Oct. 5, 1937. J. K. DELANO 2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

Filed June 20, 1934 5 Sheets-Sheet 1

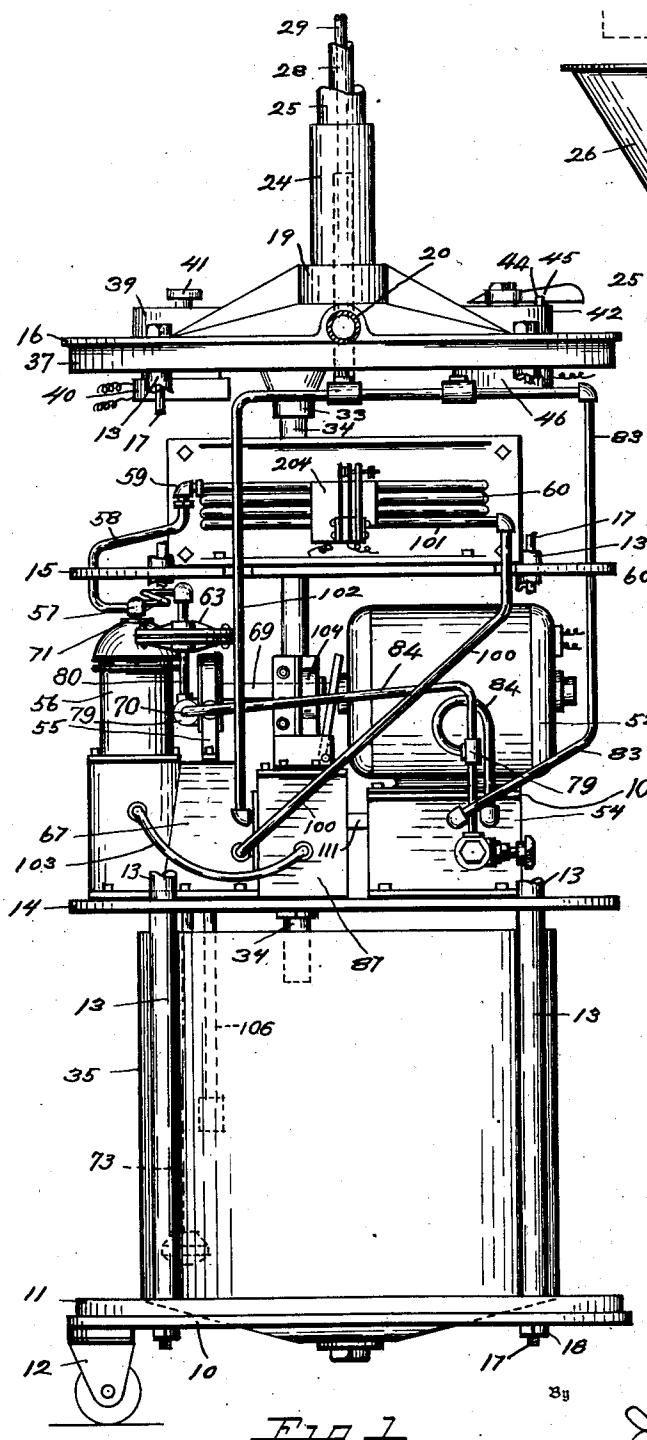


Fig 1

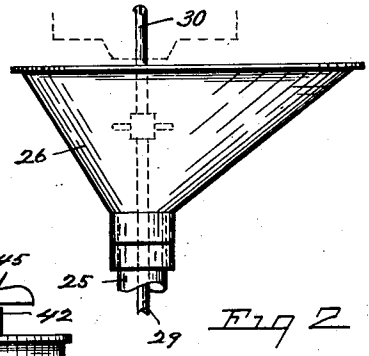


Fig 2

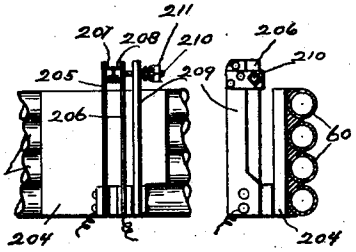


Fig 3

Fig 4

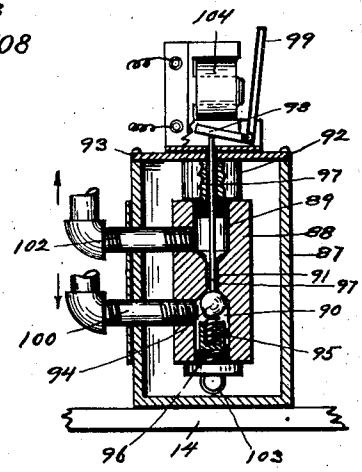


Fig 5

Inventor

James K. Delano.

By John J. Thompson

Attorney

Oct. 5, 1937. J. K. DELANO 2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

Filed June 20, 1934 5 Sheets-Sheet 2

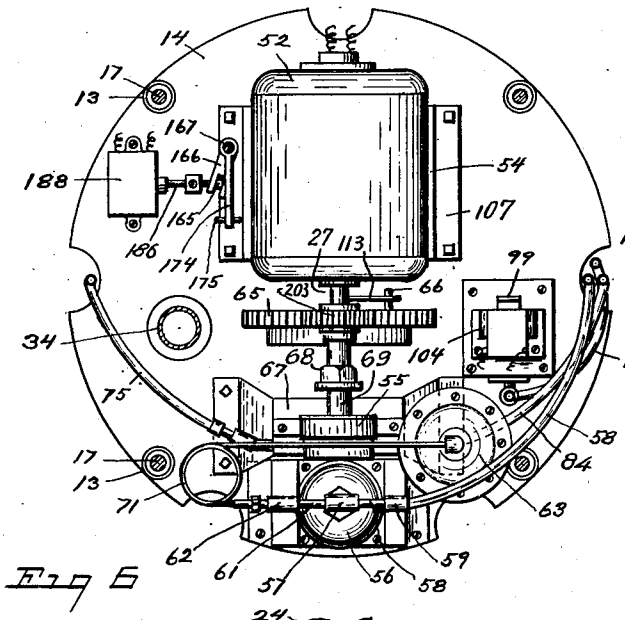


Fig 6

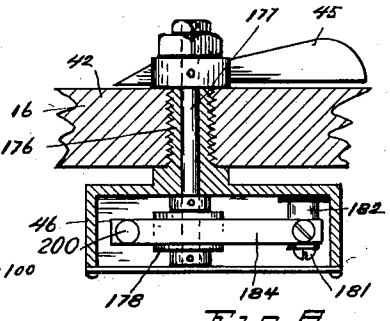


Fig 8

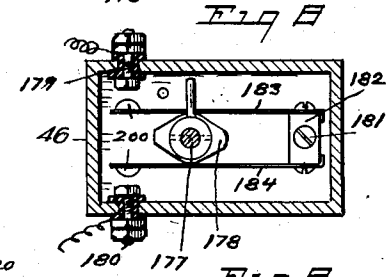


Fig 9

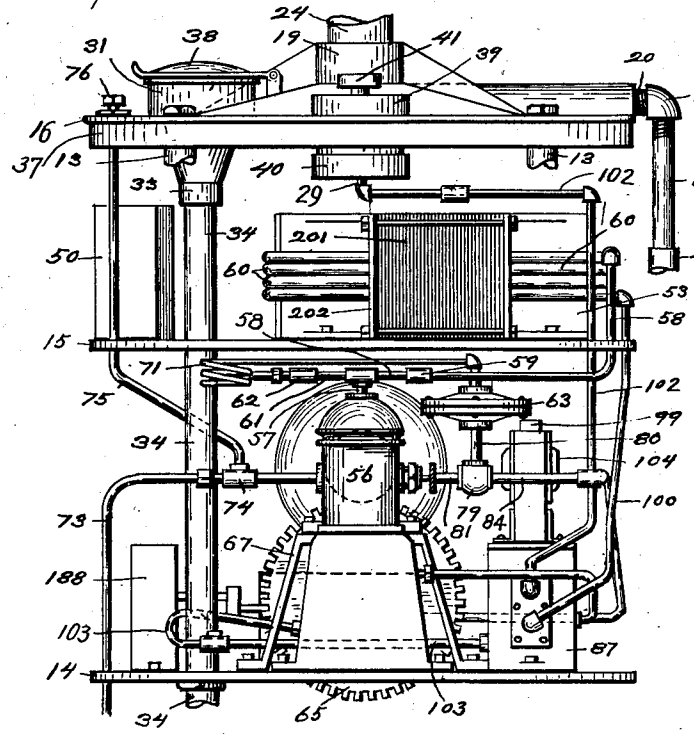


Fig 7

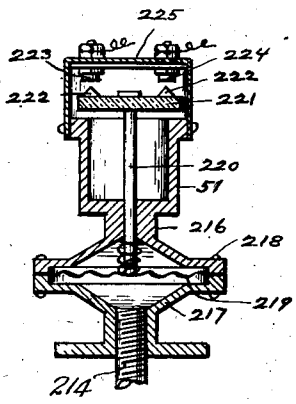


Fig 10

Inventor

James K. Delano.

By John J. Thompson

Attorney

Oct. 5, 1937. J. K. DELANO 2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

Filed June 20, 1934 5 Sheets-Sheet 3

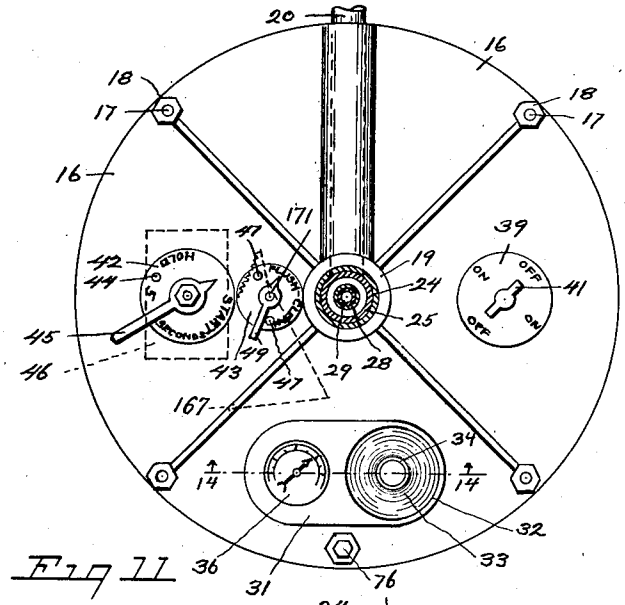


Fig 11

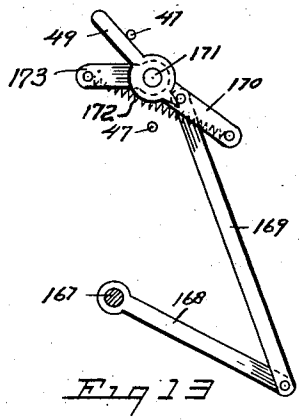


Fig 13

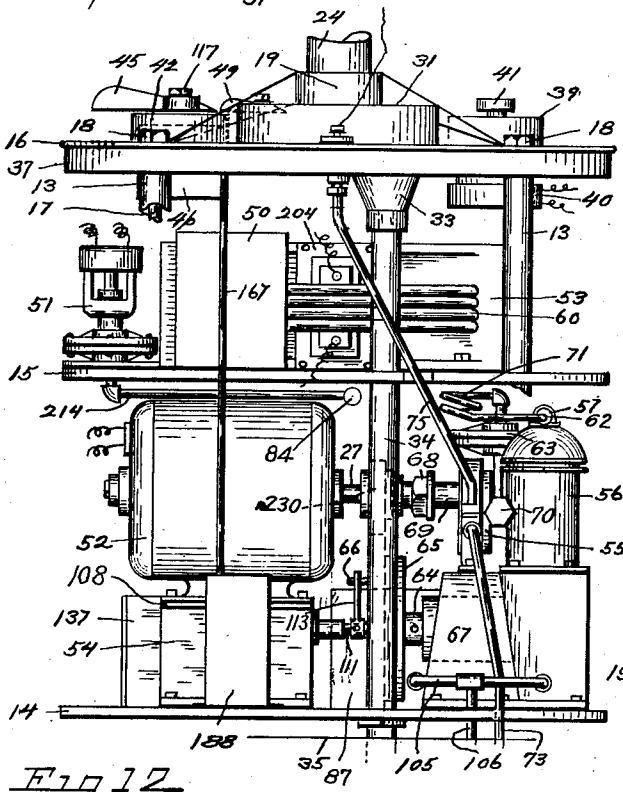


Fig 12

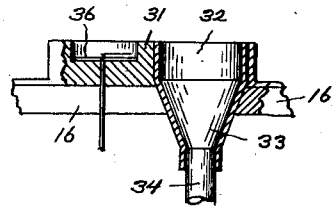


Fig 14

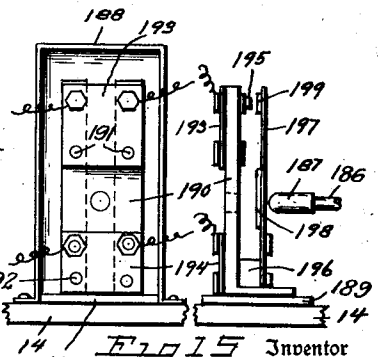


Fig 15

Inventor

James K. Delano

By

John J. Thompson

Attorney

Oct. 5, 1937. J. K. DELANO 2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

Filed June 20, 1934 5 Sheets-Sheet 4

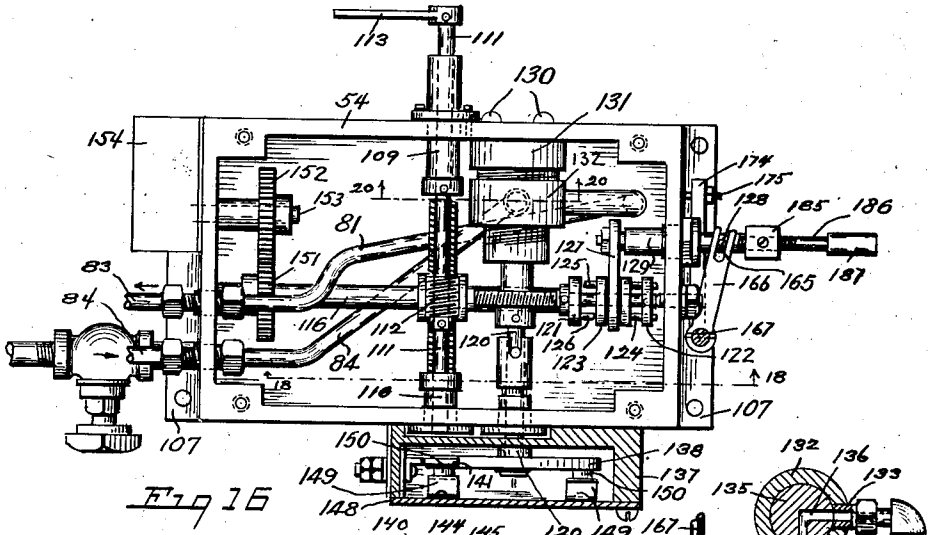


Fig 16

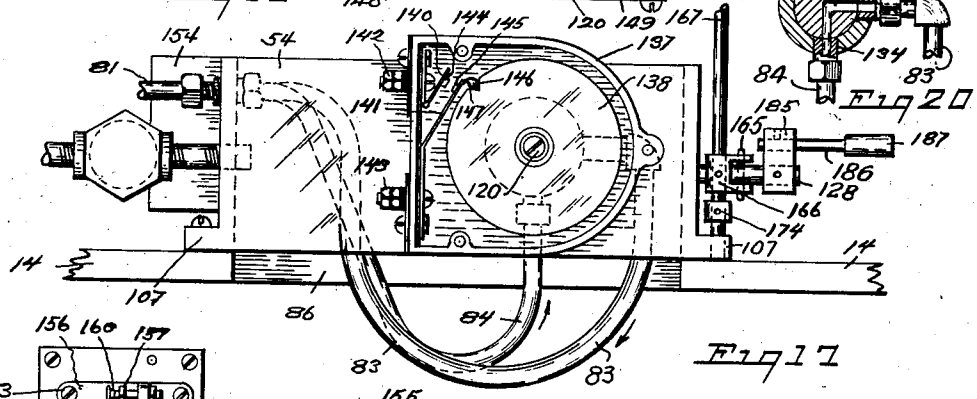


Fig 17

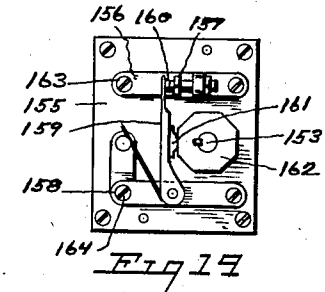


Fig 19

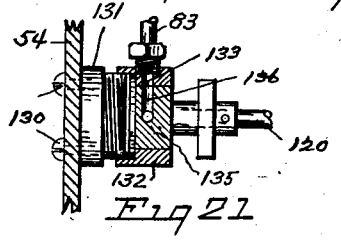


Fig 21

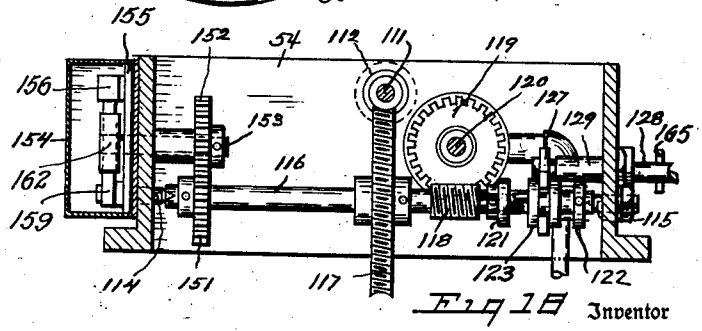


Fig 18

Inventor

James K. Delano.

By

Attorney

Oct. 5, 1937. J. K. DELANO 2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

Filed June 20, 1934 5 Sheets-Sheet 5

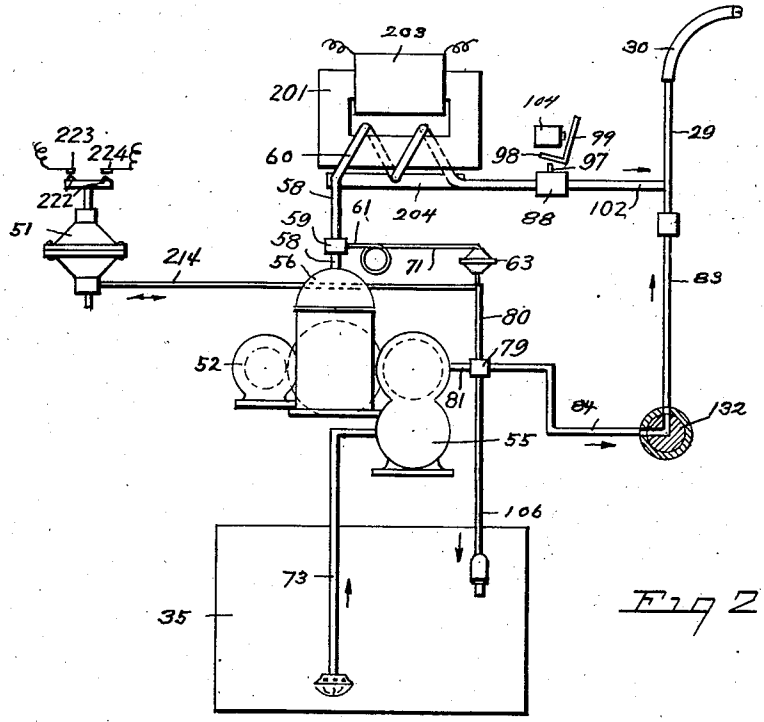


Fig 22

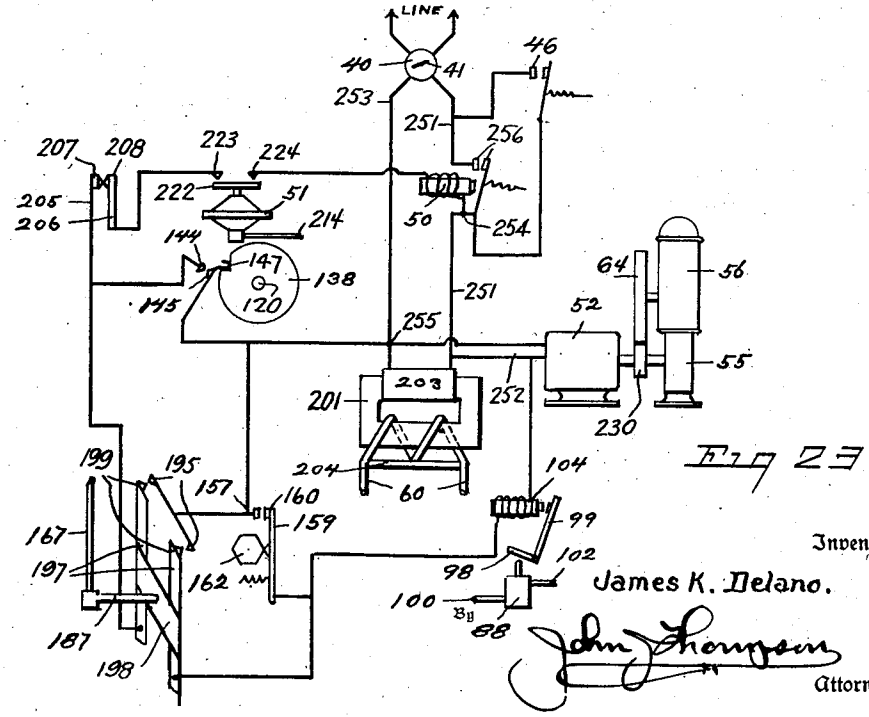


Fig 23

Inventor

James K. Delano.

By John Thompson

Attorney

Patented Oct. 5, 1937 2,094,916

UNITED STATES PATENT OFFICE

2,094,916

CRANK AND GEAR CASE CLEANER AND FLUSHER

James K. Delano, New York, N. Y.

Application June 20, 1934, Serial No. 731,458

4 Claims. (Cl. 184—1.5)

This invention relates to a universal cleaning and flushing apparatus for cleaning crank-cases, gear-cases, transmissions, differentials, springs, etc., of automobile and other internal combustion engines, machines, and gearing that require cleaning from time to time, and their lubricant changed and renewed.

While devices have been made for the cleaning and flushing of engine crank-cases, and others for the removal of old lubricant, such as heavy oil and grease from gear-casings, there has not been any device of a universal nature that will accomplish all of these operations as desired.

In the thorough cleaning of a crank-case, within a reasonable length of time, it is very essential that the entire interior of the casing be reached by the cleaning medium to remove all particles of grit and dirt from the corners and inaccessible places not readily reached by a direct jet of the cleaning fluid. I have accomplished this by the use of a proper mixture of oil and air, which is brought to a high degree of temperature to reduce it to an oily vapor before it is injected into the case.

It has been found that such an oily vapor not only heats the casing, to assist the liquefication of the hardened lubricant, but by my method and apparatus employed, this oily vapor is injected into the casing under great pressure, whereby the entire inner surface of the casing is reached.

This oily vapor is entered into the casing in a series of injections, each of which comprises a predetermined quantity of the mixture of oil and air which has been confined within the heater for a predetermined length of time, within which its pressure has been built up and its temperature raised. When this has taken place, the "charge" is released and injected into the casing with considerable force to reach the entire inner surface, and, during the draining period, the next charge is being prepared, this action being repeated a number of times. This storing of vapor obviates the use of a much larger compressor and motor and gives the "charge" ample time to thoroughly heat in the transformer secondary.

After the required number of these vapor injections have been delivered to the interior of the casing, an appreciable volume of the flushing oil or compound is added to the cleaning mixture and this flushing compound is injected into the casing under pressure.

In the cleaning of gear-casings, differentials, etc., where thick lubricant has been used, greater difficulties than those in cleaning crank-cases are to be met with, as the old lubricant has become thick and hard packed into the corners of the casing, adhering to the inner surfaces, it is required that the casing be heated so that this old lubricant will be melted down and reduced to a state where it will readily drain out.

In my present invention, which is especially adapted for this purpose, the oily vapor being very hot, not only heats the casing, but by its nature, readily combines with the old lubricant, penetrating into and softening it quickly and easily and removing it from the casing.

The device may also be used in the cleaning of springs, and other parts of automobiles and the like, and is so arranged that a steady spray of oily vapor may be directed upon the part to be cleaned.

While the apparatus has been designed to consume a predetermined amount of time and material for each cleaning operation and for automatic cyclic operation, I have provided manual controls whereby the cyclic operation may be cut out if desired. I have also provided automatic safety devices, whereby should the supply of oil fail, or the motor fail, the operations of the device will stop and no damage will be caused to any of the parts.

The object of the invention is to provide in an apparatus for this purpose, means whereby a quantity of oil or other cleansing compound and air may be mixed together, heated to convert into an oily vapor, and temporarily confined for a period of time until its pressure has been raised and also its temperature, when it is injected into the casing. This same process is repeated for a number of times before the injections are stopped and a volume of flushing fluid injected.

Another object of the invention is to provide means whereby the operations of the machine may be automatic, cyclic, or manually controlled.

In the accompanying drawings, I have eliminated some of the parts in some of the views, so as not to confuse the illustrations. I have also omitted showing the electrical wires in these views, but have shown a wiring diagram, as well as a schematic view of the parts, to take care of this omission in the other views. I have also omitted the outer casing of the apparatus and the handles by which it is moved from place to place.

In the drawings:

Figure 1 is an elevation of one side of the apparatus, showing the top with a part of the drain pipe; the heater-deck with the heater thereon; the pump-deck with the pump, air compressor, motor and gear box; and the bottom with the

supply tank, some of the spacers and stay-rods being omitted.

Figure 2 is a side elevation of the drain funnel and injection nozzle with a part of the stand pipes, both injection and drain.

Figures 3 and 4 are enlarged detail views of the thermostatic control, partly in section.

Figure 5 is an enlarged view, partly in section, of the control or magnetic valve, and the means for operating the same.

Figure 6 is a top plan view of the power-deck, showing the several units mounted thereon.

Figure 7 is another side elevation of the heater and power-decks with their units, taken from a different side.

Figure 8 is an enlarged detail sectional view of one of the switch control units.

Figure 9 is a top plan sectional view of the same.

Figure 10 is a sectional view of the pressure switch.

Figure 11 is a top plan view of the top plate, showing the several control pointer levers, main switch, etc.

Figure 12 shows another side view of the power and heater decks.

Figure 13 shows an enlarged detail view of the gear-shift levers in the opposite position from that shown in dotted lines in Figure 11.

Figure 14 is a vertical partial detail sectional view of the filler and oil level gage, taken on the line 14—14 of Figure 11.

Figure 15 is an enlarged detail view of the front and side of the bridging switch for the timing gear.

Figure 16 is an enlarged detail top plan view of the gear-box, with the cover removed.

Figure 17 is a side view of the same, partly in section.

Figure 18 is a vertical sectional view of the same, taken on the line 18—18 of Figure 16.

Figure 19 is an enlarged detail view of the timing device for the gearing.

Figure 20 is an enlarged detail sectional view of the cyclic valve, taken on the line 20—20 of Figure 16.

Figure 21 is an enlarged detail sectional view of the same.

Figure 22 is a schematic view of the apparatus.

Figure 23 shows a wiring diagram for the apparatus.

Describing the apparatus in detail, the main frame is composed of the bottom plate 10 which is in the form of a ring with the open center for the oil-supply tank 35. The ring 10 is provided with the upper flange 11 to accommodate the sheet metal casing, which is not shown. To this plate 10, are secured the casters 12 and a suitable pair of legs and a handle, also not shown, to support the apparatus and by which it may be moved from place to place.

Above the bottom 10, and spaced therefrom, by the tubular posts 13, is the power deck 14, and again above this, and spaced therefrom by similar posts 13, is the heater deck 15, and again above this, and spaced by the posts 13, is the top plate 16. All of the decks, top, and bottom, are retained together by the stay rods 17, passing through the posts 13 and having nuts 18 thereon.

The top plate 16 is formed with a flange 37 for the outer casing, and a tubular central boss 19 which communicates with the drain pipe 20 which is contained within the channel formed in the top plate 16 with its inner end threaded into the wall of said tubular boss 19, and its outer end supplied with a fitting 21 and a drain pipe 22 leading to the drain hose 23.

Within the central boss 19 is secured the lower end of the telescoping drain pipe 24. The inner pipe 25 is secured to the funnel 26. Both of these pipes are held in telescoping relation in any suitable manner. Within these pipes 24 and 25 are mounted the telescoping injection pipes 28 and 29. The lower end of the pipe 28 is mounted in the tubular boss 19, and the upper end of the pipe 29 is fitted with a detachable injection nozzle 30.

Referring to Figure 11, the top plate 16 is also formed with a raised portion 31 which is provided with the filler opening 32 having a neck 33 and provided with a filler pipe 34 extending downward through the decks 14 and 15 to and within the fluid supply tank 35. Also in this raised portion 31 is mounted the dial 36 of an oil level gage that is also contained within the tank 35, but not shown. Both the filler opening and the dial 36 are protected by a hinged cover 38, as shown in Figure 7.

The top plate 16 is also formed with a raised boss 39 within which is mounted the usual type "on" and "off" switch 40 having the knob 41. Also on the plate 16, there are formed, the two raised bosses 42 and 43. The boss 42 has a stop pin 44 and a hand lever or pointer 45, and is marked with the words, "Start—Hold 5 seconds". To the bottom of this boss 42 is secured the control switch box 46, shown in Figures 8 and 9, and which will hereinafter be described in detail. The top of the boss 43 is marked with the words "Flush—Clean", and is provided with the stop pins 47 for the pointer hand lever 49 which operates the gear clutch in the gear box through the levers and rods as shown in detail in Figures 11, 13 and 16, and which will be fully described.

Upon the heater deck 15 is mounted the electrical induction heater 53, which comprises a laminated core 201 retained in a clamping frame 202 which is mounted upon the deck 15. This core 201 is supplied with a primary coil 203 (Figure 23) of the usual type connected into the proper electrical circuit, and a tubular secondary coil 60, through which the oil to be heated is passed, is shortcircuited by having its convolutions brazed or welded to a strip or plate 204, as shown in Figures 3 and 4. To the plate 204 is secured a thermostat, (see Figures 3 and 4) comprising the resilient arms 205 and 206 of bi-metal which are secured to and insulated from said plate 204, and which are provided with the contacts 207 and 208. To the rear of the arm 206 is mounted a plate 209 formed with a transverse hole near the upper end thereof through which a pin 210, having one end secured to the arm 206 and the other end threaded for the adjusting nut 211, is mounted, the electrical connections being shown in the Figure 23.

Upon the power deck 14 is mounted the transmission or gear box 54, and upon which is secured the electrical motor 52. This motor 52 drives both the pump 55 and the air compressor 56, and the transmission or reduction gearing in the box 54. Mounted on the motor shaft 27 is secured a pinion 230 which is in mesh with and drives the spur gear 65 on the compressor shaft 64.

The air compressor 56 is of the usual piston type and is provided with a top outlet 57 connected by the pipe 58 and check valve 59 to the

upper part of the heater coil 60, and by a pipe 61, check valve 62, and the very small diameter tube 71 to the top of the filter 63. The shaft 64 of the compressor 56 has mounted thereon a spur gear 65, from the face of which projects a drive pin 66.

To the rear of the compressor 56 on the deck 14 is mounted a support 67 upon which is secured the rotary oil pump 55, which is driven from the motor 52 through the shaft 27 and coupling 68 to the pump shaft 69. Said pump 55 is supplied with an adjustment 70 and the intake and outlet. The intake is connected to the oil supply tank 35 by the suction pipe 73 and also by the T-fitting 74 to a primer pipe 75 having a plugged top 76 in the top plate 16, for the purpose of priming the pump if required.

The outlet side of the pump 55 is connected by the pipes 81 and 84 to the cyclic operated valve 132 located in the gear box 54, the operation of which will later be fully described.

This outlet pipe 81 is provided with a T-fitting 79, upon which is mounted the filter 63 by a short pipe 80. The oil from the top of the coil 60 is carried by the pipe 58 to the top 57 of the compressor 56 where it becomes mixed with the air from the compressor 56, and both the oil and the air are carried through the pipes 61 and 71 to and through the filter 63 and pipe 84 to the valve 132.

Between the gear box 54 and the pump base 67 on the deck 14, is mounted a box-shaped support 87, within which is mounted the injection or cyclic valve, shown in detail in Figure 5, and which comprises the body 88 formed with the two alined bores 89 and 90 which are connected by a small duct 91. The upper bore 89 is threaded for attachment to the boss 92 of the cover 93 of the box 87. The lower bore 90 is provided with a valve seat for the ball valve 94 which is retained in a normally closed position by the spring 95 located in the hollow plug 96, and which is threaded into the lower end of the bore 90.

Within the duct 91 and the bore 89, and slidably mounted in the boss 92 of the cover 93, is a rod 97. The lower end of this rod 97 is in contact with the ball 94, and the upper end with the foot 98 of a magnet lever 99 which is mounted on the box cover 93 in such a manner that when the magnet 104 is energized, the lever will be attracted thereto, depressing the foot 98 and the rod 97 to depress the ball 94 and open the valve, allowing the oil to enter the valve through the pipe 100 from the lower coil 101 of the heater and pass through said valve and out through the pipe 102 to the injection pipe 29.

As the rod 97 must have some play in its bearings, and there may be some leakage in the box 87 of fumes or vapor, I have connected the box 87 by an exhaust pipe 103 with the compressor 56 so that all of the fumes will be sucked out of the box.

The lower parts of both the box 87 and the compressor 56 are connected by a drain pipe 105 which leads by the pipe 106 to the tank 35, for the purpose of returning any leakage of oil back to the tank 35.

The reduction gearing in the gear box comprises a frame 54 formed with the flanged ends 107 for attachment to the deck 14, and having a top 108, but which is not shown in Figures 16, 17, and 18 to which I now refer. The frame 54 has no bottom, and is mounted over an opening 86 formed in the deck 14, so that all drainage and leakage will drain into the tank 35 which is directly under said opening 86.

Rotatably mounted within the bearings 109 and 110 in the sides of the box 54 is a transverse shaft 111, and upon this is secured the worm 112, while one end of said shaft 111 is extended from the side of the box 54, and has secured thereon an arm 113 which is rotated by the pin 66 of the spur gear 65 of the compressor shaft 64.

At right angles to, and below the shaft 111, is rotatably mounted on the adjustable point bearings 114 and 115, the longitudinal shaft 116. Upon this shaft 116 is mounted the worm gear 117, which is in mesh with and driven by the worm 112. A second worm 118 is in mesh with and rotates a worm gear 119 which is secured upon a transverse shaft 120 parallel to the shaft 111. This reduction gearing is such that the shaft 111 runs at approximately motor speed, while the shaft 120 makes one complete revolution every seven minutes. The rotation of the worm 118 and the gear 119 with the shaft 120 is controlled through a clutch mechanism which comprises a member 121 secured to the worm 118 and freely rotatable upon the shaft 116. Secured upon said shaft 116 is a member 122, while between said members 121 and 122 upon the shaft 116 is a sliding member 123 having secured to one side the pins 124 which slide through holes in the member 122, and upon the other side the pins 125 which are adapted to engage with and drive the pins 126 which are secured in the member 121. The sliding clutch member 123 is operated by a yoke 127 which is mounted on a sliding shaft 128 mounted in the bearing 129 in the end of the box 54.

Secured to the side of the box 54 by the screws 130 is the cyclic valve member 131, shown in detail in Figures 20 and 21, comprising the body 131 which is formed with a threaded portion to which is attached the valve body 132 formed with the inlet port 134 and the outlet port 133. To these ports 133 and 134 are attached the pipes 83 and 84. Within said body 132 and secured to and rotated by the shaft 120, is the rotary valve member 135, formed with the right angle passage 136, establishing communication between the ports 133 and 134 when the valve 135 is in the proper position, which in this case is once every seven minutes, unless otherwise stopped.

To the outer side of the box 54 is mounted a timing device 137, within which is mounted, on the extended end of the shaft 120, a timing disk of insulating material 138, which is formed with a notch 147 in the periphery thereof. Attached to the said box 137, and insulated therefrom, are the contact spring arms 140 and 141. These arms 140 and 141 are secured to the binding posts 142 and 143 and provided with the electrical contacts 144 and 145. The contacts 144 and 145 are normally in a closed position when the end 146 of the arm 141 rides upon the periphery of the disk 138, but when this end 146 reaches and drops into the notch 147, the contacts will break apart and open the circuit, but will again close as the rotation of the disk 138 is resumed.

To provide for the even rotation of the disk 138 and place a tension thereon, the cover 148 of the box 137 is provided with two spring arms 149, upon the outer ends of which are mounted the fiber contacts 150 which ride and press upon the face of the disk 138.

Mounted near the end of the shaft 116 and

rotated thereby, is a spur gear 151 which is in mesh with and drives a spur gear 152 which is secured on and rotates a short shaft 153 rotatably mounted in the end of the box 54 and extending into a timing box 154 secured thereto. Within this timing box 154 and mounted on an insulated base 155, shown in detail in Figure 19, is the contact plate 156, having the adjustable contact point 157 and the plate 158 upon which is pivoted the breaker arm 159 having the contact 160 and the fiber bumper 161 which rides upon the face of the cam 162. Said cam 162 is secured upon the end of the shaft 153 in such a manner that upon the rotation of the shaft 153, the electrical current passing from the terminal 163 to the terminal 164 will be opened and closed, due to the shape of the cam 162.

For operating the clutch within the reduction gear box 54, the shaft 128 is provided with a transverse pin 165 which is engaged by a yoke arm 166 that is secured to a vertical rocker shaft 167 having its lower end journaled in the flange 107 of the gear box 54 and its upper end journaled in the top plate 16. By referring to Figures 11 and 13, it will be seen that to the upper end of this shaft 167 and under the top plate 16 is secured an arm 168 to the outer end of which is pivoted one end of an arm 169 having its inner end pivoted to an arm 170 which is attached to and moved by the shaft 171 of the pointer lever 49. The outer end of the arm 170 is secured by a spring 172 to the outer end of an arm 173 which is secured to the top plate 16, the levers 49 and 170 both being secured to the shaft 171, the movement of the lever 49 will move the lever 170 against the action of the spring 172, which spring will retain it in either of its two positions. The pointer lever 49 thus moves the yoke 166 to either engage or disengage the clutch within the gear box. The movement of the yoke 166 is adjustable by an arm 174 secured to the shaft 167 and provided with a stop screw 175 threaded therein and abutting the side of the box 54. The movement of the pointer lever 49 is limited by the stop pins 47.

The manually operated switch 46, which is operated by the pointer lever 45, comprises an electrical switch box 46 which is mounted under the top plate 16 and the boss 42 by a stud 176 formed on the top of the switch box 46 and threaded into the boss 42. The stud 176 is formed with a bore, within which is rotatably mounted the shaft 177 to the upper end of which is secured the pointer lever 45, and to the lower end of which is secured the cam 178 of insulating material such as fiber.

This box 46 is provided with two binding posts 179 and 180 which are insulated from the box, and within the box and secured by the screw 181 a post 182 which is also insulated from the box, and to the opposite sides of said post 182 are secured the two spring contact arms 183 and 184, the outer ends of which are provided with the contacts 200, which by the turning of the cam 178 are brought into contact with the ends of the binding posts 179 and 180, completing the circuit through the arms 183 and 184 and the post 182 from the source of power.

When the clutch in the reduction gear box 54 is in the open position and when the valve passage 136 is closed, it is desirable to close the electrical circuit through the timer, and to do this, there is mounted on the deck 14 adjacent the end of the sliding clutch shaft 128 an electrical make and break switch, which is shown in detail in Figures 6 and 15, and which is operated in a mechanical manner by the movement of the shaft 128. The shaft 128 is offset by the block 185 and the adjustable arm 186 threaded therein and having the fiber end 187.

This switch comprises the casing 188 mounted on the deck 14 and within which is a base 189 of insulating material having secured thereon a support 190 to which are secured by the screws 191 and 192 the two insulating plates 193 and 194 the plate 193 also having the contacts 195. To the rear of said support 190 and spaced therefrom by the insulating block 196 are a pair of parallel resilient arms 197 which are joined together by a strip of insulating material 198 and which have at their upper ends the contacts 199. The strip 198 is in line with and adapted to be moved by the end 187 of the arm 186 to close the contacts.

The oil filter 63 which is mounted upon the vertical pipe 80 leading from the fitting 79 in the pipe 81, is composed in the usual manner of two parts secured together by flanges and screws. Between these two parts, is placed the usual screen of fine mesh material, through which the oil must pass.

The pressure switch 51, which is mounted on the deck 15 and connected by the pipe 214 to the pipes 80 and 84 to the valve 132, pipe 83 and the injection pipe 29, is composed of two parts, 216 and 217, secured together by the screws 218 to form two chambers divided by a diaphragm 219, into a lower pressure chamber and an upper chamber within which is slidably mounted a rod 220 having its lower end attached to the diaphragm 219 and its upper end to a plate 221 insulated from the rod 220 and having electrical contacts 222 that are adapted to contact with the contacts 223 and the terminals 224 to close the circuit when the diaphragm 219 raises the rod 220 by the pressure built up in the pressure chamber and the oil line. The upper parts of the device are covered by a cap 225.

In the operation of the device:

When the machine is inoperative, or not in use, the contacts of the switch 46, relay 50, and the contacts 223, 224 and 222, 144 and 145 are open. The contacts 199, 195, and 160, 157 are normally open, and the contacts 207, 208 are closed.

To start the operation for flushing the crankcase, the selector handle 49 marked "Clean—Flush", is placed at "Flush" and the main switch button 41 is closed. The switch 46 is also held closed by the operator, and current flows from one side 251 of the main line through the contacts of the switch 46 into the transformer primary 203 and to the motor 52 by the wire 252. The return line from the motor 52 and primary 203 is joined to the other side 253 of the main line as at 255 and thence back to the switch 46.

The motor 52 will now start and run the compressor 56 and also the oil pump 55. The gearing to the disk 138 will also revolve, causing the disk 138 to close the contacts 144 and 145. As the oil pressure is raised in the member 51, the diaphragm 219 will cause the contacts 222, 223 and 224 to close, and as soon as all these contacts mentioned above close, a current is established in the relay coil 50, as current will flow from the junction 254 through the winding 50 and through the contacts 222, 223 and 224, through the thermostat contacts 207 and 208 which are always normally closed and through the contacts 144 and 145 back to the junction 255 to the side 253 of the main line.

The starting contacts of the switch 46 can

now be released, as the relay 50 will close and hold closed the contacts 256.

Current also flows from the side 253 of the line at the junction 255 to the current breaker contacts 157 and arm 159 to the magnetic valve coil 104, hence back to the other side 251 of the line through the wire 252.

These contacts 157 and arm 159 are interrupted by a cam 162 which is driven from the gearing in the box 54, the interruption being timed so that the compressor 56 makes several strokes and thereby has stored air in the heated coils 60 of the transformer 53. The air so stored has oil in mixture with it supplied by the pump 55 from tank 35 and admitted to the air line at 58. The air and oil being held in the heated coils 60, the oil is soon in a vaporized state, and the air, due to expansion, increases its pressure and at intervals timed mechanically by the dwell of the cam 162, the contacts 157 close and the magnet 104 attracts the armature 99 opening the valve 88 allowing the heated oil-air vapor under pressure to be expelled with great force into the supply hose 30 and thence into the crank-case of the engine being cleaned. The mixture gives up its heat to the walls, etc., of the engine and the interior of the engine is thus heated, and as the oil vapor combines with the dirty oily residue in the engine it washes the interior of the engine and drains out through the drain at the bottom of the crank-case.

It is apparent, that by this method of retaining the pressure at the valve 88, results of a hotter mixture and a higher pressure with a greatly reduced size and weight of apparatus can be gained. If, instead of storing the air, the compressor 56 discharged it directly into the heater 60 and into the engine, a much larger motor and compressor and heater would be required to give a continuous blast of hot air at the pressures being used in this device at the nozzle, and the weight of the apparatus and its size would be prohibitive for a portable unit.

The amount of oil entering the air line at 57 is limited by the size of the pipe line 71 and is also limited to the amount which the heater will handle effectively.

As the injections are being made, the gear box 54 is slowly rotating the disk 138 and the rotor of the valve 132 which will align the ports 136 so that just before the disk 138 reaches its shut-off position, and the contacts 144 and 145 open, the rotary valve 132 will open and the full pump pressure of oil will be put into the line 83 and the hose 30 from the pipe 84.

The excess or flood of oil will wash out the drainings, etc., in the crank-case and as the valve 132 again closes the contacts 144 and 145 will be opened by the disk 138, and as this interrupts the circuit through the relay coil 50, the relay contacts 256 will open and current will be shut off from the motor 52, heater 53, etc., and the flushing period will be finished.

To repeat the operation, re-supply the tank 35 with the required amount of oil and hold the lever 49 which closes the contacts of the switch 46 again and the cycle will be repeated. During the operation, should there be insufficient oil supply for the pump, the pressurestat 51 will break the relay circuit and cause the motor 52 and heater 53 to be shut off. Should the heater 53 for any reason go beyond a given heat, the thermostat strip 206 will expand and open the contacts 207 and 208 and also trip the relay contacts 256.

It is readily understood that the valve member 135 and the disk 138, being driven by the positive gearing can be set so that their timing will be accurate and in sequence of operation.

Should the operator wish to use the apparatus to clean out a transmission case, the nozzle is inserted into the drain of the case and the lever marked "Clean—Flush" is moved to the "Clean" position, which causes contacts 199, 195, 193, and 260 to close. These contacts were open during the flushing cycle, just described. Closing of these contacts acts as a two bridge circuit around the timing contacts 159 and 157. The turning of the lever to "Clean" also disconnects the gearing in the gear box 54 by releasing the clutch mechanism 122 and 123 in the gear box 54.

In Figure 16, the clutch parts are shown at 124, 123, 122, and pins 125, etc., so that the timing of the rotary valve 132 and disk 138 are not changed for a flushing operation, the arm 166 being moved to engage and disengage the clutch of the pointer 49.

If the gearing was not disconnected during the cleaning period, the timing for "Flush" would be disarranged and it would require allowing the device to make a complete cycle to get back in proper time.

Bridging of the two circuits just mentioned causes the magnetic valve 88 to be held open and allows a full flow of hot oil and air mixture at pump and compression pressures to be supplied to the transmission casing. As this pressure is nominal, it will not blast or blow the grease which is melted by the heated mixture out of the drain hole, but by suffering a steady supply of heated oil, air in the transmission and its parts will readily heat up and cause the lubricants to become fluid and drain off. The thermostat and pressurestat however are still in circuit as safeguards for excess heat or pressure.

By the throwing of the selector 49 to either "Flush" or "Clean", the same apparatus, heater, compressor, pump, etc., is made to do both operations effectively.

This cleaning period may be continued just as long as the operator may desire and may be stopped by turning "off" the main switch. It has been found that such a jet of oil and air is very effective for cleaning the exterior parts of the engine, transmission, etc.

It is to be understood that the timing of the valve and disk for the cyclic operation may be changed to give longer or shorter periods of spraying by a different gear ratio between the worm 112 and wheel 117.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent, is:

1. In a crank and gear case cleaning apparatus, comprising in part of a cleaning fluid supply tank, of means for combining air with the cleaning fluid under pressure, means for heating the same to convert the mixture into a vapor, means for retaining the mixture within the apparatus for a predetermined length of time, means for raising the temperature of said mixture during the detention period, means for raising the pressure of said vapor during the detention period, and means for injecting the heated and compressed vapor into the crank or gear case upon its having reached the predetermined state.

2. In a crank and gear case cleaning apparatus, comprising in part of a cleaning fluid supply tank, of means for combining air with the cleaning fluid, means for compressing the mixture while

subjected to the action of heat to convert the same into a vapor, means for retaining a quantity of said vapor within the apparatus until its temperature and pressure has reached a predetermined degree, means for injecting such quantity into the crank or gear case, means for repeating this action, means for adding to said vapor a volume of the cleaning fluid for flushing the crank or gear case.

3. In a crank and gear case cleaning apparatus, comprising in part of a cleaning fluid supply tank, of means for combining air with the cleaning fluid, means for converting the mixture into a vapor by the application of heat, means for increasing the pressure of said vapor to a predetermined degree, means for releasing the heated and compressed vapor into the crank or gear case, and means for flushing out the interior of the crank or gear case by an increased volume of the cleaning fluid.

4. In a crank and gear case cleaner of the class described and in combination with a cleaning fluid supply tank, of means for mixing air with the cleaning fluid, means for heating and compressing the resultant mixture to a predetermined degree to vaporize the same, means for injecting the vapor into the crank or gear case and means for manually controlling the injection of the vapor.

JAMES K. DELANO.