Nov. 11, 1969 J. E. J. DULAIT 3,477,085

SOOT BLOWING DEVICES

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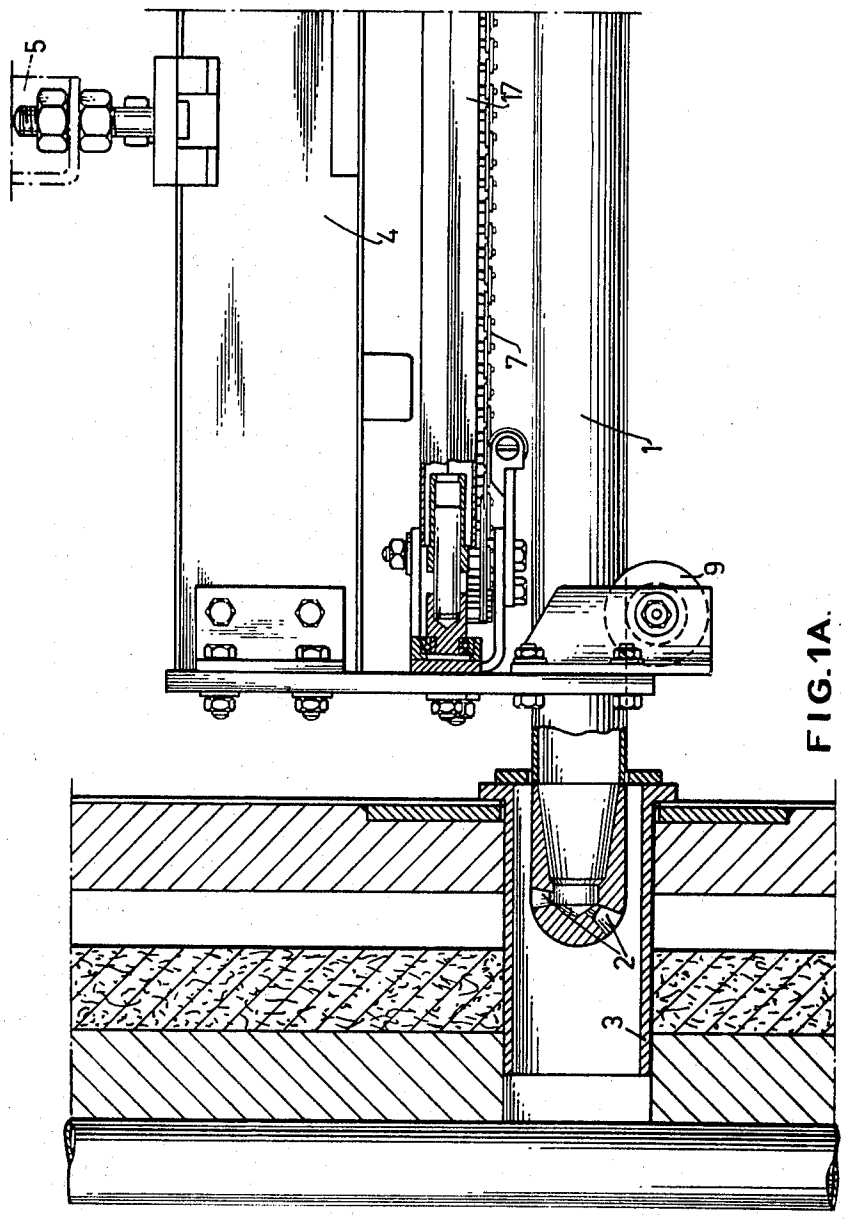


FIG. 1A.

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Nov. 11, 1969 J. E. J. DULAIT 3,477,085

SOOT BLOWING DEVICES

Filed Sept. 19, 1966 9 Sheets-Sheet 2

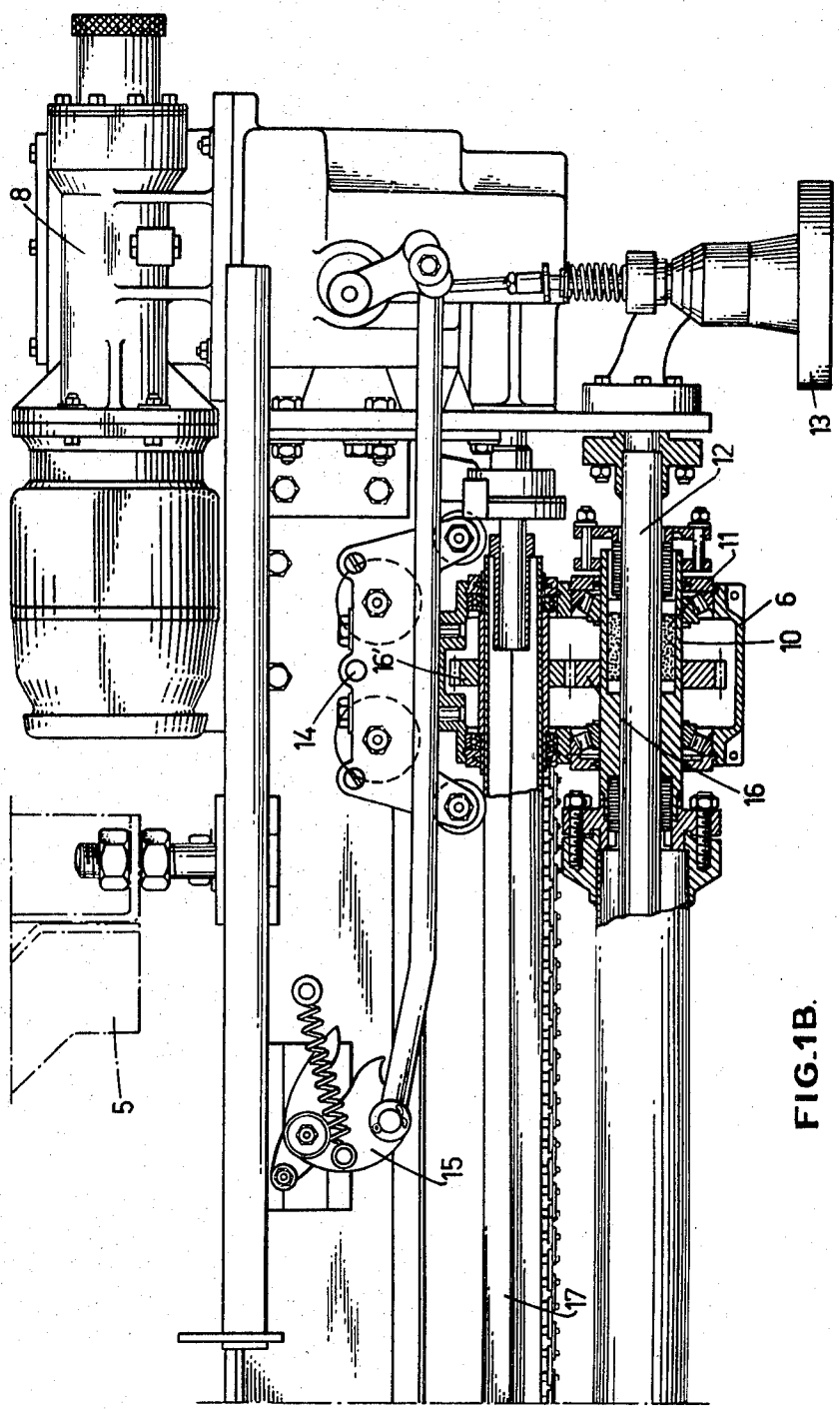


FIG.1B.

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SOOT BLOWING DEVICES

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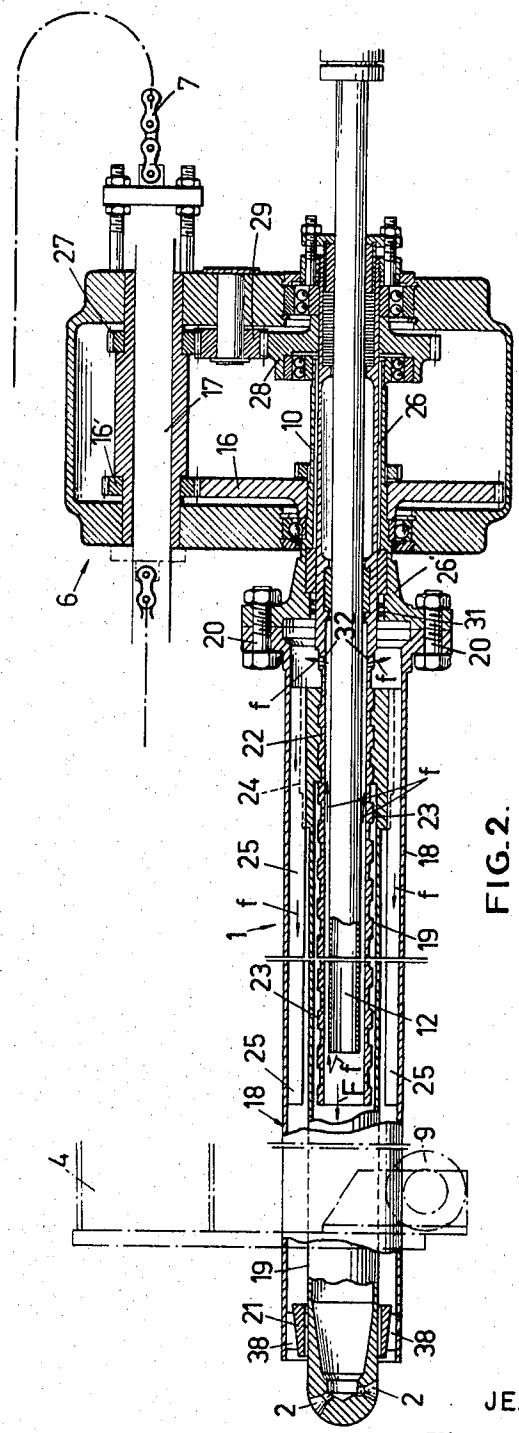


FIG. 2.

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SOOT BLOWING DEVICES

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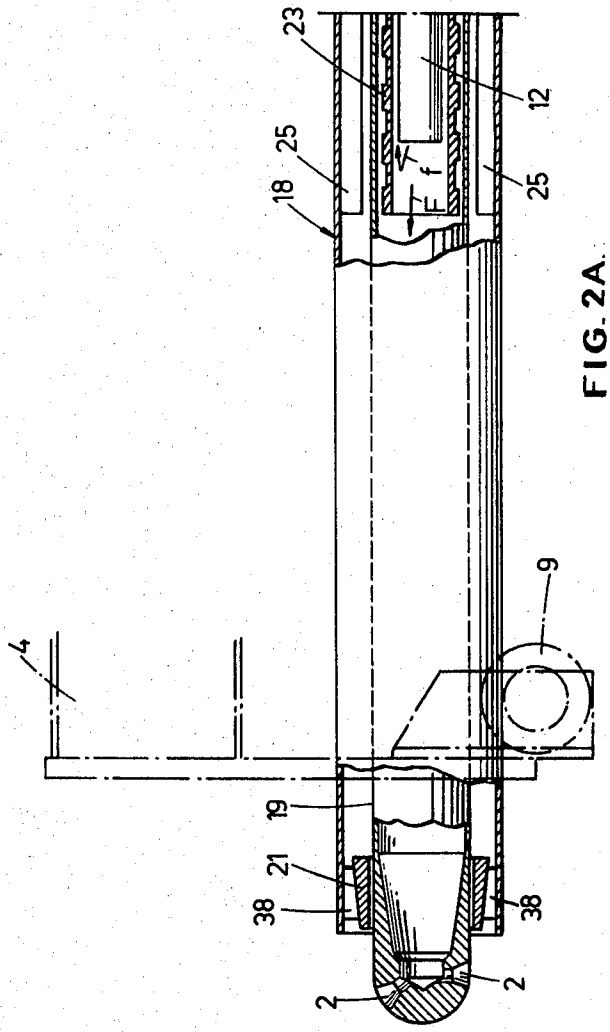


FIG. 2A.

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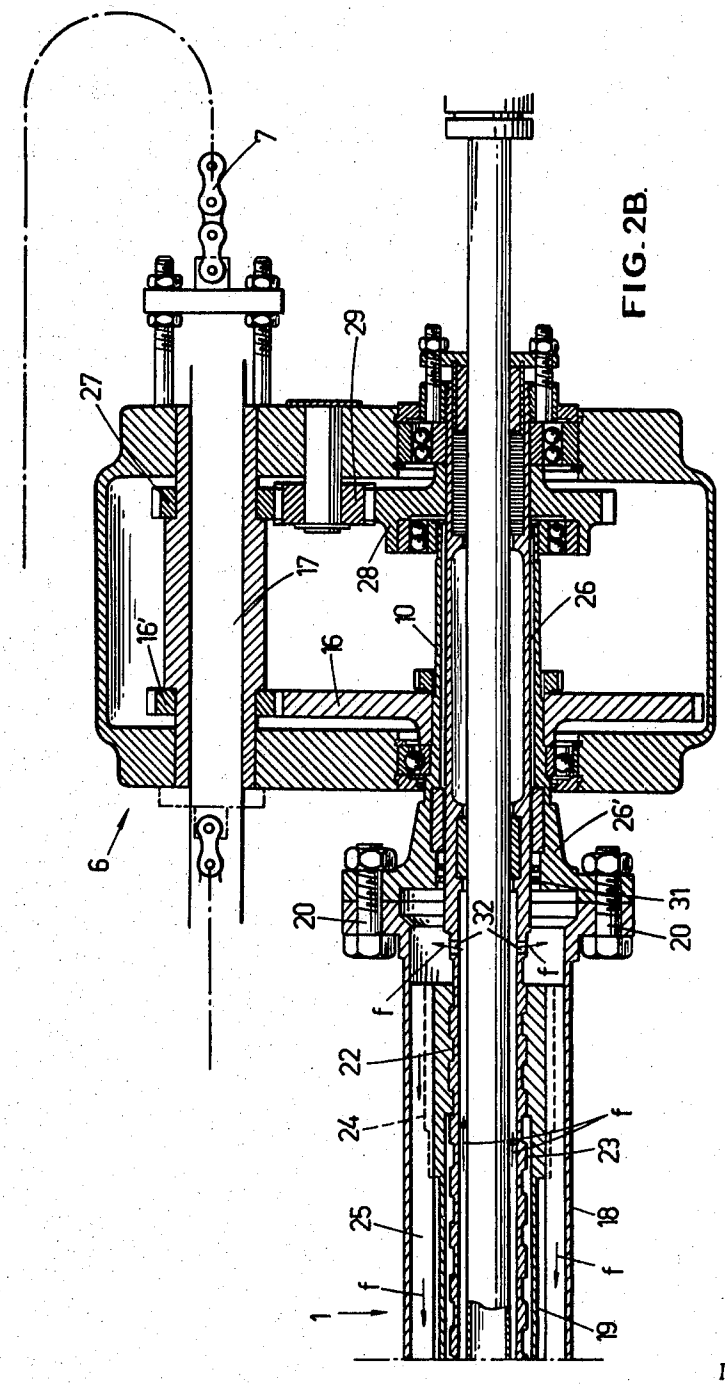


FIG. 2B.

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SOOT BLOWING DEVICES

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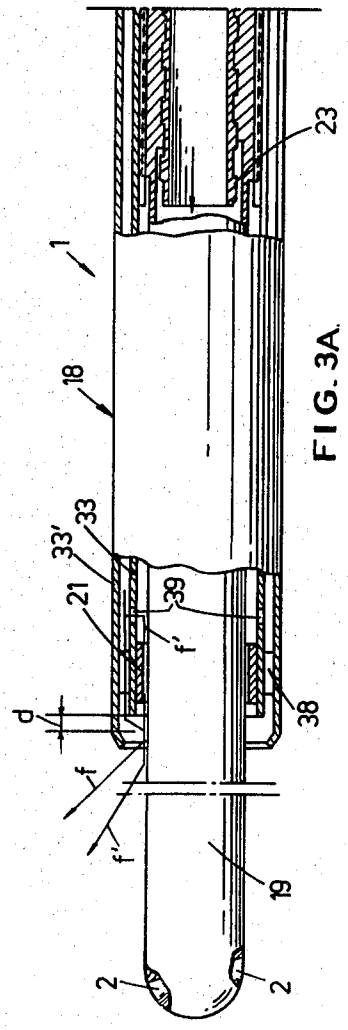


FIG. 3A.

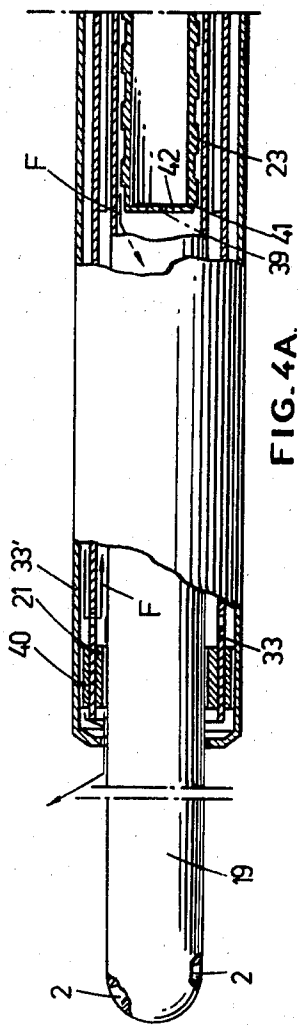


FIG. 4A.

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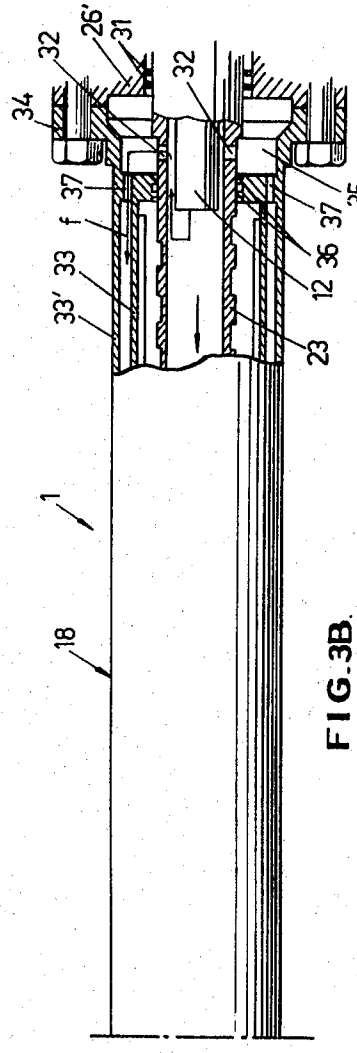


FIG.3B.

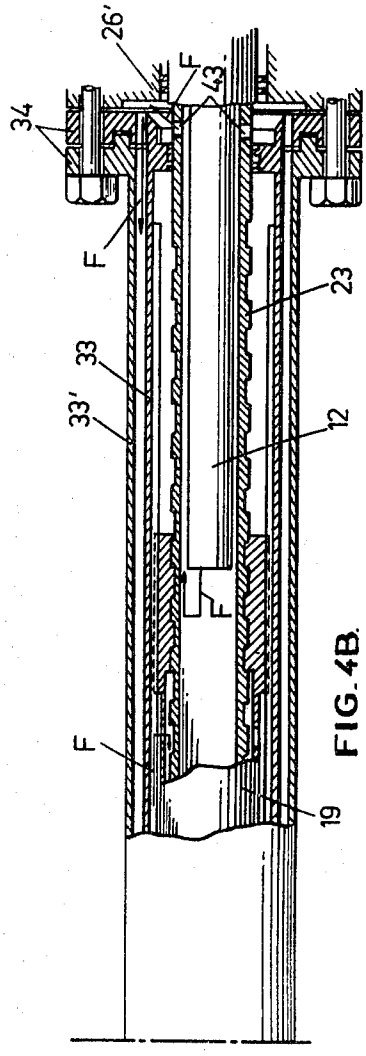


FIG.4B.

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SOOT BLOWING DEVICES

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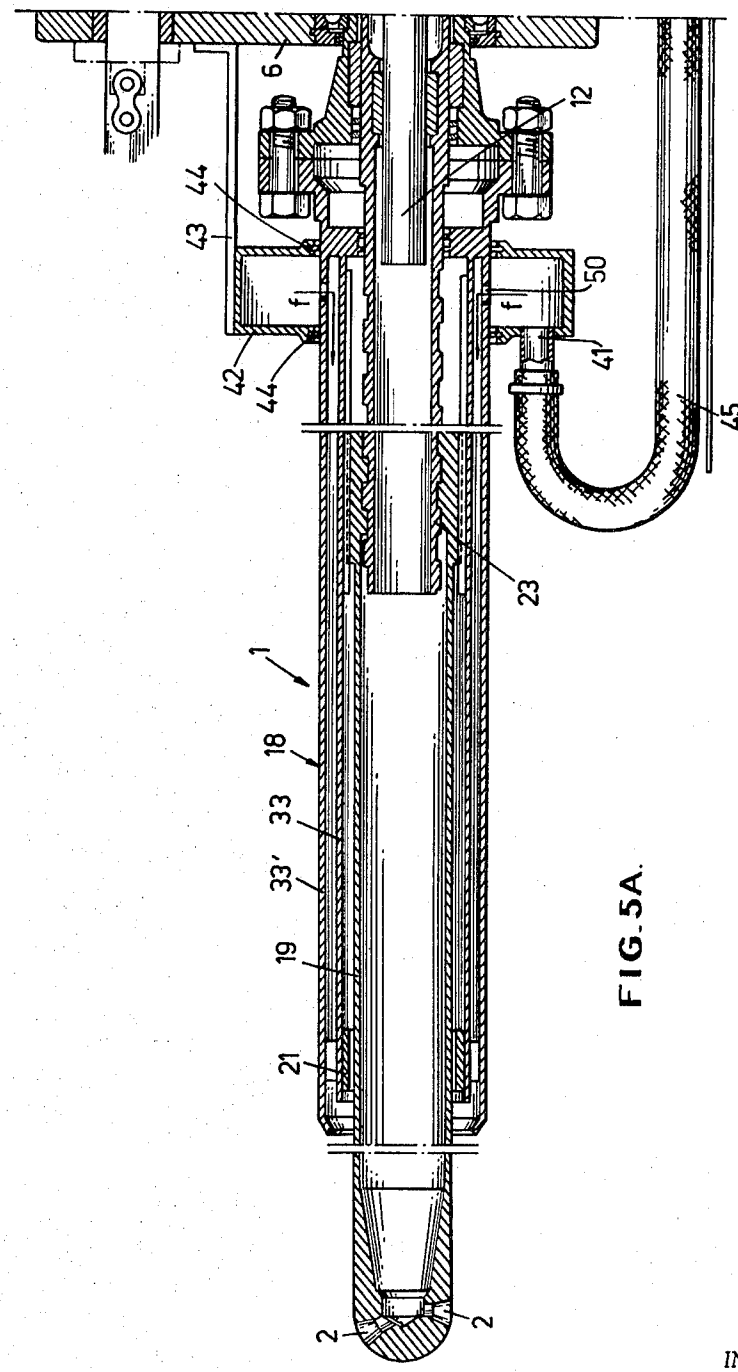


FIG.5A.

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SOOT BLOWING DEVICES

Filed Sept. 19, 1966 9 Sheets-Sheet 9

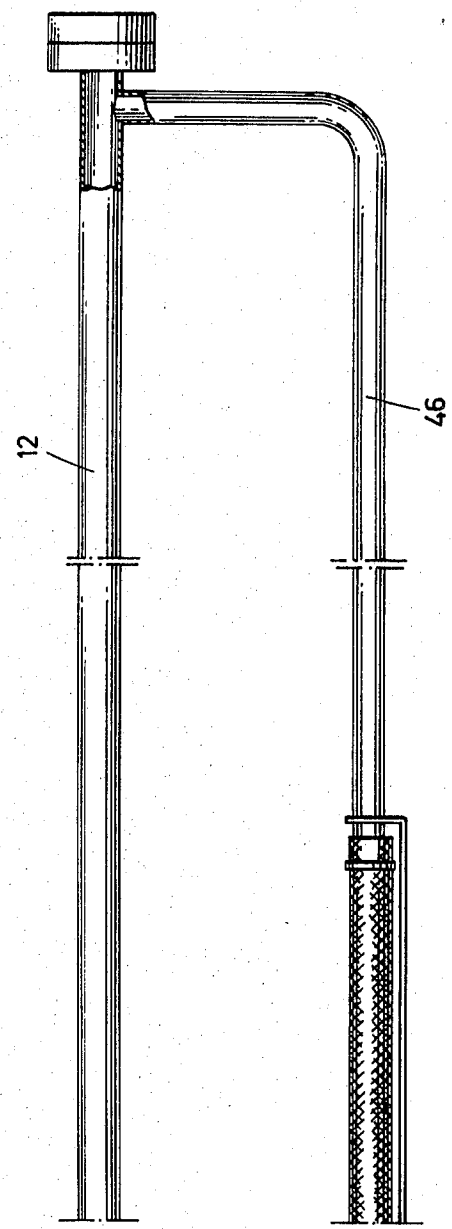


FIG.5B.

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United States Patent Office 3,477,085
Patented Nov. 11, 1969

3,477,085

SOOT BLOWING DEVICES

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Claims priority, application Belgium, Sept. 21, 1965, 669,895
Int. Cl. F23j 3/00; F27d 23/00; F28g 13/00
U.S. Cl. 15—317 19 Claims

ABSTRACT OF THE DISCLOSURE

A device for blowing out the soot to clean heat exchangers, boilers, etc., said device comprising two lance telescopic sections which are supported by a trolley driven on rails. The external section is the lance carrier rotatably mounted on the said trolley while the internal section is provided with a nozzle to blow a blowing fluid inside the apparatus. The internal lance section is provided with an internal thread cooperating with a screw which is supported by the said carriage. The external face of the lance internal section is provided with catches engaging slides provided on the inner face of the lance-carrier. When on the trolley being moved the lance-carrier is rotated it drives in rotation the internal section of the lance, which on account of its thread engaging the screw, moves in relation to the lance-carrier.

The object of the invention is to provide a device for blowing out the soot to clean the inner faces of apparatus such as heat exchangers, boilers, etc., comprising a mobile lance to be used to penetrate the said apparatus for the cleaning operations, said lance being provided with one or more blowing nozzle and being controlled from a trolley running on guide rails, means being provided for driving said trolley, for controlling the admission of blowing fluid to the lance and to assure the cooling of the latter.

The known soot blowing devices comprise a mobile lance provided at its end with one or a plurality of nozzles, through which escapes a blowing fluid, such as compressed air, stream, etc., for impinging on the internal faces of apparatus, such as heat exchangers, boilers, etc., in order to clear them of the soot deposits accumulated thereon. The said lance is integral with a trolley, which, in order that the lance be driven in or withdrawn from said apparatus, is hauled for example on an endless chain by means of a motor and a reduction gear, and runs on a beam, the ends of which are connected to the frame-work of the building housing the apparatus. The disadvantage of this type of device is its large overall dimension. Indeed, in addition to the space needed for housing the drives and accessories of the lance, the full length thereof must, when in the rest position, be located outside of the said apparatus. When large size apparatus are used, the overall dimension of the device becomes excessive and, particularly when a plurality of apparatus are mounted side by side, the cost of construction of the buildings for housing said apparatus and the blowing devices together with the accessories thereof, becomes prohibitive.

The purpose of the invention is to overcome this disadvantage by providing blowing devices, the lance whereof is of low overall dimension when it is in the rest position.

For that purpose, according to the invention, the said mobile lance comprises two or more telescopically assembled components, one of said component being actuated, in order to move along the longitudinal axis thereof, by the said trolley, means being provided to control the other component from the component actuated by

the trolley, so as to assure the longitudinal displacement thereof with reference to the latter component, the longitudinal movements of the two components taking place in the same direction.

According to a form of embodiment of the invention, the component of the lance actuated by the trolley comprises a tube wherein is coaxially mounted the second component, also in the shape of a tube, the latter component having, at it send penetrating the apparatus to be cleaned, the blowing nozzle, a feed duct for the blowing fluid opening inside the latter component.

According to an advantageous form of embodiment of the invention, the component of the lance actuated by the trolley is rotated around its axis, for example through the means provided for the drive of said trolley, the means provided to assure the lengthwise movement of the second component of the lance with reference to the component controlled by the trolley comprising a screw, coaxial with the said components, and mounted inside the component carrying the blowing nozzle, said screw being driven in a travel, along its axis, by the trolley, at the same speed as the component of the lance actuated by said trolley, the said screw not rotating around the axis thereof and cooperating with a tapping provided in the component carrying the blowing nozzle, the latter being driven in a rotary motion by the component actuated by the trolley, through one or more catches, integral with the external face of the component provided with the said nozzle engaging a corresponding slide provided, parallel to the axis thereof, inside the component of the lance driven by the trolley.

According to a particularly advantageous form of embodiment of the invention, the said screw is provided, through the member rotating the component of the lance actuated by the trolley, with a rotary movement around its axis.

Other details and features of the invention will become apparent from the description of the drawings accompanying the present specification and which represent, by way of non limitative examples, various forms of embodiment of the object of the invention.

FIGURE 1, subdivided in FIGURES 1A and 1B, shows an elevational view, partially in section, a known soot blowing device, this view showing the drive of the blowing lance and the equipment for admitting the blowing fluid in the said lance.

FIGURE 2 shows an elevational sectional view of a blowing device according to the invention as well as the drives of the components comprising the lance and the said screw.

FIGURES 2A and 2B are subdivisions of FIGURE 2 to show the same on an enlarged scale.

FIGURES 3, 4 and 5, subdivided in FIGURES 3A and 3B, 4A and 4B, 5A and 5B, show elevational sectional views of blowing devices according to the invention wherein the cooling of the different components comprising said devices is carried out in a different manner from that shown in FIGURE 2.

In the different figures, the same reference items refer to similar components.

The known device shown in FIGURE 1, comprises a lance 1 provided with nozzles 2 through which escapes the blowing fluid, on being introduced into and withdrawn from the apparatus to be cleaned, the lance 1 is provided with a rotary movement around its longitudinal axis, in order that the blowing fluid shall clear the internal walls of the apparatus of soot deposits accumulated thereon. The lance 1 passes through the walls of the apparatus to be cleaned inside a channel 3 and is driven by a trolley 6 guided on a rail 4 the ends of which are secured by beams 5 to the frame-work of the building housing the apparatus and the blowing devices. Trolley 6 is hauled

on rail 4 by means of an endless chain 7 driven by a reduction gear motor 8. The lance 1 is guided at its end close to the said apparatus, by a bearing carrying a roller 9 and is fastened, at is opposite end with reference to the nozzles 2, to a casing 10 carried by the trolley 6. The casing terminates in a stuffing box 11 which surrounds the blowing fluid feed pipe 12, this pipe being fed through a valve box 13 which admits the blowing fluid to the pipe 12 and from there to the nozzles 2, when a rocker 14, mounted on the trolley 6, tilts a fork 15 which actuates the opening of the valve, the opening of the latter taking place on the lance 1 entering the apparatus to be cleaned, the closing of the valve taking place when the trolley has brought the lance 1 to its rest position (position shown on the drawing). The rotation of the casing 10 and of the lance 1 is effected by the gear wheels 16 and 16' housed in the trolley and is controlled by the rotation of a pin 17, of square cross-section, on which is mounted the driving gear wheel 16, the pin 17 being rotatively driven by the reduction gear motor 8.

The device shown in the FIGURE 1 has the disadvantage of being very bulky. The devices, according to the invention, shown in the FIGURES 2, 3, 4 and 5 offer the great advantage that, for a length of lance equal to the length of that of the device described hereinbefore, their total length is substantially reduced by half with reference to the length of the device shown in FIGURE 1.

As shown in the FIGURES 2, 3, 4 and 5, the lance 1 comprises two telescopically assembled coaxial tubular components 18 and 19. The component 18 termed hereinafter "the lance-carrier" is fastened, at one of its ends, to the casing 10 carried by the trolley 6 and is guided, at its other end, by a bearing carrying the roller 9. The lance-carrier 18 is of such a length that it may penetrate or be withdrawn from the apparatus to be cleaned by a length substantially equal to one half of the overall length of lance 1 when the trolley carries out, on account of the endless chain, a complete stroke. The lance-carrier 18, fastened to the casing 10 by bolts 20, is rotatively driven by the shaft 17 of square cross-section through the gear wheels 16 and 16'. The actual lance 19 with the nozzles 2, is carried at its end close to said nozzles inside a bearing 21, provided inside the lance-carrier 18 while its other end has a tapping 22 cooperating with a screw 23, coaxial with the lance 19 and with the lance-carrier 18, mounted inside the lance 19. The screw 23 is carried by the trolley 6 and driven on its travel along its axis by the said trolley at the same speed as the lance-carrier 18. The lance 19 is driven in a rotary motion by the lance-carrier 18, through catches 24 cooperating with corresponding slides 25, provided parallel to the axis thereof inside the lance-carrier. When the lance-carrier 18 rotates, it drives the lance 19 in a rotary motion at the same speed as itself and effects at the same time, through the screw 23, the catches 24 and the slides 25, a travelling motion of lance 19 with reference to itself and therefore with reference to the trolley.

The working pitch of the lance is consequently equal to the pitch of the lance-carrier 18 increased by the relative pitch of the lance 19 with reference to said lance-carrier.

If it is desired, when the trolley carries out a full stroke, that the lance-carrier 18 shall enter in or be withdrawn from the apparatus to be cleaned by a length substantially equal to one half of the overall length of the lance, which assures the minimum dimension of the device, the relative pitch of the lance must be substantially equal to the pitch of the lance-carrier 18. If the screw 23 does not rotate around the axis thereof, its pitch, in order to assure the minimum dimension of the device, would have to be more or less equal to the working pitch of lance-carrier 18. In view of, on the one hand, the size generally selected for this working pitch, and, on the other hand, the narrow diameter of the screw 23, the pitch of said screw would substantially differ from the pitch of best possible efficiency for such a screw, which would have as a result a heavy wear, a great stiffness of operation and possibly seizing. In order to prevent these disadvantages, the screw 23 may, as shown in FIGURE 2, be rotated, so as to permit, by selecting a favourable pitch with reference to the diameter thereof, a variation of the relative pitch lance-lance-carrier from zero to infinity. Indeed, the relative pitch will be zero should the screw 23 rotate in the same direction at the same speed as the lance-carrier 18, the relative pitch lance-lance-carrier shall be equal to the pitch of screw 23 should the latter be stationary and equal to twice the pitch of the screw should the latter rotate at the same speed as the lance-carrier 18 with a direction of rotation inverse to that of the lance-carrier.

Evidently, for an ideal value of the pitch of screw 23, it will be easy to determine gear wheels driving screw 23 so that the relative pitch of the lance shall be equal to one half of its working pitch.

Screw 23 is hollow and surrounds the blowing fluid feed pipe 12. Said screw comprises an extension 26 mounted inside the casing 10 and is driven by the pin 17 by means of the gear wheels 27 and 28. In order to invert the direction of rotation of the screw 23 with reference to the direction of rotation of the lance-carrier 18, it is sufficient to intercalate a pinion 29 between the gear wheels 27 and 28 as shown in FIGURES 2 and 2B.

In the form of embodiment of the device shown in FIGURE 2, the lance 19 starts its relative movement inside the lance-carrier, as soon as the lance-carrier 18 begins its travelling and rotary motion, said relative movement of the lance continuing throughout the stroke of trolley 6. The friction stresses between the screw 23, the lance 19 and the lance-carrier 18 on account of the overhang of the lance 19 increase in magnitude progressively with the advance of the latter inside the apparatus to be cleaned. The lance and the lance-carrier are also exposed to an increase of temperature in proportion with the influence of the temperature of the gases of combustion as well as of the radiation, with the result that the frictions connected with the operation of the device occur between faces, the temperature whereof is continually rising, so as to lead, in the case of extended strokes, to wear and eventually to disastrous jamming.

According to the invention and in order to mitigate these difficulties it has been provided to initiate the relative movement lance-lance-carrier when the lance-carrier is located outside the apparatus to be cleaned. The frictions arising from the normal operation of the device will then take place in the cold state under the best possible conditions. In order that the lance 19 shall penetrate the apparatus while the lance-carrier is immobile with reference to the travel thereof, it is provided, for example, to actuate the shaft 17 and the endless chain 7 by means of separate reduction gear motors, end of stroke members starting or stopping said motors at the given moment. The operations of introducing the lance in the apparatus to be cleaned then take place in two steps. During the first step, the trolley 6 is immobile and is in its position most remote from the apparatus, while the lance-carrier 18, also immobile as regards the travel thereof, rotates and causes the progression of the lance 19 in the apparatus by a length substantially equal to one half of the overall length of lance 1. During the second step, the trolley is provided with a travelling motion which will result in the lance-carrier 18 penetrating, while rotating on its axis inside the apparatus by a length substantially equal to one half of the overall length of said lance 1. During the whole of the second step, the screw 23 rotates at the same speed as the lance-carrier 18 and in the same direction as the latter, so as to cancel out the relative movement lance-lance-carrier.

The lance of a soot blowing device has generally to penetrate apparatus at locations where it is exposed to the action of combustion gases at very high temperatures as well as to flame radiation. In order that the metal of the lance **19** and the lance-carrier **18** shall retain adequate mechanical characteristics, it is essential to cool the components of the lance. In the devices shown in the FIGURES 2 and 5, use is made of the blowing fluid itself for the cooling action. The known devices have the disadvantage, that when they are used in very hot areas of the apparatus to be cleaned and in the case of large strokes of the lance, they call for a flow at the nozzles far in excess of that needed for the cleaning alone, this supplementary flow being solely caused by the need to cool the lance. The blowing devices according to the invention offer the advantage of using a lance **19** of fairly narrow diameter. The diameter of said lance may indeed be narrow, considering that the lance **19** is of a length substantially equal to one half of the length of a normal lance. The narrow diameter of the lance **19** entails a reduction of the rate of strain of the tube, comprising said lance, where it is fitted inside the lance-carrier **18** with the result that the flow needed for cleaning the apparatus is substantially adequate to cool the lance, even in the case of the most heavy thermal stresses. The lance-carrier **18** is of a fairly large diameter considering the mechanical stresses arising from its own weight and from that of the lance **19**. In order that it shall retain permissible mechanical characteristics, the lance-carrier has to be efficiently cooled. This cooling will of course be conditioned by the temperatures present in the apparatus to be cleaned at the location where the blowing devices operate. The object of the invention is to cool the lance-carrier **18** as well as bearing **21** at the end thereof and which carries the lance while taking care to maintain at a permissible temperature the slides **25** as well as the threads of the tapping **22** and of the screw **23**. Depending on the conditions of cost, on the permissible loss of head within the device and on the temperature to which the tubes of the lance **19** and of the lance-carrier **18** are exposed, the invention provides two types of solutions. The first of these solutions makes use of a lance-carrier comprising a single tube, while the second solution provides a lance-carrier **18** comprising two concentric tubes. The first solution is shown in FIGURE 2 (lance in the position at rest). The blowing fluid leaving the feed pipe **12** passes without restriction in the lance **19**, according to arrow F; the cross-section of the nozzles **2** conditioning the adequate cleaning flow. The cooling fluid bled from the blowing fluid follows the path shown by the arrows *f*, said cooling fluid flowing between the fluid feed pipe **12** and the inner wall of screw **23** to pass through ports **32**, provided in the screw **23**, in order to flow between the lance **19** and the lance-carrier **18**, the packing ring **31** provided between the screw **23** and the casing **10** preventing any leak of fluid towards the trolley **6**. The cooling fluid will be of satisfactory efficiency as it flows inside an annular space of small cross-section. The flow of the cooling fluid may be controlled through the cross-section of flow of the ports **32** provided in the screw **23**, but will also be conditioned by the annular space present between the lance **19** and the bearing **21**. This annular space bears an immediate relationship to the wear of said bearing. It is therefore necessary to reduce such wear and to provide forcible cooling of the bearing with that end in view. In order to achieve a satisfactory cooling of bearing **21**, this is of taper shape and is mounted on the lance-carrier **18** by means of fins **38** disposed in a radial direction, the cooling fluid, flowing between the outer wall of the bearing **21** and the fins **38**, passes through cross-sections of increasing size so as to expand more or less adiabatically in order to achieve a satisfactory cooling of the end of lance-carrier **18** and the bearing **21**.

The second solution put forward for cooling the lance-carrier **18** may be carried out in several variants, two of which are shown in FIGURES 3 and 4. The lance-carrier **18** comprises two coaxial tubes **33** and **33'**. Said tubes **33** and **33'** have their end close to the trolley **6** integral with a common flange **34** (FIGURE 3) or with a flange in two components (FIGURE 4) fastened to the flange **26'** of the casing **10**. The flanges **34** and **26'** provide between one another an annular space **35** made leakproof by the packing rings **31** and **36**. Ports **32** and **37** provided respectively in the screw **23** and in the flange **34** allow the cooling fluid to pass, as shown by the arrows *f*, from the interior of the screw **23** into the annular space **35** and, from there, into the annular space provided between the two tubes **33** and **33'** which make up the lance-carrier **18**. As shown in FIGURE 3, the bearing **21** of the lance **19**, drawn out in full, is fastened to the tube **33** of the lance-carrier **18**, said tube **33** being supported by tube **33'** through fins **38** secured either to the tube **33**, or to the tube **33'**, this assembly allowing both tubes to expand freely one with reference to the other. In the form of embodiment shown in FIGURE 3, it will be noted that the cooling flow is quite independent from the wear of bearing **21**. In order to prevent wear of said bearing to the fullest possible extent, its cooling may eventually be assisted by the provision of one or a plurality of ports **39** which cause a leak of the cooling fluid along the arrows *f'*. The distance *d* may control the flow of cooling fluid. As the distance *d* varies in ratio of the temperature of the tube **33'**, when the latter expands the flow of cooling fluid will be the greater, the more said distance *d* increases, i.e. the greater, the more the temperature of the tube **33'** rises.

The lance-carrier **18** shown in FIGURE 4 also comprises two co-axial tubes **33** and **33'** which are assembled by the flange **34** to the flange **26'** of the casing **10**. The bearing **21** of the lance **19** is mounted inside the tube **33** and the spacing between the tubes **33** and **33'**, at the location of bearing **21**, is maintained by members **40** permitting differential expansions of the tubes, said members **40** afford a maximum restriction of the passage of the cooling fluid to the outside to the extent consistent with an adequate cooling of bearing **21**. The blowing fluid feed pipe **12** delivers the blowing fluid within the hollow screw **23** sealed off at its end **41**. It is therefore substantially the whole of the flow of fluid meant for cleaning the apparatus which will flow, along the arrows F, to cool the tubes **33** and **33'**, the bearing **21**, the screw **23** and lastly the tube comprising the lance **19**. This embodiment makes it possible to achieve a forcible cooling of lance-carrier **18**, but entails a considerable loss of head of the cleaning fluid. In order to produce this loss of head, the wall **42** sealing the screw **23** may be provided with an opening **39** shown in dashed lines in FIGURE 4, the cross-section of said opening being computed so that the flow of fluid passing through the ports **43** of the screw shall be adequate to assure the cooling of the tubes comprising the lance-carrier **18**.

It should be noted that the embodiments described shown in the FIGURES 2, 3 and 4 only differ in the design of the lance-carrier **18**. The lance, the screw and the casing are identical in these three cases. This feature is of interest with reference to the global cost of a soot blowing installation. The devices located in the hottest areas will be the only ones to be provided with a lance-carrier **18** with two tubes **33** and **33'**. The other devices, located in less hot areas, will be provided with a single tube lance-carrier. The temperature of the gases to which these latter devices are exposed being lower, the wear of bearing **21** will be low and to the extent that this wear shall affect the cooling flow, it will affect a flow which will be low for the same reason. This wear of the bearing **21** will therefore not be very considerable.

As mentioned hereinbefore, it is of interest to provide in the devices according to the invention a lance **19** of

narrow diameter in order that the flow of cleaning fluid shall be sufficient for the cooling thereof. This entails evidently a fairly narrow diameter for the feed tube **12**. As the latter, according to the devices described hereinbefore, has to feed both the cleaning flow as well as the cooling flow of the lance-carrier **18**, it may happen that, in the case of the devices located at the hottest locations of the apparatus to be cleaned, the loss of head in the fluid feed pipes becomes prohibitive. For the few devices of a cleaning installation which would be in that case, it would not be economical to design a special blower with larger feed tube diameters and consequently greater diameters of the screw **23**, lance **19** and lance-carrier **18**. The invention provides to retain the normal dimensions of said components which are adequate for the majority of devices and to supply the devices operating in the hottest locations with cooling fluid by means of a feed separate from the feed pipe **12**.

As shown in FIGURE 5, the cooling fluid is fed through a pipe **41** and independently from the blowing feed pipe **12**, into an annular chamber **42**, the latter being connected, through ports **50**, with the annular space provided between the two tubes **33** and **33'**, the cooling fluid flowing according to the arrows *f*, between the two tubes, so as to cool the lance-carrier **18** as well as the bearing **21** of the lance **19**. A rigid connection **43** between the chamber **42** and the trolley **6** prevents said chamber from being rotated by the lance-carrier **18**, packing rings **44** preventing any leak of the cooling fluid between the chamber and the tube **33'** of the lance-carrier. The pipe **41** is supplied with fluid by a contractible pipeline connected downstream of the blowing fluid inlet valve either directly to the valve chamber **13**, or, as shown in FIGURE 5, to the start of the blowing fluid feed pipe **12**. The contractible pipeline comprises a hose **45** connected to a rigid pipe **46** in communication with pipe **12**. The contractible pipeline could also, for example, be carried out using rigid coaxial tubes fitting one into the other and able to slide along their axis one with reference to the other.

The principle of a separate cooling fluid feed offers another advantage. Indeed, if the blowing is carried out by compressed air (frequently at 30 atmospheres at the compressor) it is possible to feed the device, through a separate pipeline with cooling fluid from an intermediate compressor stage or again from the general compressed air main. The pressure of said fluid will in that case be lower than that needed for cleaning and the power needed for the compression of the fluid to an unnecessarily high level may be saved. If the blowing is carried out by steam, the lance-carrier **18** may be cooled by compressed air, which affords a better cooling of the lance-carrier particularly when the steam used for blowing out is heavily superheated. If, on the contrary, the whole output of the said compressor is needed for cleaning, it may then be suitable to carry out the cooling of the lance-carrier **18** with steam produced, for example, by the very apparatus to be cleaned. The lance-carrier may also be cooled with water or with a fluid of low steam tension.

It must be understood that the invention is in no way limited to the forms of embodiment described and that many changes may be made to the latter without departing from the scope of the present patent application.

Thus the improvements to blowing devices do not solely apply to devices making use of a chain **7** and of a shaft **17** of square cross-section, these improvements may also apply to any other devices, such as for example devices making use of a rack and a shaft of square cross-section, or again of a rack and a reduction gear motor mounted on the trolley and driving the latter.

It is also to be noted that the cooling system for the bearing **21** shown on the FIGURE 2 might also be applied to cool the bearing **21** of the devices shown in FIGURES 3, 4 and 5.

I claim:

1. A device for blowing out the soot to clean the inner faces of apparatus such as heat exchangers, boilers, etc. comprising a pair of lance pipe sections arranged for telescopic movement one within the other, a nozzle carried by the inner section named hereinafter the lance, a blowing fluid feed pipe connected to feed blowing fluid inside said lance, a trolley mounted for movement in a direction parallel to the lance, driving means for said trolley, said pipe sections being mounted on said trolley for movement therewith, means for rotating said external section named hereinafter the lance-carrier upon movement of said trolley and means operating upon rotation of said lance-carrier to move the lance longitudinally relative to said lance-carrier.

2. A device as claimed in claim **1**, which comprises a screw coaxial with said lance sections and mounted inside said lance, supporting means for the said screw in the said trolley, a thread provided on the lance for cooperation with the said screw, means operating upon rotation of the said lance-carrier to rotate the said lance.

3. A device as claimed in claim **2** wherein means to rotate the said lance upon rotation of the said lance-carrier comprise catches provided on one of the lance sections and slides provided on the other lance section parallel to the longitudinal axis thereof, the catches engaging said slides.

4. A device as claimed in claim **3**, wherein the said screw is hollow, so as to admit the blowing fluid feed pipe.

5. A device as claimed in claim **3**, wherein means are provided for rotating the said screw.

6. A device as claimed in claim **5**, wherein means are provided so as to render the speed of rotation of the screw variable with reference to the speed of the lance-carrier.

7. A device as claimed in claim **6**, comprising a rotating member mounted in the said trolley, means for rotating the said member, first driving means for rotating the said lance-carrier upon rotation of the said member, a set of gear wheels to vary the speed of rotation of the screw with reference to the speed of rotation of the said lance-carrier and driving means for the rotation of the said gear wheels upon rotation of the said member.

8. A device as claimed in claim **7**, wherein the said screw is provided, around the axis thereof, with a rotary movement taking place in a direction contrary to the rotary movement imparted to the lance-carrier actuated by the trolley, the inversion of the direction of rotation being achieved by providing a pinion between the driving gear wheel driven by the said member and the driving gear wheel integral with the screw.

9. A device as claimed in claim **8**, wherein the trolley and the means for rotating said member are driven by separate motors, end of stroke members starting and stopping said motors at the given moment, the introduction or the withdrawal of the said lance sections in the apparatus to be cleaned being carried out in two steps, on the introduction of said sections and during the first step, the trolley being immobile and taking up its position most remote from the said apparatus, while the lance external section actuated by the trolley also immobile as regards the travel thereof, rotates to cause the progression of the lance in the apparatus, and when it has reached the end of its stroke, the second step consists in providing the trolley with a travelling motion so as to let penetrate, while rotating on its axis, the lance-carrier the screw being driven from the motor driving the lance-carrier, in order to rotate during the said second step, at the same speed and in the same direction as the latter component, in order to cancel out during the whole of the second step the relative movement of the lance sections, the said two steps being carried out in reverse order on the withdrawal of the lance sections from the apparatus to be cleaned so that the travel motion of the lance with reference to

the lance-carrier occurs when the trolley shall take up its end position most remote from the apparatus to be cleaned.

10. A device as claimed in claim 3, wherein the lance is guided, on the one hand, by the said screw and, on the other hand, by a bearing mounted, closed to its end remote from the trolley, inside the lance-carrier, the portion of the said screw, housed inside the lance sections, being of a length considerably shorter than the length lance-carrier, so as not to be subject to the effects of the deflection to said lance-carrier may be subjected.

11. A device as claimed in claim 10, wherein the said bearing is mounted on the lance-carrier by means of fins, said bearing being so designed that the cooling fluid escaping between said sections at the end of said sections remote from the trolley and flowing between the outer wall of the bearing and the said fins passes through cross-sections of increasing size so as to expand more or less adiabatically in order to achieve an excellent cooling.

12. A device as claimed in claim 2, wherein the cooling of the lance is carried out by the blowing fluid flowing in the said lance, the cooling of the screw and of the lance-carrier being carried out by the flow of blowing fluid between the feed pipe of said fluid and the inner wall of the screw, the latter being provided with one or more ports through which the said fluid may pass to flow between the two lance sections.

13. A device a claimed in claim 12, wherein the lance-carrier comprises two concentric tubes made integral one with the other at their end close to the trolley, where holes are provided for entry of cooling fluid, the spacing between the two tubes being maintained, at their other end by radially mounted fins.

14. A device as claimed in claim 13, wherein the cooling fluid, bled from the blowing fluid, passes through the said port provided in the screw to flow afterwards between the two tubes providing the lance-carrier, the tube of smaller diameter having one or more ports located upstream of the guide bearing of the lance and through which the fluid may pass in order to cool said bearing, the screw and the lance being cooled directly by the blowing fluid.

15. A device as claimed in claim 13, wherein the said hollow screw is sealed off at the end thereof closest to the said lance nozzle, the whole of the blowing fluid, flowing from the feed pipe located inside the screw, passing between the lance-carrier two concentric tubes, the whole of the blowing fluid with the exeption of the minimum loss of fluid needed for cooling the said bearing as well as of the components maintaining the spacing between the said two tubes and substantially sealing off the free space in-between the latter, passing through the said port located upstream of the guide bearing of the lance and through at least one port provided close to the end of the lance remote from said nozzle, inside the lance in order to be ejected, through the latter, in the apparatus to be cleaned.

16. A device as claimed in claim 15, wherein to prevent too heavy losses of head, part of the blowing fluid passes immediately from the inside of the said screw to the inside of the lance, through an opening provided in the wall sealing off the screw.

17. A device as claimed in claim 13, wherein the cooling fluid is fed through a hose, selectively connected to a source of cooling fluid and to the blowing fluid feed pipe, downstream of the valve controlling the admission of the blowing fluid to said pipe, in a chamber surrounding the lance-carrier, said chamber being connected to the said trolley, for example by means of a rigid member, so as not to be drawn into a rotary motion, said chamber communicating with the space provided between the two tubes making up the lance-carrier, through an opening provided in the tube of larger diameter, the screw and the component of the lance provided with the nozzle being directly cooled by the internal flow of the blowing fluid.

18. A device as claimed in claim 17, wherein the cooling fluid is a fluid different from the blowing fluid.

19. A device as claimed in claim 12, further comprising a bearing mounted in the lance-carrier by means of fins, said bearing being so designed that the cooling fluid escaping between said sections at the end of said sections remote from the trolley and flowing between the outer wall of the bearing and the said fins passes through cross-sections of increasing size so as to expand more or less adiabatically in order to achieve an excellent cooling.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,477,085 Dated November 11, 1969

Inventor(s) JEAN EUGENE JULIEN DULAIT

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 43, change "stream" to --steam--;

Column 2, line 43, after "section" insert --of--;

Column 9, line 11, after "to" insert --which--.

SIGNED AND
SEALED
MAY 12 1970

(SEAL)
Attest:

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Attesting Officer

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