July 7, 1959 F. G. SCHWEISTHAL 2,893,515

AUTOMATICALLY CONTROLLED PNEUMATICALLY POWERED LUBRICATOR

Filed Sept. 8, 1955 4 Sheets-Sheet 1

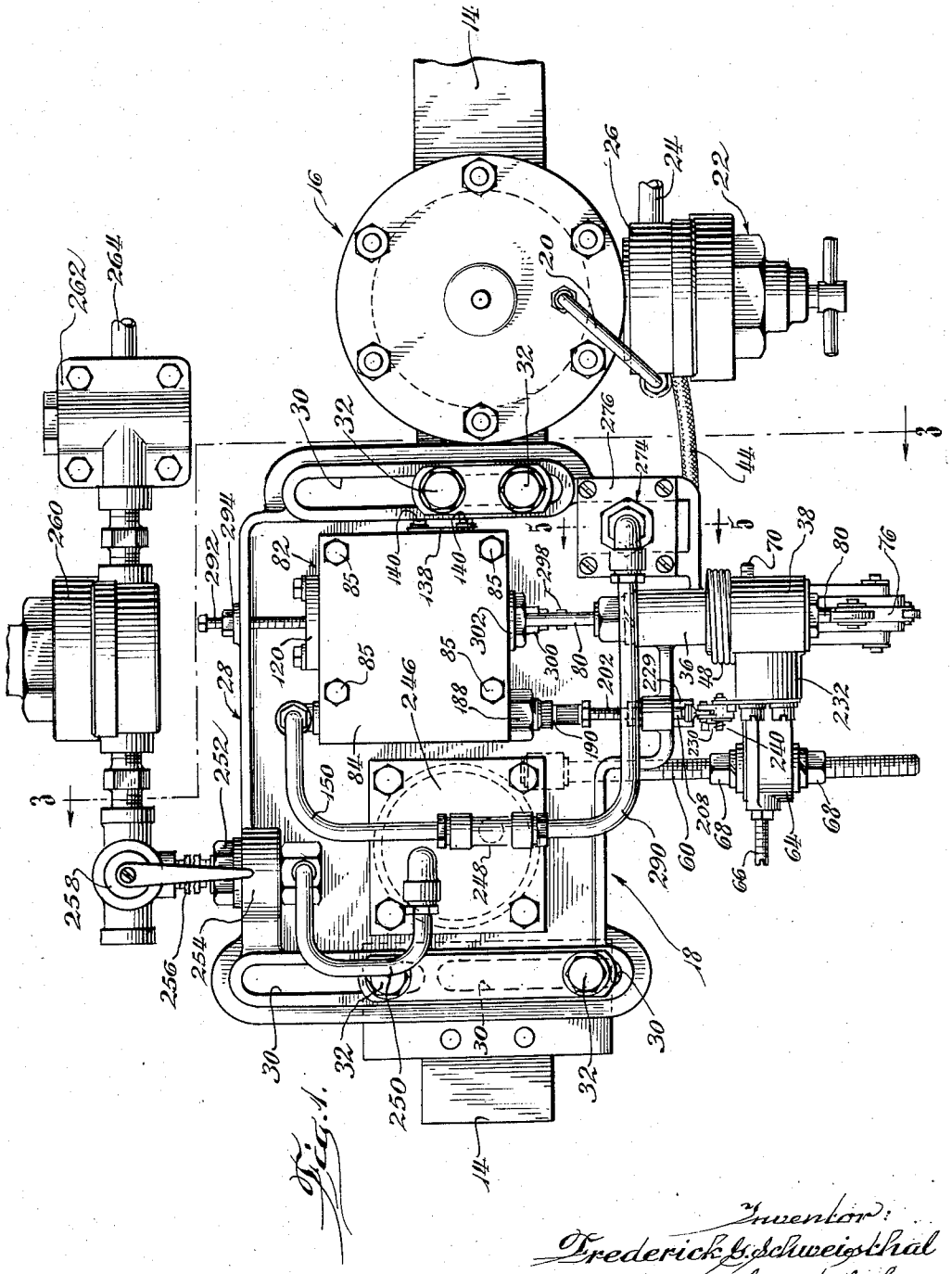


Fig. 1.

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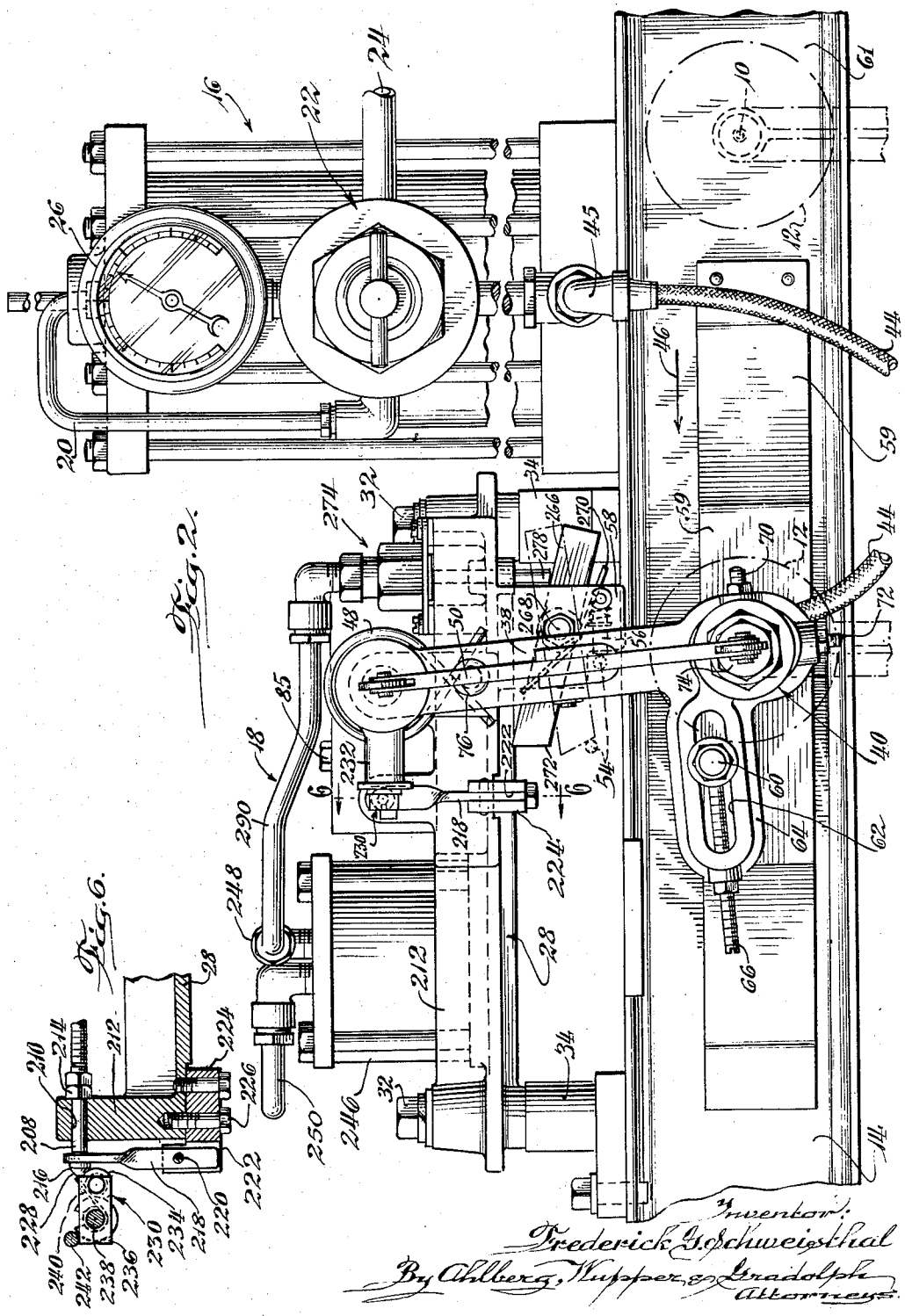


Fig. 2.

Fig. 6.

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AUTOMATICALLY CONTROLLED PNEUMATICALLY POWERED LUBRICATOR

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Fig. 3.

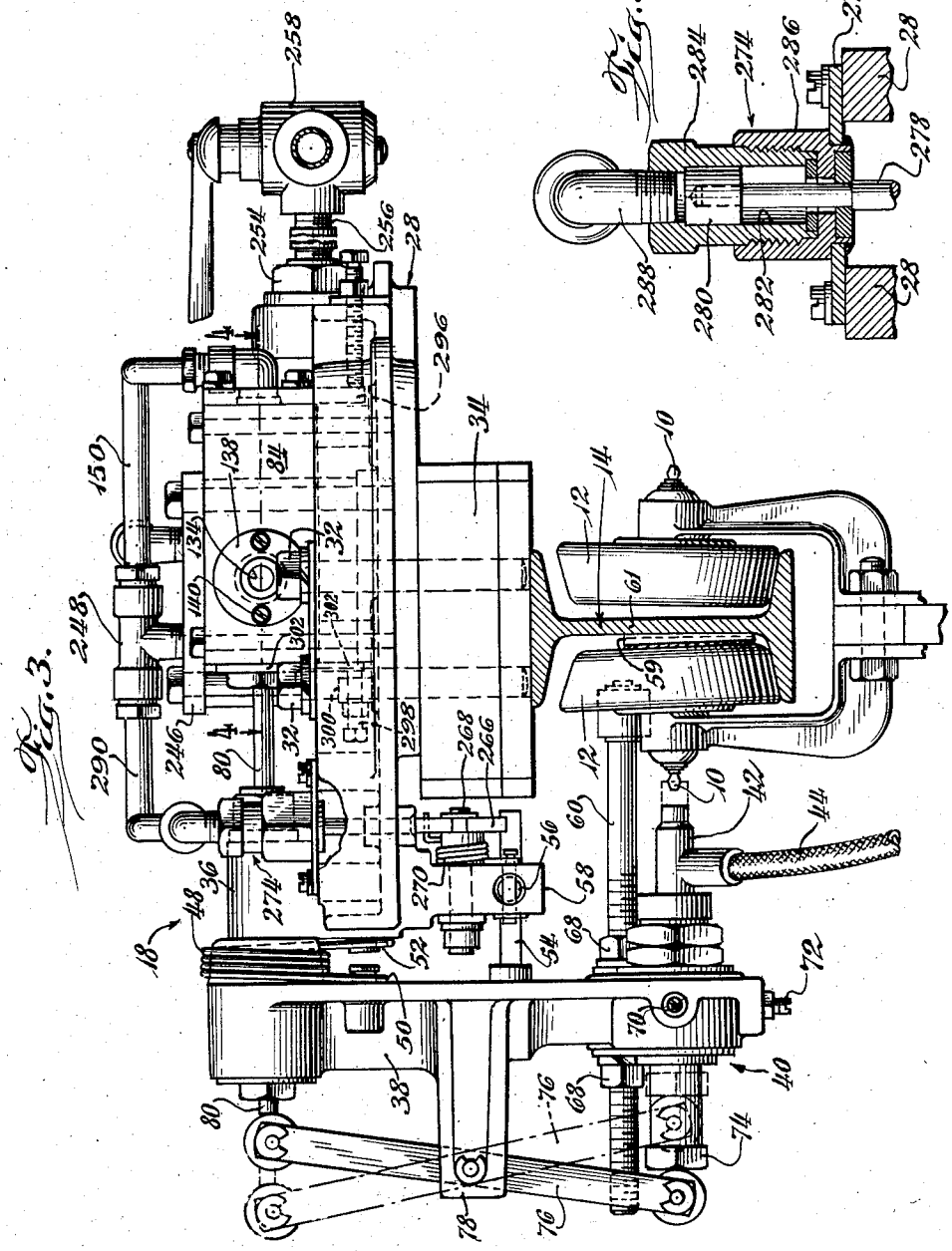


Fig. 5.

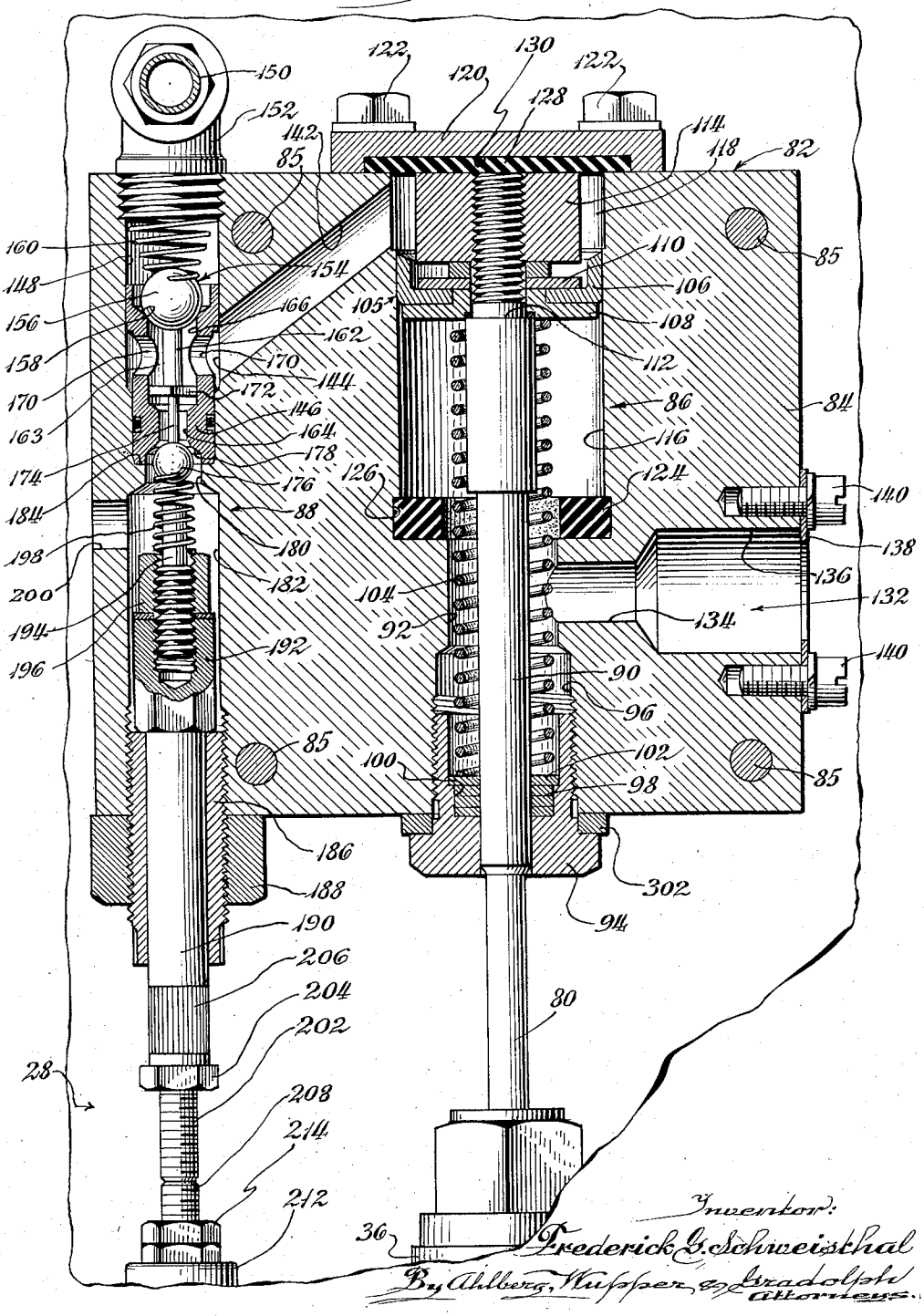
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Fig. 4.



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United States Patent Office 2,893,515 Patented July 7, 1959

2,893,515

AUTOMATICALLY CONTROLLED PNEUMATICALLY POWERED LUBRICATOR

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Application September 8, 1955, Serial No. 533,062

7 Claims. (Cl. 184—15)

The present invention relates to apparatus for automatically injecting lubricant charges successively into a passing parade of lubricant fittings on an endless conveyor or the like. Lubricating apparatus of this general character is shown in U.S. Patent No. 2,696,277 issued December 7, 1954, to Frederick G. Schweisthal and Ernest G. Stock.

One object of the invention is to provide automatic lubricating apparatus of the above character which is pneumatically powered and fully controlled mechanically by improved means which has superior operational capabilities, including among others—a capacity to operate with complete safety in an explosive atmosphere, an extremely fast cyclic action, quiet operation, and an extended service life. A related object is to provide lubricating apparatus, as recited in the previous object, which affords worthwhile economies of manufacture.

Another object is to provide automatic lubricating apparatus of the above character which is well adapted for remote control in that it is rendered fully operative as an incident to the supplying of operating air to a supply line to the apparatus and fully inoperative upon bleeding of air from the supply line.

Other objects and advantages will become apparent from the following description of the form of the invention illustrated in the drawings, in which:

Figure 1 is a plan view of automatic conveyor lubricating apparatus incorporating the invention;

Fig. 2 is a side view of Fig. 1;

Fig. 3 is a vertical sectional view taken along the irregular line 3—3 of Fig. 1;

Fig. 4 is a fragmentary horizontal sectional view on an enlarged scale taken along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary vertical sectional view on an enlarged scale taken along the line 5—5 of Fig. 1; and

Fig. 6 is a fragmentary vertical sectional view taken generally along the line 6—6 of Fig. 2.

Various specific components of the lubricating apparatus forming the illustrated embodiment of the invention are essentially the same as structural counterparts in the lubricating apparatus disclosed in the previously mentioned Patent No. 2,696,277. Since reference may be made to this patent for a detailed description of such components, the description here will be confined, where possible, to a more general pattern adequate for an understanding of the present invention.

Specially adapted for automatically injecting charges of lubricant into the successive grease fittings **10** on the bearings of a continuous series of endless conveyor wheels **12**, Figs. 2 and 3, the illustrated embodiment of the invention is preferably constructed substantially as a fully integrated unit including an I-beam track member **14** adapted to be installed as an integral segment of the regular trolley track structure for the conveyor wheels. The regular trolley track structure (not shown) is essentially similar to the track member **14**.

The track member **14** of the preassembled lubricating unit provides support to a central lubricant reservoir **16** fixed to the upper side of the track member to supply lubricant to two automatic lubricant injecting assemblies **18** mounted on opposite ends of the track member. Only one lubricating assembly **18**, designed to inject lubricant into the fittings **10** for the wheel bearings on one side of the track member **14** is shown in the drawings, Figs. 1 to 3, as this is adequate for an understanding of the invention. The other assembly, designed to inject lubricant into the fittings **10** on the opposite side of the track member **14**, is essentially identical to the assembly **18** shown except for certain components formed substantially as mirror images of the illustrated structure.

Constructed essentially as described in the previously mentioned Patent No. 2,696,277, the lubricant reservoir **16** contains a supply of lubricant maintained under pressure by air supplied to the upper end of the reservoir, Figs. 1 and 2, through a conduit **20** leading from a conventional pressure regulating valve **22** connected to a high pressure air line **24**. The pressure of air applied to the reservoir **16** is indicated by a conventional pressure gauge **26** connected to the valve **20**.

The lubricant injecting assembly **18** shown is supported on the track member **14** by a base frame **28** adjustable laterally with respect to the track member, Fig. 1. Formed as a unitary casting, the base **28** defines at opposite ends slots **30** which are elongated perpendicularly to the track member **14** to adjustably receive lag bolts **32** extending downwardly into supports **34**, Fig. 2, secured to the track member **14**, Figs. 1, 2 and 3.

A laterally elongated, upwardly extending boss **36** formed on one longitudinal side of the base frame **28**—with reference to the track member **14**—near the end adjacent the lubricant reservoir **16** is centrally bored to support means which journals the upper end of an elongated support arm **38**, Figs. 1 to 3, for swinging movement in a vertical plane parallel to the track member. The lower end of the arm **38** supports the medial portion of a generally horizontal lubricant ejector or gun **40** extending through the arm and including a lubricant dispensing nozzle **42**, Fig. 3, extending toward the track member **14** in general vertical alignment with the adjacent grease fittings **10** for conveyor wheels **12** traveling on the track member.

Lubricant is supplied continuously to the gun **40** by a flexible conduit **44** connected between the gun and a lubricant outlet **45** in the reservoir **16**, Fig. 2. The conduit **44** has sufficient slack to permit free horizontal swinging movement of the gun by the arm **38**. The detailed construction of the gun **40**, as such, is described in the previously mentioned Patent No. 2,696,277.

Each operating cycle of the lubricating apparatus **18** begins, as shown in Fig. 2, with the lubricating gun **40** and the lower end of its support arm **38** displaced horizontally somewhat from a vertical plane extending through the upper pivoted end of the arm in a direction from the plane opposite to the normal direction of movement of the conveyor trolley wheels **12** along the track member **14**. The direction of movement of the trolley wheels is indicated by the arrow **46**, Fig. 2. A coiled spring **48**, Figs. 1, 2 and 3, encircling the pivotal support means for the upper end of the arm **38** and slidably engaging at opposite ends two anchoring studs **50**, **52**, mounted on the arm and the base **28**, respectively, as shown in Fig. 3 biases the lower end of the arm **38** in a direction opposite to the direction of horizontal movement of the trolley wheels **12**. Movement of the arm **38** is terminated at its starting position by engagement of an inwardly extending horizontal pin **54**, Figs. 2 and 3, with a spring cushioned stop **56** mounted in a depending projection **58** on the adjacent side of the base **28**.

As each trolley wheel **12** on the side of the track member **14** adjacent the lubricating gun **40** moves horizontally

past the starting position of the gun, the wheel is biased outwardly toward the gun by a horizontal leaf spring **59** riveted or otherwise fixed at one end, Fig. 2, to the vertical web portion **61** of the track member, Fig. 3, at a substantial distance from the starting position of the lower end of the arm **38** in a direction opposite to the horizontal direction of movement of the trolley wheels. The opposite end of the spring **59** slidably engages the track web **61**. The central portion of the spring extending horizontally past the starting position of the gun **40** is bowed outwardly toward the gun.

Upon movement of a conveyor trolley wheel **12** across the track member **14** into general horizontal alinement with the gun **40**, Fig. 2, the periphery of the wheel is engaged somewhat above and ahead of the wheel axis by a rider **60**, Figs. 1 to 3, extending from the lower end of the arm **38** horizontally inward toward the track member **14**. As shown, the rider **60** is supported in a slot **62**, perpendicular to the arm **38**, formed in an ear **64** integral with the lower end of the arm and extending perpendicularly therefrom in the direction of movement of the wheels **12** along the track member **14**.

Upon installation of the lubricating apparatus, the wheel rider **60** is adjusted in the slot **62** by means of a screw **66**, Fig. 2, to effect a generally horizontal alignment between the lubricating gun nozzle **42** and a lubricant fitting **10** for a wheel **12** when the rider **60** is in contact with the wheel. The rider **60** is fixed in the slot **62** by tightening lock nuts **68** on the rider, Fig. 1, against opposite sides of the support **64**. The gun **40** is preadjusted horizontally and vertically with respect to the arm **38** by adjusting screws **70** and **72** in the arm, Figs. 1 to 3.

Continued movement of a trolley wheel **12** along the track member **14** after engagement of the wheel with the rider **60** swings the lower end of the arm **38** and the gun **40** away from starting position in a generally horizontal arc in which the lubricating nozzle **42** travels in substantial alignment with the grease fitting **10** for the wheel. In this connection, it is noteworthy that the structure supporting the gun **40** on the arm **38** (as described in Patent No. 2,696,277) provides radial flexibility in the support to the gun to compensate for the difference between the arcuate motion of the support arm and the linear movement of the adjacent grease fitting.

After traveling a predetermined distance with the engaged wheel **12**, the rider **60**, swinging about the pivoted upper end of the arm **38** as a center, clears the wheel allowing the spring **48** to return the arm to starting position.

As the support arm **38** swings with a trolley wheel in engagement with the rider **60**, the lubricating gun **40** is advanced toward the track member **14** to engage the nozzle **42** with the grease fitting **10** for the wheel and inject a shot of lubricant into the fitting. The gun **40**, described in the previously mentioned Patent No. 2,696,277, effects this action upon the application of force to the outer end of a plunger element **74** of the gun projecting from the side of the arm **38** opposite the track member **14**, Fig. 3.

As shown, the plunger element **74** is moved from the position shown in solid lines in Fig. 3 to the position shown in phantom in the same figure by the lower end of a rock lever **76** medially pivoted to a horizontal projection **78** integral with the central portion of the arm **38**. The upper end of the lever **76** is forced outwardly, to accomplish this action, by a horizontal plunger **80** extending through the upper end of the lever **38** and through the support boss **36** into overlying relation to the base **28**, Figs. 1, 3 and 4.

Actuation of the plunger **80** to operate the lubricating gun **40**, as an incident to the swinging of the arm **38** away from starting position, is effected by improved means pneumatically powered and fully controlled mechanically to improve the overall operational capabilities of the lubricating apparatus as will presently appear.

More particularly, the plunger **80** is reciprocated in timed relation to swinging movement of the arm **38** away from its starting position, Fig. 2, by operation of a mechanically controlled pneumatic actuator assembly **82** adjustably positioned on the base **28**, Figs. 1 and 4. The working parts of the pneumatic actuator assembly **82** are mounted in a rectilinear body **84**, Figs. 1 and 4, secured in a pre-adjusted position on the base frame **28** by four lag bolts **85**.

As shown in Fig. 4, the body **84** defines and supports a horizontal cylinder and piston assembly **86** extending substantially therethrough in coaxial relation to the plunger **80**. A most efficient pneumatic control of the piston and cylinder assembly **86** to actuate the plunger **80** is provided by an inlet and exhaust valve assembly **88** extending substantially through the body **84** in parallel relation to the piston and cylinder assembly **86** to be mechanically operated by control structure on the swingable arm **38** with a snap action that is independent of the speed of movement of the arm.

The piston and cylinder assembly **86** comprises a piston stem **90** axially aligned with the plunger **80** and making abutting contact at one end with the plunger. From the plunger the stem **90** extends into a horizontal bore **92** within the body **84**, passing through a centrally bored cap **94** threaded into a counterbore **96** in the end of the bore **92** adjacent the plunger **80**. A seal between the cap **94** and the plunger **90** extending slidably therethrough is formed by suitable packing **98** fitted around the plunger in a counterbore **100** in the inner end of the cap. The packing **98** is compressed by a washer **102** held against the packing by one end of a helical spring **104** coiled around the stem **90** and extending away from the cap **94** through the bore **92**.

The end of the spring **104** opposite the washer **102** engages an enlarged piston **105** fixed to the end of the stem **90** opposite the plunger **80**. As shown, the piston **105** comprises an annular seal **106** sandwiched between an annular retainer **108** and suitable pressure applying washers **110**. The retainer **108** is held firmly against an annular shoulder **112** on the stem **90** by axial pressure applied to the washers **110** by a nut **114** of substantial size and length threaded onto the extreme outer end of the stem **90** opposite the plunger **80**.

The piston **105** is slidably contained in a horizontal cylinder **116** formed in effect as a large counterbore of the previously mentioned bore **92** extending substantially half way through the block **84** from the side opposite the plunger **80**.

An air chamber **118** slightly larger in diameter than the cylinder **116** is formed at the outer end of the cylinder by counterboring the cylinder from the outer end to a depth somewhat less, as shown, than the axial length of the piston nut **114**.

The outer end of the cylinder **116** as continued by the air chamber **118** is closed by a cap **120** secured to the body **84** by lag bolts **122**.

To actuate the plunger **80** for effecting movement of the lubricating gun **40** through an operating cycle in the manner described, the air chamber **118** is connected to a supply of operating air under pressure and to exhaust in rapid succession by the previously mentioned valve assembly **88**, to be described presently in detail. Air entering the chamber **118** under pressure forces the piston **105** quickly to the opposite end of the cylinder **116** thus acting through the stem **90**, plunger **80**, and rock lever **76** to engage the lubricating gun **40** with an aligned grease fitting **10** and inject a charge of lubricant into the fitting. Exhausting of air from the chamber **118** allows the spring **104** to shift the piston **105** back to starting position freeing the lubricating gun **40** to retract from the serviced grease fitting **10**.

Retraction of the gun **40** from the grease fitting is

effected by internal spring structure of the gun described in the previously mentioned Patent No. 2,696,277.

The comparatively quiet pneumatic actuation of the piston **105** through an operating cycle is further silenced by bringing the piston to a cushioned stop at opposite ends of its reciprocable movement. For this purpose a rubber annulus **124** is fitted into a radially enlarged annular recess **126** at the inner end of the cylinder **116** to noiselessly terminate inward movement of the piston **105**. Also, a circular rubber pad **128** is fitted into a circular recess **130** in the inner face of the cap **120** to noiselessly stop the return movement of the piston.

Quiet breathing of the space within the bore **92** and cylinder **116** inwardly of the piston **105**, as an incident to reciprocation of the piston, is provided by a muted breather passage, indicated generally by the numeral **132**, intersecting the bore **92** between the cushion **124** and the counterbore **96**. As shown in Fig. 4, the passage **132** comprises a horizontal bore **134** entering the bore **92** from the side adjacent the lubricant reservoir **16**. The bore **134** is counterbored from the outer end to a much larger diameter, forming a muting chamber **136** partially covered at the extreme outer end by an annular ring **138** secured to the body **84** by lag bolts **140**.

The air chamber **118** is connected to the control valve **88** by an oblique horizontal bore **142**, Fig. 4, extending from the air chamber to an annular space **144** encircling a horizontal valve sleeve **146** fitted into a bore **148** extending substantially half way through the block **84** from the side opposite the plunger **80**. Air under pressure is supplied to the outer end of the bore **148** through a conduit **150** connected to an elbow **152** threaded into the outer end of the bore.

The pneumatic actuator air supply bore **142** is connected to either the high pressure air supply in the outer end of the bore **148** or to exhaust by the snap action of a reciprocable flow control element **154** cooperable with the valve sleeve **146**. The inlet end of the valve element **154** is formed by a spherical valve closure member **156** separably engageable with the upstream side of an annular valve seat **158** of truncated conical shape formed at the inlet end of the sleeve **146** and opening toward the air supply fitting **152**. The valve closure member **156** is urged toward engagement with the seat **158** by a helical spring **160** having a small end engaging the valve member and a large end engaging the inner end of the fitting **152**.

The spherical valve closure member **156** is welded to the adjacent end of a cylindrical stem portion **162** of an axial connecting member **163** of the valve element **154** extending through an axial bore **164** in the valve sleeve **146**. The bore **164** is counterbored **166** from the valve seat **158** past the longitudinal center of the sleeve **146**. Communication between the counterbore **166** and the space **144** surrounding the sleeve **146** is established by two radial bores **170** in opposite side walls of the sleeve.

The end of the counterbore **166** opposite the valve seat **158** provides radial support to a square guide **172** centrally formed on the valve element connecting member **163**. The spaces between the square periphery of the guide **172** and the inner cylindrical surface of the counterbore **166** provide for the flow of air axially through the counterbore around the guide.

A second stem portion **174** of the valve element connecting member **163** extends from the guide **172** through the sleeve bore **164** in a direction opposite from the spherical closure member **156**. The diameter of the stem **174** is substantially less than that of the surrounding cylindrical surface of the bore **164** thus providing for free flow of air along the stem through this portion of the bore.

The end of the stem **174** opposite the guide **172** connects with a second spherical valve member **176** having a diameter substantially less (approximately one-half, as shown) than that of the spherical valve member **156**. The smaller valve member **176** opposes an annular valve seat **178** of truncated conical shape on the sleeve **146** encircling the end of the bore **164** opposite the valve seat **158**.

The overall length of the axial connecting member **163** of the valve element **154** is sufficient to prevent the closure members **156** and **176** from simultaneously engaging the respective valve seats **158** and **178**. In fact, the length of the connecting member **163** is such as to force one of the spherical valve members into open position when the other valve member is in closed position.

As will presently appear. the valve element **154** is shifted reversely between two extreme operating positions with a snap action having an operating speed entirely unaffected by the operating speed of extremely simple actuating structure for the valve element.

Mechanical control means for the valve element **154** are mounted in a small bore **180** in the block **84** axially aligned with the bore **148** and counterbored to a substantially larger diameter **182** from the side of the block adjacent the plunger **80**. An annular shoulder **184** formed on the block **84** at the juncture of the bore **180** with the bore **148** provides support to the adjacent inner end of the sleeve **146**.

A mount for the valve element operating structure is provided by a centrally bored sleeve **186** threaded into the outer end of the counterbore **182** and held in an axially adjusted position by a lock nut **188** threaded onto the sleeve for engagement with the block **84**. The sleeve **186** provides support to an axially slidable plunger **190** extending through the sleeve and having an enlarged head **192** on its inner end engageable with the inner end of the sleeve. The enlarged plunger head **192** is internally threaded axially to receive the threaded end of a stem **194** extending from the plunger toward the valve member **176**. The stem **194** is locked in an axially adjusted position on the plunger head **192** by a lock nut **196**.

A helical compression spring **198** encircling the inner end of the stem **194** reacts at opposite ends of the lock nut **196** and the spherical valve member **176** respectively to urge the latter toward the valve seat **178**.

As will be more clearly developed presently in connection with the overall operation of the apparatus, the axial position of the valve element **154** in relation to the sleeve **146** is determined by the differential force of the opposed springs **160** and **198** and the differential force of air pressure acting on the valve element.

An exhaust outlet from the valve assembly **88** is provided by a horizontal bore **200**, Fig. 4, opening outwardly from the end of the counterbore **182** adjacent the valve seat **178**.

The end of the valve control plunger **190** projecting outwardly from the sleeve **186** is internally threaded to receive one end of a threaded stem **202**, Fig. 4, locked in an axially adjusted position on the plunger by means of a lock nut **204**. As shown, the projecting end portion of the plunger **190** is circumferentially knurled at **206** to be held by a suitable tool while turning the stems **194** and **202** and lock nuts **196** and **204**.

The free end of the stem **202** projecting from the plunger **190** opposes one end of a horizontal control plunger **208**, Figs. 4 and 6, slidably mounted in a horizontal bore **210** in an upright boss **212** on the adjacent longitudinal edge of the base **28**. Axial movement of the plunger **208** through the bore **210** away from the stem **202** is limited by engagement with the boss **212** of two nuts **214**, Fig. 6, threaded onto the inner end of the plunger **208** and jammed together in an axially adjusted position on the plunger.

The plunger **208** is moved inwardly toward the valve **88**, Fig. 4, as an incident to swinging movement of the arm **38** away from its starting position, Fig. 2, by a substantially pure thrust action of cam and follower means

which effectively avoids the application of radial forces to the plunger tending to cause binding against the bore 210.

As shown in Fig. 6, actuating thrust is applied to the plunger 208 by the back side of a cam follower 216 mounted in the upper end of a generally vertical lever 218. The lower end of the lever 218 is supported by a horizontal pivot 220 for limited swinging movement in a vertical slot 222 formed in a pivot support bracket 224 attached by lag bolts 226 to the adjacent lower marginal edge of the base 28.

The end of the cam follower 216, Fig. 6, opposite the plunger 208, defines a generally conical cam follower surface 228 adapted for coaction with a swingable cam assembly 230. The cam assembly 230 is pivotally mounted on a support 232, Figs. 1 and 2, integral with the upper end of the arm 38 and extending laterally from the arm in substantially parallel relation to the previously mentioned rider support ear 64.

Generally similar to its structural counterpart in the previously mentioned Patent No. 2,696,277, the cam assembly 230 comprises a cam roller 234, Fig. 6, journaled on the outer end of a link 236 swingably supported on a pivot pin 238 projecting from the support 232. The end of the link 236 carrying the cam roller 234 is biased downwardly by a spring 240, Figs. 1 and 6, anchored to the pin 238. However, downward swinging movement of the roller end of the link 236 is stopped in a generally horizontal position by engagement of the opposite end of the link with a stop pin 242 on the support member 232.

Upon swinging of the arm 38 away from its starting position (clockwise with reference to Fig. 2) by engagement of the rider 60 with a trolley wheel 12, the cam assembly 230 is carried upwardly in its generally horizontal position, Fig. 6. The cam roller 234 moves across the follower 216 forcing the follower inwardly toward the boss 212. The pivoted lever 218 absorbs the entire component of the force of the cam roller 234 on the follower 216 perpendicular to the plunger 208. Hence the cam follower 216 applies a substantially pure axial thrust to the plunger 208 which is transmitted to the valve operating plunger 190, Fig. 4.

As the arm 38 swings back to its starting position in the manner described, the cam assembly 230 moves downwardly across the cam follower 216. However, the roller end of the link 236 pivots upwardly against the action of the spring 240 to allow the cam roller 234 to pass the follower 216 without moving the plunger 210 inwardly.

In the preferred construction shown, the lubricating assembly 18 is operated with air supplied under pressure directly from a hollow accumulator 246, Figs. 1 and 2, mounted on the base 28. As shown, the accumulator 246 is connected through a T fitting 248 with the previously mentioned conduit 150 leading to the high pressure inlet fitting 152 for the control valve 88.

Air is supplied under pressure to the accumulator 246 by suitable air supply means which, by virtue of the storage capacity of the accumulator, can be of a minimized size having an effective air delivery rate far below the instantaneous rate of air consumption by the lubricating apparatus during an operating cycle. As shown in Figs. 1 to 3, the air supply to the accumulator 246 includes a conduit 250 extending from a suitable connection with the accumulator to a coupling 252, Fig. 1, mounted in a boss 254 on the base 28. A connecting line 256 extends from the coupling 254 to a two-way control valve 258, Figs. 1 and 2, which may for convenience be located at a control station any desired distance from the trolley lubricating unit. Hence, a lubricating unit installed in an out-of-the-way overhead position can be controlled by a valve 258 located for convenient operation from the floor level. Air is supplied under pressure to the valve 258 through a conventional pressure regulator 260 and an air filtering device 262 of conventional construction connected to a high pressure air supply line 264.

Having a conventional internal construction, the control valve 258 is effective when turned to one position to connect the accumulator air line 256 to the air supply from the valve 260 and effective when turned to another position to connect the accumulator air line 256 to exhaust.

Full remote control of the lubricating assembly 18, as an incident to operation of the valve 258, is completed by means which renders the assembly fully inoperative upon draining of air from the accumulator 246 and fully operative upon filling the accumulator with air under pressure. More particularly this action is obtained by pneumatic control of a generally horizontal disabling lever 266, Figs. 2 and 3, medially pivoted on a horizontal pivot 268 on the support projection 58. A spring 270 coiled around the pivot 268 and reacting at opposite ends on the support 58 and the disabling lever 266 urges the left hand end of the lever, Fig. 2, defining a cam surface 272, downwardly into the path of return movement of the pin 54 incident to swinging of the arm 38 back to starting position. Hence, unless restrained, the arm 266 swings toward the position indicated in phantom in Fig. 2, for engagement with the pin 54 to hold the arm 38 in an inoperative position in which the rider 60 clears the trolley wheels 12.

The disabling lever 266, however, is rendered inoperative as an incident to the supplying of operating air under pressure to the accumulator 246. For this purpose a piston and cylinder assembly 274, Figs. 1, 2, 3 and 5, is mounted in overlying relation to the end of the lever 266 opposite the cam 272 by a plate 276 supported on the base 28.

As shown, the assembly 274 comprises a vertical piston stem 278 extending downwardly into abutting engagement with the underlying edge of the lever 266. The upper end of the stem 278 is connected to a piston 280, Fig. 5, slidably mounted in a cylinder 282 formed in a sleeve 284 threaded into a circular base 286 mounted on and extending downwardly through the support plate 276. The upper end of the cylinder 282 is connected by an elbow fitting 288 and an air supply tube 290, Figs. 1, 2, 3 and 5, to the outlet T 248 from the accumulator 246.

Hence, upon operation of the valve 258 to fill the accumulator 246 with air under pressure, air flows through the conduit 290 into the cylinder 282 to force the piston 280 and stem 278 downwardly against the disabling lever 266. This immediately swings the disabling lever to its inoperative position, shown in solid lines in Fig. 2, allowing the spring 48 to return the arm 38 to starting position for normal operation.

Upon installation of the lubricating unit thus provided, a proper longitudinal adjustment of the lubricating gun 40 in relation to the grease fittings 10 for the trolley wheels 12 is effected by adjusting the base 28 laterally on the track member 14. This adjustment is provided for by the previously described base slots 30 which receive the hold-down bolts 32.

The lubricating gun 40 and the rider 60 are adjusted on the arm 38 in the manner described for proper engagement with each successive trolley wheel 12 and lubricant fitting 10 passing along the adjacent side of the track member 14.

Adjustment of the axial stroke of the lubricating gun 40 in relation to the support arm 38 is provided for by adjusting the pneumatic assembly 82, Fig. 1, toward or away from the upper end of the arm 38. Adjustment of the assembly 82 toward the arm 38 is facilitated by an adjusting screw 292 threaded through a support boss 294 on the side of the base 28 opposite the arm support boss 36 and engaging a depending abutment 296, Fig. 3, formed on the pneumatic cylinder cap 120 affixed to the adjacent side of the pneumatic assembly block 84. Ad-

justment of the pneumatic assembly **82** in the opposite direction is facilitated by a horizontally adjusting screw **298**, Figs. 1 and 3, threaded into an upwardly extending lug **300** on the base **28** and engaging the lower end of an abutment member **302** held against the side of the block **84**, Figs. 1, 3 and 4, by the previously mentioned cap **94**. After adjustment of the pneumatic assembly **82**, the lag bolts **85** are tightened to maintain the block **84** in fixed position on the base **28**.

The control valve **88** is fully adjustable to assure proper operation in service. The residual stress on the spring **198**, Fig. 4, when the operating plunger **190** is in its outwardly extended position shown, is adjustable by varying the axial adjustment of the threaded sleeve **186** in the counterbore **182**. The outer end of the sleeve is knurled for this purpose.

The degree to which the spring **198** is compressed by inward movement of the plunger **190** can be varied by adjusting the position of the threaded stem **194** in the plunger head **192**. The maximum compression of the spring **198** is limited by engagement of the inner end of the stem **194** with the spherical flow control member **176**.

The extent to which the valve control plunger **190** is moved inwardly by engagement of the cam assembly **230** with the cam operator **216**, Fig. 6, can be varied by adjusting the axial position of the threaded stem **202**, Fig. 4, in the outer end of the plunger **190**.

Upon being installed and properly adjusted, the improved lubricating apparatus embodying the present invention operates quietly with extraordinary efficiency. Upon operation of the remote control valve **258** to supply air under pressure to the accumulator **246**, the pneumatic control assembly **274**, Fig. 5, operates automatically as described to disable the member **266** allowing the lubricating support arm **38** to swing immediately to starting position.

When the arm **38** is in starting position, the valve spring **198**, Fig. 4, holds the plunger **190** in extended position, in which position the force of the spring on the flow member **176** is relaxed. At this time the other valve spring **160** together with the force of the air pressure at the inlet end of the bore **148** holds the larger flow control member **156** in firm engagement with the valve seat **158**. The passage **142** from the air chamber **118** of the cylinder-piston assembly **86** is then connected to exhaust through the valve seat **178**. The closure member **176** at this time is held away from the seat **178** by the axial connecting member **163** of the valve element **154**.

Upon swinging of the arm **38** away from starting position by the rider **60** in the manner described, the valve control plunger **190** is moved inwardly by the cam assembly **230**. This compresses the spring **198** to increase its force tending to move the valve member **176** to closed position. Upon engagement of the stem **194** with the valve member **176** by continued inward movement of the plunger **190**, the valve member **156** at the opposite end of the valve element **154** is unseated from the valve seat **158**.

Unseating of the valve member **156** drops the force of differential pressures on the valve member tending to move it toward the seat **158**. The strength of the spring **198** compressed by inward movement of the control plunger **190** exceeds the force of the spring **160** on the valve member **156**. Hence, the differential force of the two springs **198** and **160** operates immediately upon unseating of the valve member **156** to snap the valve member **176** into engagement with the seat **178**—simultaneously moving the valve member **156** into fully open position.

The result is to close the exhaust valve seat **178** while connecting the air supply at the inlet end of the valve seat **158** through the passage **142** to the air chamber **118**. Air rushing into the chamber **118** quickly shifts the piston **105** to the opposite end of the cylinder **116** to operate the lubricating gun **40** in the manner described. Because of the smaller effective diameter or size of the valve seat **178** in relation to the valve seat **158**, the differential force of air pressure tending to move the valve member **176** away from seated position, after the element **154** is shifted to admit air under pressure to the bore **142**, is much less than the force of differential air pressure tending to hold the member **156** against the seat **158** before shifting of the element **154**.

As the cam assembly **230**, Fig. 6, moves past the follower **216**, the spring **198**, Fig. 4, moves the plunger **190** outwardly until the compressive force in the spring acting on the closure member **176** is reduced to a value at which the opposite spring **160** initiates closing movement of the valve member **156**. The incipient movement of the valve member **156** toward the seat **158** accompanied by unseating of the valve member **176** from the seat **178** immediately accentuates the differential air pressure on the valve element **154** which is cumulative with the force of the spring **160** tending to move the member **156** into engagement with the seat **158**. The result is a snap action of the valve element **154** which simultaneously seats the valve member **156** and shifts the valve member **176** to fully open position. This shuts off the supply of high pressure air from the inlet fitting **152** to the connecting passageway **142** and simultaneously connects the open valve seat **178** to the exhaust outlet **200**.

The spring **104**, Fig. 4, then returns the piston **105** to its starting position, allowing the lubricating gun **40** to retract from engagement with the serviced lubricating fitting **10**.

As previously intimated, the shifting movement of the valve element **154** by the differential forces of the springs **160** and **198** operating in conjunction with the differential air pressure on the valve element effects a most efficient snap action of the valve that is not slowed by the relatively slow movement of the arm **38**, which effects a mechanical control of the valve.

Capable of operating with complete safety in an explosive atmosphere, the pneumatically powered, mechanically controlled lubricating apparatus provided by the invention is extremely efficient yet extraordinary quiet in operation.

While I have shown and described a preferred embodiment of my invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles and scope of the invention. I therefore desire, by the following claims, to include all such variations and modifications by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means.

I claim:

1. Pneumatic powered apparatus for automatically injecting lubricant quietly into lubricant fittings on the successive components of passing machine structure such as an endless conveyor, comprising, in combination, a lubricant ejector, pivoted means supporting said ejector swingably alongside the path of movement of the structural components to be lubricated to seek a starting position, said ejector supporting means including rider means engageable with each successive structural component to be lubricated for movement by the latter to swing said supporting means and said ejector away from said starting position until the rider means moving in an arcuate path clears the structural component thus carrying the ejector through a limited distance in general alignment with the component, a pneumatic actuator including a piston mounted in a cylinder and interconnected with said ejector for advancing the latter toward the structure to be lubricated upon admission of air under pressure to one end of the cylinder, resilient cushioning means mounted adjacent opposite ends of said piston to quietly terminate translation of said piston at opposite ends of said cylinder, an outwardly open breather passage connected to the end of said cylinder

opposite said one end, means restricting the outlet end of said breather passage to form therein a muting chamber for minimizing sound incident to breathing of said cylinder through said passage upon reciprocation of said piston, means forming a supply of operating air under pressure, an inlet and exhaust valve connected to establish communication between said one end of said cylinder and said air supply means and exhaust alternately, said valve including mechanical control means therefor, and mechanical valve operating means mounted on said swingable ejector supporting means and positioned for coaction mechanically with said valve control means as an incident to swinging movement of said ejector supporting means away from said starting position to effect operation of said valve to connect said air supply means to said cylinder for actuation of said ejector.

2. Pneumatic powered apparatus for automatically injecting lubricant into lubricating fittings on successive components of passing machine structure such as an endless conveyor, comprising, in combination, a lubricant ejector adapted to inject lubricant into a lubricating fitting, means movably supporting said ejector for movement alongside the structure to be lubricated toward and away from a starting position, means engageable with each successive component of the structure to be lubricated for moving the ejector a short distance from said starting position in general alignment with the component, said ejector supporting means including means normally operable to return said ejector to starting position after each movement thereof away from starting position, a pneumatic actuator connected with said ejector for advancing the latter toward the structure to be lubricated, means defining a control valve passageway and forming inlet and outlet valve seats encircling opposite ends of said passageway and facing therefrom, inlet and outlet valve members movably disposed in opposing relationship to said respective inlet and outlet valve seats, connecting means between said valve members dimensioned to force either of said members into open position away from the seat therefor upon movement of the other member into closed position against the seat therefor, means connecting the passageway between said valve seats to said actuator, air supply means connected to supply air under pressure to the upstream end of said inlet valve seat, the downstream end of said outlet valve seat being connected to exhaust, a control member for the inlet and outlet valve members movable in relation thereto, spring means interconnected between said control member and one of said valve members to be stressed variably by movement in relation to the latter of said control member to effect shifting movement of said valve members in unison to bring alternate ones thereof into engagement with the valve seats therefor, and means for operating said control member in synchronism with movement of said ejector supporting means away from the starting position therefor to energize said pneumatic actuator to advance said ejector toward the structure to be lubricated.

3. In apparatus for automatically ejecting lubricant into the lubricating fittings on successive components of passing machine structure such as an endless conveyor, the combination of a lubricant ejector adapted for ejecting lubricant into a lubricating fitting, movable means supporting said ejector for movement along side the path of movement of the structural components to be lubricated toward and away from a starting position, said ejector supporting means including rider means positioned thereon for engagement with each successive component of the structure to be lubricated to be actuated by the latter to carry the said lubricant ejector for a limited distance away from said starting position in general alignment with the moving component, a pneumatic cylinder containing a piston therein connected to move said ejector toward the structure to be lubricated, a valve for controlling operation of said piston and including means defining a passageway, means defining an inlet valve seat encircling one end of said passageway, air supply means connected to supply air under pressure to the upstream side of said inlet valve seat, an inlet valve member movably disposed on the upstream side of said inlet valve seat for separable engagement therewith, a spring mounted to urge said inlet valve member toward engagement with said inlet valve seat, means defining an outlet valve seat encircling the end of said passageway opposite said inlet valve seat, said inlet and outlet valve seats facing away from each other, an outlet valve closure member movably disposed on the downstream side of said outlet valve seat for separable engagement therewith, means connecting said passageway between said valve seats to the end of said cylinder away from which said piston moves to actuate said ejector, the downstream side of said outlet valve seat being connected to exhaust, movable valve control means engageable with said outlet valve member, a spring connected between said movable control means and said outlet valve member to urge the latter toward engagement with the seat therefor, said last mentioned spring being subjected to additional stress upon movement of said control means toward engagement with said outlet valve member, a connecting member extending between said inlet and outlet valve members and dimensioned to hold one of said members in fully open position away from the adjacent valve seat when the other valve member is engaged against its adjacent valve seat, and valve operating means mounted in association with said ejector supporting means for movement thereby mechanically into mechanical coacting relation with said valve control means as an incident to movement of said ejector supporting means away from starting position to operate said valve control means to shift said outlet valve member into closed position.

4. Pneumatic powered apparatus for automatically injecting lubricant into lubricant fittings on successive components of passing machine structure such as an endless conveyor, comprising, in combination, a lubricant ejector, means movably supporting said ejector for limited movement alongside the path of movement of the structure to be lubricated toward and away from a starting position, said ejector supporting means including means for moving the latter for a short distance in alignment with each successive structural component to be lubricated, a pneumatic actuator connected to shift said ejector toward the structure to be lubricated, compressed air supply means including an inlet and exhaust control valve connected to said pneumatic actuator to supply air under pressure thereto and exhaust operating air therefrom, said control valve including a mechanical control member therefor, a rotatably mounted wheel carried by said ejector supporting means for movement in an arc substantially intersecting the axis of the control member, a cam follower, and a lever pivotally supported for rotation in a plane substantially tangential to the arc defined by the wheel at its intersection with the control member axis and connected to said cam follower to support the latter in opposing relation to said valve control member and in the path of said wheel for operation thereby as an incident to movement of said ejector supporting means away from starting position, said lever serving to oppose the lateral force of said cam operator on said cam follower thus enabling the latter to transmit a substantially pure thrust to said valve control member for effecting operation thereof, the wheel being supported for pivotal movement over the follower incident to movement of the ejector supporting means toward the starting position.

5. Pneumatic powered lubricating apparatus for automatically injecting lubricant into lubricating fittings on successive components of moving machine structure such as an endless conveyor, comprising, in combination, a

lubricant ejector, a swingable arm supporting said ejector for movement alongside the path of movement of the structure to be lubricated toward and away from a starting position, a pneumatic cylinder, a piston slidable within said cylinder and connected to said ejector for advancing the latter toward the structure to be lubricated, means defining a control valve passageway and forming inlet and outlet valve seats encircling opposite ends of the passageway, inlet and outlet valve members movably disposed in opposing relation to said respective inlet and outlet valve seats, connecting means between said inlet and outlet valve members dimensioned to shift either of said members into fully open position away from the valve seat therefor upon movement of the other member into engagement with the seat therefor, means providing communication between the intermediate portion of said passageway between said valve seats and the end of said cylinder away from which said piston moves to shift said ejector toward the structure to be lubricated, reciprocable control means for said inlet and outlet valve members, a spring connected between said control means and one of said valve members for actuating the latter in response to reverse movement of said control means, translatory guide means supporting said control means for reverse movements thereon, a cam follower lever pivotally supported at one end, a cam follower mounted on the opposite end of said lever in opposing force transmitting relation to said control means, a cam control mounted on said ejector supporting arm for engagement with said cam follower as an incident to swinging movement of said arm away from said starting position to effect pneumatic operation of said actuator to advance said ejector toward the structure to be lubricated.

6. Pneumatic powered apparatus for automatically ejecting lubricant into lubricating fittings on successive components of moving machine structure such as an endless conveyor, comprising, in combination, a lubricant ejector adapted for coaction with a lubricating fitting, movable means supporting said ejector for movement through a limited distance alongside the path of movement of the structural components to be lubricated toward and away from a starting position, the ejector supporting means including rider means engageable with each successive structural component to be lubricated for movement through a limited distance therewith to move said ejector away from said starting position in substantial alignment with the component, a pneumatic cylinder having a piston therein interconnected with said ejector for advancing the latter toward the structure to be lubricated, means defining an inlet and exhaust valve passageway and forming an inlet valve seat and an outlet valve seat encircling opposite ends of the passageway, said valve seats facing away from each other, the end of said passageway opening through said inlet valve seat being substantially larger in transverse sectional area than the end of the passageway opening through said outlet valve seat, inlet and outlet valve members separably engageable with said inlet and outlet valve seats respectively, a connecting member extending through said passageway in guided relation thereto and engaging at opposite ends said inlet and outlet valve members, said connecting member being dimensioned to move either of said inlet and outlet valve members into open position away from the adjacent valve seat when the other valve member is moved into seated position against the adjacent valve seat, spring means interconnected with said inlet valve member to urge the latter toward engagement with said inlet valve seat, air supply means connected to supply air under pressure to said inlet valve seat at the upstream side thereof, passage means connecting said passageway between said inlet and outlet seats to the end of said cylinder from which said piston moves to force said lubricant ejector toward the structure to be lubricated, the downstream side of said outlet valve seat being connected to exhaust, control means for said inlet and exhaust valve members movable into engagement with the outlet valve member to force the latter toward engagement with the valve seat therefor, a spring connected between said valve control means and said outlet valve member to urge the latter toward closed position against the valve seat therefor, said last mentioned spring being stressed increasingly upon movement of said valve control means toward said outlet valve member, and mechanical operating means mechanically connected with said ejector supporting means for movement thereby and positioned to mechanically actuate said valve control means to shift said outlet valve member into closed position as an incident to movement of said ejector supporting means away from starting position.

7. Pneumatic powered apparatus for automatically injecting lubricant quietly into lubricant fittings on the successive components of a passing machine structure such as an endless conveyor comprising, in combination, a lubricant ejector, means movably supporting said ejector for limited movement alongside the path of movement of the structure to be lubricated and for lubricating engagement with the fittings in a predetermined position of the ejector in its path of movement, rider means engageable with each successive structural component to be lubricated for moving the ejector in alignment with the fitting, a pneumatic actuator including a piston mounted in a cylinder and interconnected with the ejector, resilient cushioning means mounted adjacent opposite ends of said piston to quietly terminate translation of said piston at opposide ends of said cylinder, an outwardly open breather passage connected to one end of said cylinder, means restricting the outlet end of said breather passage to form therein a muting chamber for minimizing sound incident to breathing of said cylinder through said passage upon reciprocation of said piston, means forming a supply of operating air under pressure, an inlet and exhaust valve connected to establish communication between the other end of said cylinder and said air supply means and exhaust alternately, said valve including mechanical control means effective in a predetermined position of the ejector to connect said air supply means to said cylinder for actuation of the ejector.

References Cited in the file of this patent

UNITED STATES PATENTS

1,704,238	Barks	Mar. 5, 1929
2,048,323	Cutts	July 21, 1936
2,264,649	Tebaldi	Dec. 2, 1941
2,502,659	Livingston	Apr. 4, 1950
2,696,277	Schweisthal et al.	Dec. 7, 1954
2,699,756	Miller	Jan. 18, 1955

FOREIGN PATENTS

571,844	Great Britain	Sept. 11, 1945