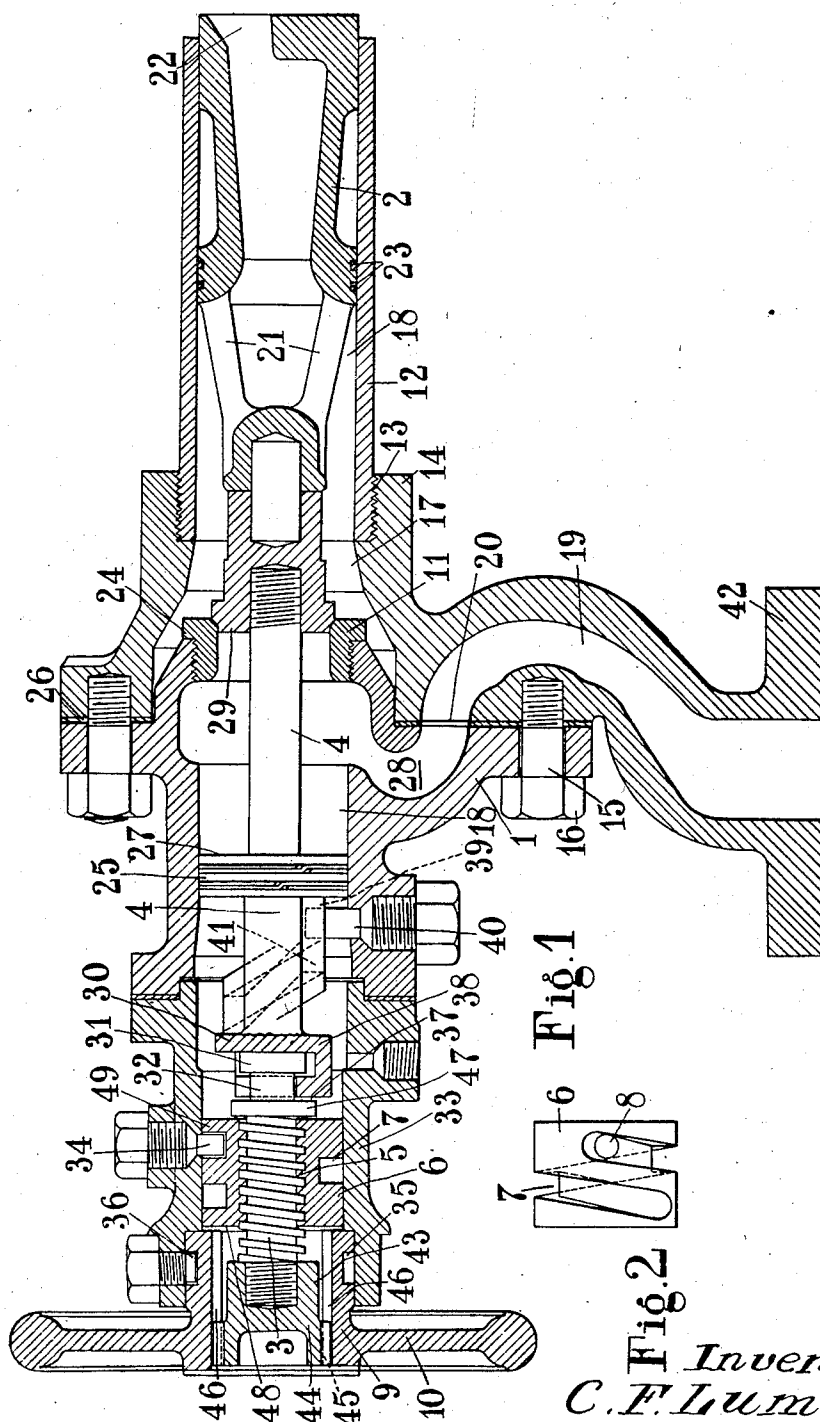


Fig. 1

Fig. 2

Inventors
C. F. Lumb
F. G. W. Spears
By Glascock, Downing & Peabody
Attys.

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TUBE CLEANING APPARATUS FOR BOILERS
AND THE LIKECharles Fletcher Lumb, Kingston Hill, and Frank
George William Spears, Potters Bar, EnglandApplication August 10, 1942, Serial No. 454,318
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1 Claim. (Cl. 15—104.045)

This invention relates to apparatus for cleaning boiler tubes and the like, commonly termed "soot blowers," and to the operator mechanism for advancing and retracting the steam ejector, which is mounted for reciprocating movement within a steam chest so that when installed in position on a boiler the steam ejector may be moved forwards or backwards into and out of its operative position under the control of an operating member in the form of a screwed spindle co-operating with a nut.

The invention has for its object to provide an improved construction of soot blower, or operating mechanism therefor, according to which the projection and retraction of the steam ejector is effected in part by the engagement of the screwed operating spindle with a stationary nut and in part by the engagement of a helical groove or scroll in this nut with a fixed pin whereby during this part of the movement of the steam ejector the nut is rotated.

The invention also consists in operating mechanism for advancing and retracting the blower nozzle of a soot blower comprising a blower nozzle and a threaded member accommodated within a stationary housing, the threaded member being adapted to be fed backwards and forwards axially relatively to the housing and to carry the nozzle with it, the nozzle being loosely operatively connected to said threaded member as a coaxial extension thereof, whereby the blower nozzle may have rotation imparted to it or be restrained against rotation during its movement of translation without altering its connection to the said threaded member, said threaded member being in screwed engagement with another, and means for rotating one threaded member relatively to the other which is restrained against rotation to produce a part of the said backwards and forwards motion but is rotatable to produce the remainder of such motion.

It is preferred (but it is not essential), in accordance with the invention, that the pitch of the helical groove or scroll on the outer surface of the nut shall be much coarser than the pitch of the screwed spindle and of the internally screw-threaded central bore into which spindle extends and it is also preferred in accordance with the invention that the operation of the mechanism shall be such that the first part of the projecting movement of the steam ejector is effected due to the engagement of the screwed spindle with the screw-threaded central bore of the nut, while the latter is held stationary, and until such time as the nut is allowed to rotate, when the second

and final part of the projecting movement of the steam ejector will take place as the result of the co-operation of the helical groove or scroll and the pin.

The invention also consists in a soot blower wherein the forward or projecting movement of the blower nozzle is effected by the engagement of a screwed operating spindle with a stationary nut, while the backward movement of the nozzle is effected by the steam loading of a piston connected with the nozzle and movable within the steam chest.

In the accompanying drawing—

Figure 1 is a longitudinal section of one and a preferred form of soot blower in accordance with the invention,

Figure 2 illustrates a detail, namely, the nut and the pin which co-operates with the helical groove therein.

Throughout the figures of the drawing, like parts have been given the same reference numeral.

In carrying the invention into effect in one convenient manner, as illustrated in Figures 1 and 2, a tube cleaning apparatus is provided comprising a fixed tubular housing or casing 1 within which there is mounted so as to be in axial alignment with each other a nozzle 2, disposed at one end of the housing, and a screwed spindle 3, disposed at the opposite end of the casing and loosely connected with the nozzle by two rod-like extensions or axially aligned tie rods 4 thereof, so that the movement of the screwed spindle backwards and forwards within the housing may be imparted to the nozzle.

Such backwards and forwards movement of the screwed spindle 3 is produced in part by the co-operation of the screwed spindle with the correspondingly screw-threaded central bore 5 of a nut 6 which is mounted within the housing and has on its exterior cylindrical surface a helical groove 7 (see Figure 2) with which a pin 8 projecting radially inwards from the fixed housing 1 engages, the outer end of the screwed spindle being formed to have a splined connection with the hub 9 of a rotary actuating wheel 10 or the like whereby the screwed spindle can slide backwards and forwards along the guideway thus provided.

The fixed casing embodies a valve seat 11 of ring formation and an axially aligned fixed tubular extension 12 of the steam chest secured, as by the screw-threading 13, to an intermediate steam branch 14 in turn jointed to the steam chest by means, for example, of studs 15 and nuts

16, the steam branch 14 having one bore 17 in axial alignment with the bore 18 of the steam chest and the said tubular extension thereof and another bore 19 directed generally radially outwards from the centre of the first bore and having its steam outlet end 20 radially offset from the central bore 17 so that both said bores at this end terminate in one and the same plane.

The steam nozzle, as is clearly shown in Figure 1, is accommodated within the fixed tubular extension 12 of the steam chest (this extension constituting the blower tube proper) and is in the form of a hollow piston having openings 21 at its inlet end, through which steam is passed to the piston interior, and a nozzle aperture 22 at its outlet end, through which the steam issues and impinges against the tubes to be cleaned. The ejector piston may be fitted with sealing rings 23 and at its outer end the piston is connected by one of the axial tie rods 4 with a plug 24 forming the movable valve part of a simple shut-down valve, the fixed seat 11 of which is the seat referred to and which movable valve part 24 is in turn connected by the other axial tie rod 4 with a piston 25 mounted for movement within the steam chest.

The apparatus is adapted to be assembled as a unit and attached to the boiler casing in the manner common to soot blowers but the present construction permits of the whole interior of the apparatus being removed while the connection to the boiler and to the main steam supply is still maintained. That this is so will appear clearer from the remainder of the description of the apparatus but it will be seen from the description already given and consideration of Figure 1 that it is only necessary to break the joint 26 between the steam chest and the steam branch, as by removal of the screw stud nuts 16, to permit the steam chest 1 and with it the entire interior thereof, including the valve seat 11, movable shut-down valve member 24 and the steam ejector 2, to be removed.

The construction of the apparatus to provide for the required movement of the steam ejector is such that the first part of the movement of the steam nozzle into the steam projecting or operative position takes place entirely or substantially in a straight line or non-rotary manner and to an extent sufficient to move the shut-down valve from the closed position to the fully open position. The steam nozzle then partakes of a rotary movement as it continues to be advanced towards the tubes to be cleaned but at that time the ejector will be receiving a full supply of steam, due to the fully open condition of the valve.

The piston 25 is formed to present an annular ledge 27 to the steam admitted to the steam chest through the steam inlet 28, via the bore 19 in the steam branch, and as the area of the ledge is greater than that of the annular end surface 29 of the shut-down valve there will be a rearward loading of the piston by the steam, with respect to the direction of flow of the steam to the ejector, and as a consequence the end surface 30 of the piston, or the rod-like axial extension 4 thereof, will tend to be maintained in close frictional engagement with the end 31 of a plain spindle portion 32 of the screwed spindle 3, which engages the nut 6 mounted within a forward axial extension 33 of the steam chest. The helical groove 7 on the exterior surface of the nut extends in the direction of the longitudinal axis of the apparatus and is en-

gaged by a pin or stud 34 fixed to the casing so as to extend inwardly therefrom. The outer end of the screwed spindle, as already described, is arranged to have sliding engagement with the interior of the hub 9 of the hand wheel 10 by which the screwed spindle is rotated and the hand wheel has an annular groove 35 on its exterior surface with which a pin 36 projecting inwards from the casing engages to prevent axial movement of the hand wheel.

The above arrangement provides that both the forward (or projecting) and the backward (or retracting) movement of the steam ejector or nozzle 2 is effected in part by co-operation of the screwed spindle 3 with the nut 6 while the latter is held stationary, and in part by the co-operation of the helical groove 7 on the nut with the fixed pin 34 engaged therein, when the nut will rotate to cause it to move forwards or backwards as the helical groove moves past the pin so that as the nut is reciprocated so will the screwed spindle be reciprocated and move, in this condition, as one with the nut.

The end face 31 of the plain part 32 of the screwed spindle is joined to the latter by the plain part being of reduced diameter to provide an annular groove 37 within which a stirrup 38 projecting from the outer end 30 of the tie rod 4 of the piston is located to provide a loose connection between these parts (in effect the screwed spindle and the piston and steam nozzle) by which the traversal movement is imparted to the steam nozzle.

As above stated, the first part of the translational movement of the steam nozzle into the operative position is merely a straight line or non-rotary motion sufficient fully to unseat the shut-down valve and this may be provided for by the rod-like axial extension 4 of the piston being provided with a straight groove 39, that is a groove which is parallel to the longitudinal axis of the apparatus, and by the stationary steam chest being provided with a stud 40 engageable with the groove. The extent of this groove is such as will provide for the complete unseating of the shut-down valve and when this has occurred the stud enters a helical groove 41 formed as a continuation of the straight groove, and for the remainder of the translational movement of the piston and hence of the steam nozzle the latter will partake also of a rotary motion. Thus, it follows that the last part of the return movement of the steam ejector, due to the steam loading of the piston, will be accompanied by a simple straight motion sufficient firmly to seat the shut-down valve and therefore close the latter again. The arrangement precludes the possibility of the movable valve member grinding upon its seat and ensures that the steam ejector nozzle receives the full steam supply before rotation thereof commences.

The steam branch 14 as above described has the bore 19 through which the steam from the main steam supply pipe flows to the steam chest and another bore 17 in which the forward end of the steam chest is received and both bores terminate at a common end surface of the steam chest, whereby it is possible to effect a steam-tight joint with the corresponding end surface of the steam chest by the single jointing member 26, which is disposed in one and the same plane. The arrangement permits of the use of the fixed valve seat 11 in rear of the steam inlet 28, having regard to the direction of flow of the steam, while permitting of the interior

of the apparatus being withdrawn without the necessity of breaking the steam joint between the end surface 42 of the steam branch and the main steam supply pipe (not shown).

The piston 25 serves to balance the steam nozzle 2 when the valve 24 is open and it is desirable to arrange that the initial part of the traversal movement of the nozzle, when the latter is connected to the steam supply and accordingly under load, shall be controlled by the rotation of the screwed spindle 3 relatively to the nut 6, which would be held stationary for this part of the traversal movement. This may be provided for by arranging that the screwed spindle has a fine pitch compared with the coarse pitch of the helical groove or scroll 7 on the outer surface of the nut and if necessary the nut could be formed to have a dragging engagement with the tubular casing in which it is mounted to ensure that the fine pitch screw operates first in the forward movement or projection of the steam nozzle. It is proposed to arrange that the fine pitch screw shall operate, by engagement with the then stationary nut, to project the steam nozzle until the valve has been unseated and the load on the piston reduced and when this happens it is proposed that the nut should rotate to produce the final part of the projection of the nozzle in a rapid manner due to the coarseness of the helical groove or scroll. On the assumption that the mechanism is arranged to operate in this manner it is proposed to provide the screwed spindle with a radial ledge at each end of the screwed portion thereof, which ledge at the outer end of the spindle may be provided by the annular end surface 43 of a plug 44 secured to this end of the screwed spindle and provided with a pair of diametrically opposite axial grooves 45 with which corresponding projections 46 on the interior of the hub of the hand wheel engage to provide the desired sliding or splined connection above mentioned. The other ledge may be provided by a collar 47 on the screwed spindle. The diameter of both ledges exceeds that of the overall diameter of the screwed spindle. With the nozzle fully retracted the ledge 43 at the outer end of the screwed spindle will be spaced from the nut but will approach the latter as the screwed spindle is rotated relatively to the nut until eventually this ledge will be brought to bear against the corresponding end wall 48 of the nut. At this time the valve 24 will have been fully unseated and thereafter rotation of the hand wheel 10 will cause the nut to rotate and move forwards (carrying with it the screwed spindle) until the pin 34 reaches the remote end of its helical groove or scroll 7. The retraction of the steam nozzle is effected by rotating the hand wheel or its equivalent in the reverse direction when, owing to the steam pressure on the piston and the rearward loading thereof, the relative movement between the helical groove or scroll 7 and the pin 34 will take place first and will be followed by the second part of the return movement of the steam nozzle by the relative rotation between the screwed spindle and the nut.

The greatest rearward load on the piston 25 is when the valve 24 is on its seat and continues to a diminishing extent until the valve has opened sufficiently to allow a substantial escape of steam

to act on the nozzle. It is therefore desirable that the forward movement which causes this to take place should be controlled by a fine pitch screw, such as it is proposed to provide on the spindle, so that as the pitch of the helical groove or scroll is coarse the fine pitch screw will be effective before the helical groove or scroll. When the valve has been opened the internal assembly is nearly in balance and the increased rapidity of thrust desirable in order to complete the blowing operation is obtained when the coarser pitch of the scroll on the periphery of the nut comes into action.

The fine pitch screw on the spindle facilitates dealing with the larger load to be dealt with at the beginning of the projecting movement of the steam nozzle and the coarse pitch of the scroll admits of a desirable increase in operational speed when the initial load has been sufficiently reduced.

On the backward movement the time of functioning of the scroll 7 will be reversed due to the permanent steam loading then prevailing so that the closing of the valve and the shutting off of the steam may be simply and rapidly effected. In any case, on the reverse rotation of the hand wheel or its equivalent the ledge 47 on the other end of the screwed spindle will under certain conditions be brought to bear against the inner end face 49 of the nut to ensure that the scroll shall at all times function to effect the desired part movement in this direction of travel.

We claim:

Apparatus for cleaning boiler tubes and the like comprising a hollow casing forming a steam chest and provided with an inlet for the operating fluid, a valve seat at the inner end of the steam chest, a blower nozzle arranged within the casing, a valve carried with the nozzle and cooperating with the seat, a finely threaded spindle arranged in the casing as a coaxial extension of the nozzle and in loose operative connection with the inner end of the blower nozzle, a piston also carried with the nozzle and of greater area than the valve so that the fluid causes the nozzle to exert pressure on the threaded spindle, the piston being provided with an inclined groove and a straight groove communicating therewith, a pin in the casing operating in the communicating grooves to effect an initial straight movement of the piston during initial opening of the valve and a subsequent turning movement thereof and of the nozzle when the pin engages the inclined portion of the groove, an abutment on the outer end of the threaded spindle, an operating member rotatably mounted on the casing and slidably receiving the abutment, a finely threaded nut mounted within the casing and through which the finely threaded spindle is operatively mounted, a pin and coarse helical groove connection between the outer surface of the nut and the casing, the arrangement being such that when the operating member is rotated, the spindle first moves through the nut until the abutment strikes the latter whereupon the nut partakes in a limited rotary movement which is translated to the blower nozzle.

CHARLES FLETCHER LUMB.
FRANK GEORGE WILLIAM SPEARS.