Oct. 2, 1956 W. L. STEEN ET AL 2,764,856

POLISHING WHEEL AND MEANS FOR DELIVERING ABRASIVE THERETO

Filed Jan. 15, 1953

3 Sheets-Sheet 1

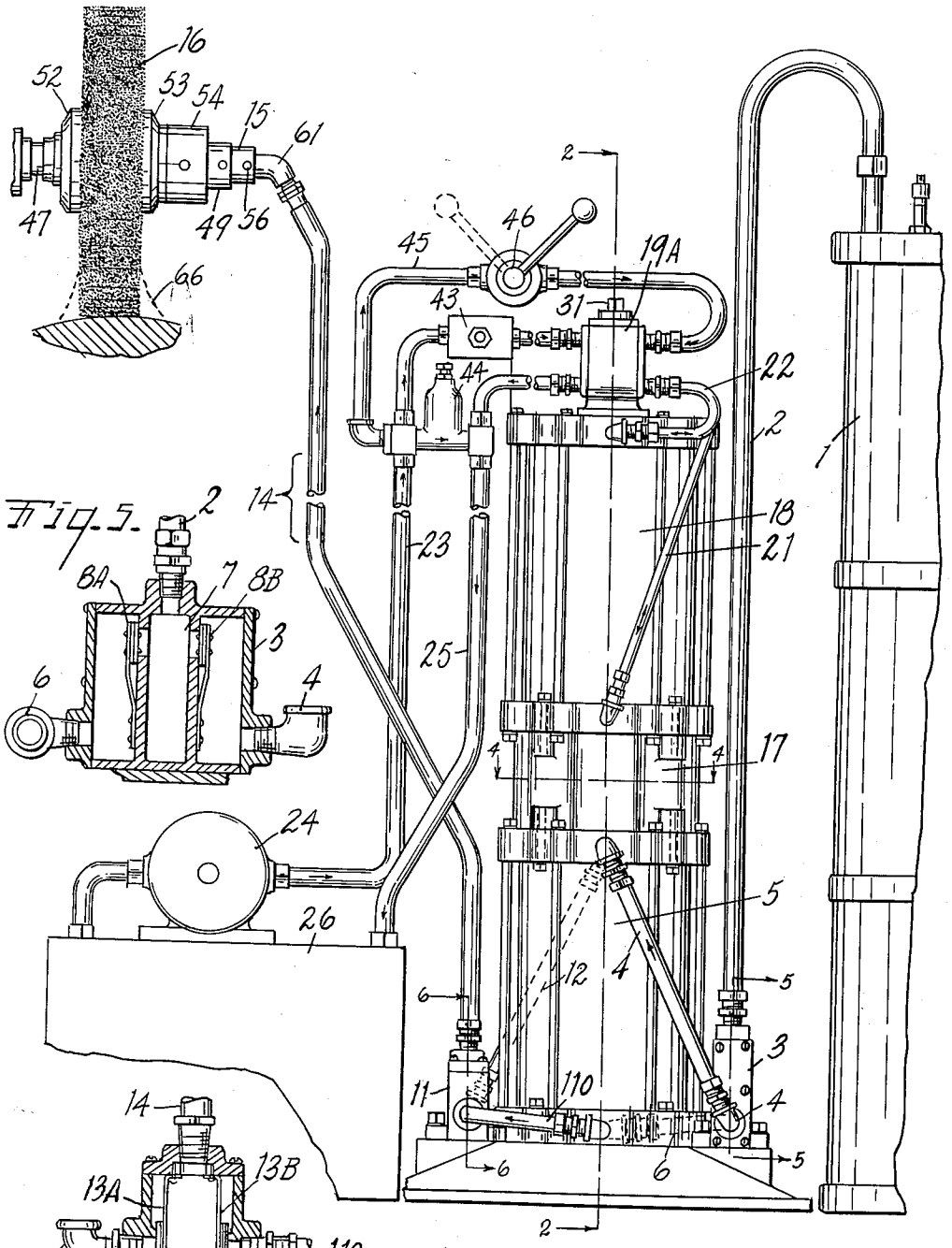



Fig. 1




Fig. 5

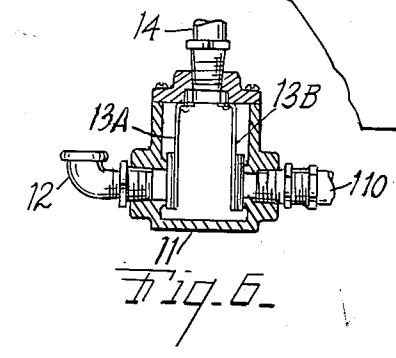



Fig. 6

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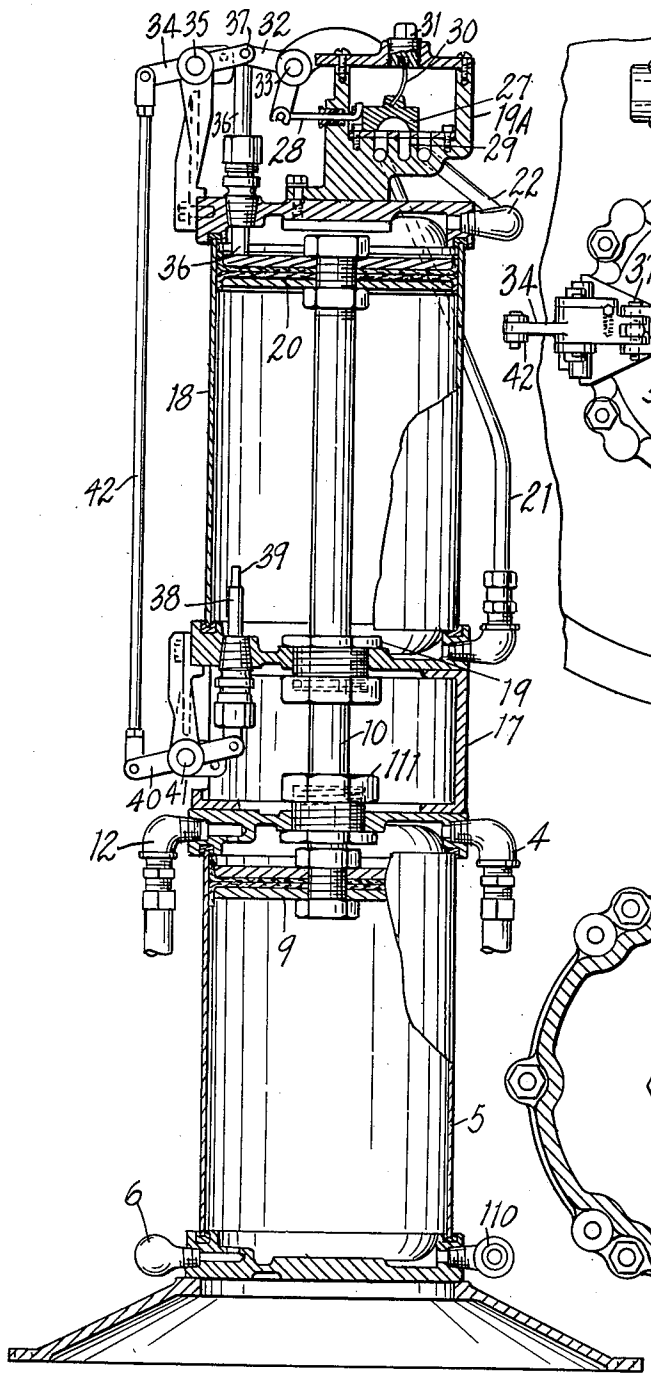



Fig. 2.

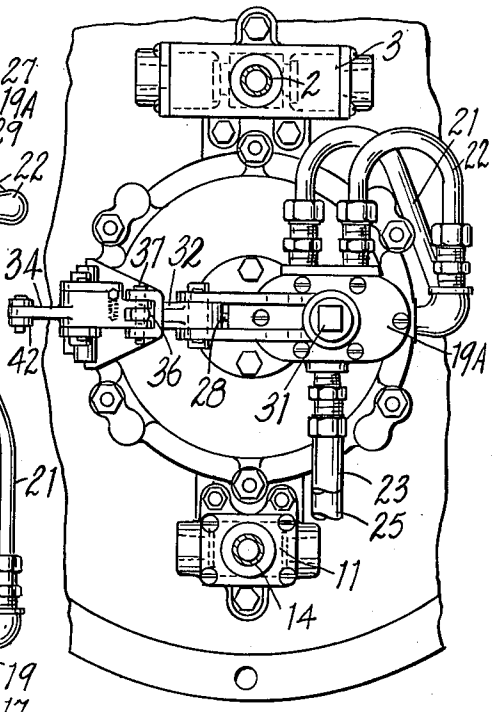



Fig. 3.

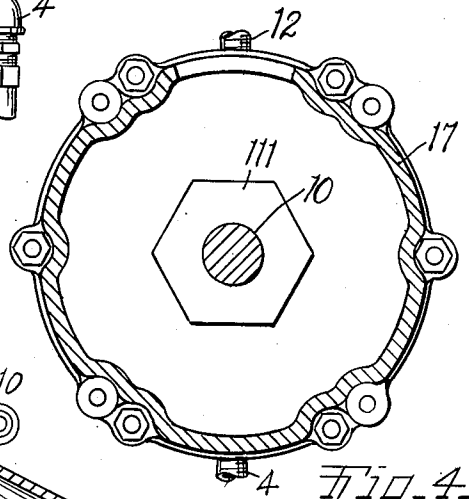



Fig. 4.

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3 Sheets-Sheet 3

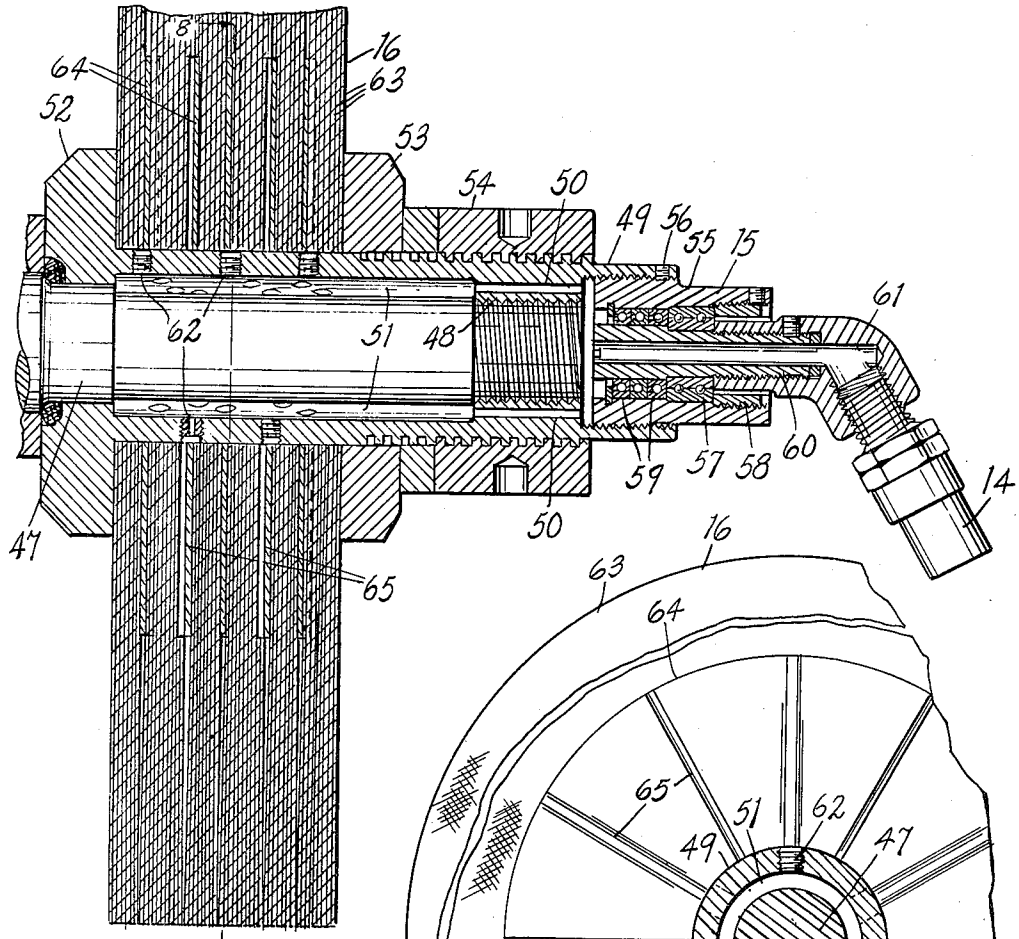



Fig. 7.




Fig. 8.

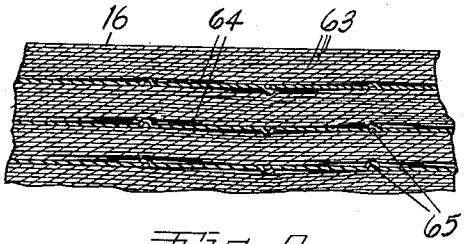



Fig. 9.

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# POLISHING WHEEL AND MEANS FOR DELIVERING ABRASIVE THERETO

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Application January 15, 1953, Serial No. 331,452

11 Claims. (Cl. 51—263)

This invention relates to improvements in polishing wheel and means for delivering abrasive thereto.

The principal objects of this invention are:

First, to provide a polishing or buffing wheel and abrasive supply system therefor which will operate without throwing off excessive abrasive.

Second, to provide a polishing wheel and abrasive supply system which function to keep sufficient abrasive at the periphery of the wheel to prevent over-heating and burning of the wheel.

Third, to provide a polishing wheel and abrasive supply system in which the abrasive fluid or paste is at all times enclosed or confined so that it does not dry out and harden and so that the system can be shut down for prolonged periods without requiring cleaning before being restarted.

Fourth, to provide a novel form of polishing wheel particularly adapted to have abrasive fluid or paste delivered along the axis thereof for further delivery radially through the wheel to the periphery thereof.

Fifth, to provide a pump or delivery means that will continuously deliver abrasive fluid or paste in predetermined constant volume to a polishing wheel regardless of variations in resistance to flow of the abrasive through the wheel to the working surface thereof.

Other objects and advantages of this invention will be apparent from a consideration of the following description and claims. The drawings of which there are three sheets illustrate a highly practical form of the invention.

Fig. 1 is a side elevational view of the abrasive supply mechanism as connected to a polishing wheel.

Fig. 2 is a vertical cross sectional view through the abrasive delivery pump taken along the plane of the line 2—2 in Fig. 1.

Fig. 3 is a fragmentary top plan view of the abrasive delivering mechanism.

Fig. 4 is a transverse cross sectional view through the abrasive delivering mechanism taken along the plane of the line 4—4 in Fig. 1.

Fig. 5 is a fragmentary cross sectional view through one of the check valves of the abrasive supply mechanism taken along the plane of the line 5—5 in Fig. 1.

Fig. 6 is a fragmentary cross sectional view through another of the check valves of the abrasive supply mechanism taken along the plane of the line 6—6 in Fig. 1.

Fig. 7 is an enlarged fragmentary cross sectional view through the polishing wheel shown in Fig. 1.

Fig. 8 is a fragmentary cross sectional view taken along a transverse radial plane of the polishing wheel indicated at 8—8 in Fig. 7.

Fig. 9 is a fragmentary cross sectional view through the polishing wheel taken along a plane parallel to the axis of the wheel and indicated by the line 9—9 in Fig. 8.

It is common practice to buff or polish metal and other articles to give them a smooth and shiny finish. This polishing operation is often performed by placing the articles against the periphery of a soft polishing wheel



made up of a series of cloth discs clamped axially together on a rotating spindle. Abrasive material in the form of a paste, stick or thick liquid is applied to the surface of the wheel and carried by the wheel against the surface of the work. The abrasive material functions both to polish the work and to act as a lubricant between the work and the wheel so that the fabric in the wheel does not become overheated. When insufficient abrasive material is present the pressure of the work against the wheel is liable to so heat the fabric that it becomes charred and the wheel must be replaced. When excess abrasive is applied to the wheel the abrasive is thrown off by centrifugal force resulting in waste of the relatively expensive abrasive and also in messy conditions around the polishing wheel. Our wheel and abrasive supply mechanism function to automatically supply the abrasive to the wheel in the correct quantity to overcome the objectionable features of prior polishing wheels and abrasive supply systems.

The abrasive supply mechanism is shown most clearly in Figs. 1 to 6 wherein 1 indicates a supply drum of the abrasive liquid or paste. The abrasive is drawn through a pipe 2 into a valve assembly 3 from where the abrasive is directed alternately through a pipe 4 to the top of a cylindrical pump chamber 5 and through a pipe 6 to the bottom of the pump chamber.

The valve assembly 3 is shown in detail in Fig. 5 wherein the pipe 2 delivers into an inner chamber 7 having two outwardly opening check valves 8*a* and 8*b*. When suction is applied to the pipe 4 the valve 8*b* opens to admit abrasive to the top of the pump chamber while pressure in the pipe 6 causes the valve 8*a* to close. Reversal of the pressure and suction naturally results in delivery of the abrasive to the pipe 6 instead of pipe 4.

The pump chamber 5 houses a piston 9 that is reciprocated in the chamber by a pump rod 10 passing through a gland or packing 111 at the top of the pump chamber. Downward motion of the piston 9 creates pressure in the bottom of the pump chamber and creates the suction in pipe 4 previously referred to. Abrasive material in the lower end of the pump chamber is delivered through the pipe 110 to a second check valve assembly 11. Upward motion of the piston 9 creates the suction in the pipe 6 and delivers abrasive from above the piston through the pipe 12 to the valve assembly 11.

The valve assembly 11 is shown most clearly in Fig. 6 and includes inwardly opening check valves 13*a* and 13*b* opening into the interior of the valve housing from the pipes 110 and 12 respectively. The outlet of the valve assembly 11 is connected to the delivery pipe 14 that extends to a running or rotating seal 15 on the end of the polishing wheel 16. The function of the valve assembly 11 is obviously to direct abrasive from the pump chamber 5 to the pipe 14 on both the up and down stroke of the piston 9.

Spaced above the cylindrical pump chamber 5 by a spacing drum 17 is a cylindrical motor chamber 18. The plunger 10 from the pump chamber extends through a gland 19 into the bottom of the motor chamber and is connected at its upper end to a driving piston 20. Mounted on top of the motor chamber 18 is a reversing valve assembly 19*a* adapted to deliver a motive liquid such as oil under pressure alternately through the pipe 21 to the bottom of the motor chamber and through the pipe 22 to the top of the motor chamber. Hydraulic pressure liquid is delivered to the valve assembly 19*a* through a pipe 23 from the motor driven pump 24. Excess and return hydraulic liquid is returned through the pipe 25 to the reservoir 26.

The reversing valve assembly 19*a* includes a movable valve element 27 "see Fig. 2" which is movable by the

push rod 28 to alternately connect the inlet port 29 with the pipes 21 and 22. An over centering leaf spring 30 compressed slightly between the plug 31 in the top of the valve assembly and the valve element 27 causes the valve element to have a snap or quick action in moving between its two adjusted positions.

The mechanism for reversing the valve assembly 19 or moving the valve element 27 includes a crank 32 pivotally supported at 33 and having one arm drivingly connected to the push rod 28. The other arm of the crank 32 is pivotally connected to an upper rock arm 34 pivotally supported at 35. A plunger 36 extending through the top of the motor chamber bears against the pivotal connection between the upper rocker arm and the crank 32 as at 37. The inner end of the plunger 36 carries a spring pressed pin engaged by and pressed upwardly when the motor piston 20 nears the top of its stroke. This moves the upper rocker arm 34 and crank 32 to the position illustrated in Fig. 2.

A similar plunger 38 having a spring pressed pin 39 at its inner end extends through the bottom of the motor chamber and is connected to the lower rocker arm 40 pivotally supported at 41. A tie rod 42 connects the upper and lower rocker arms and obviously the piston 20 will engage and actuate the lower plunger 39 to reverse the valve element 27 at the bottom of the stroke of the motor piston.

In order that the motor piston 20 may always operate under constant pressure, a metering or volume control valve 43 is connected in series in the pipe 23. The pressure relief valve 44 connects the pipe 23 to the return pipe 25 while a by-pass conduit 45 provided with an on-off valve 46 bridges the volume control valve 43 to supply hydraulic fluid to the valve assembly 19.

The polishing wheel 16 is most clearly illustrated in Figs. 7 to 9. Therein is illustrated an arbor or shaft 47 of a polishing or buffing machine. Sleeved around the end of the arbor 47 and threadedly engaged therewith as at 48 is a wheel mounting spindle 49. The threaded portion 48 of the spindle 49 has a plurality of axially opening passage 50 formed therein to deliver abrasive liquid or paste from the end of the spindle to an annular space within the spindle and around the arbor indicated at 51. The inner end of the spindle 49 has an abutment flange 52 and the polishing wheel 16 is clamped between the abutment flange and a washer 53 by a nut 54 threaded on the exterior of the spindle. The running seal 15 consists of a tubular coupling 55 threaded into the outer end of the coupling 49 and secured thereto by the set screw 56. A bearing 57 is clamped between an inner clamp ring 58 and a series of sealing gaskets 59 positioned within the coupling 55. The bearing 57 and seal gaskets 59 surround and engage a stationary nipple 60 that is threaded into an elbow 61 connecting the nipple with the pipe 14.

Abrasive liquid or paste delivered through the pipe 14 and nipple 60 passes through the ports or openings 50 and is then directed through a series of jet plugs 62 threaded through the spindle 49 in spirally arranged pattern. The jet plugs 62 are removable so that plugs having different sized delivery apertures or no apertures at all may be inserted in the spindle.

The polishing wheel 16 consists of a plurality of laminations or discs of flexible fabric 63. In between groups of the laminations are a plurality of axially spaced spacer discs 64 which function to spread the radially inner faces of the fabric discs 63. As is most clearly illustrated in Fig. 8 the discs 64 have oppositely axially opening radially extending ribs 65 formed therein. Due to the staggered or spiral arrangement of the plugs 62 one of the plugs 62 will open to the radially inner edges of the spacer discs 64.

In operation the polishing wheel and abrasive supply system are started by opening the by-pass valve 46 thus permitting the full force of the hydraulic fluid delivered by the pump to rapidly reciprocate the motor piston 20. This rapidly charges the system and it will be understood that the pipe 14 may extend to several polishing wheels. When the abrasive paste commences to ooze from the periphery of the polishing wheel the valve 46 is closed after which the continued flow of abrasive material is automatically and constantly controlled by the metering valve 43. Desirably the pressure created in the pump valve 11 by movement of the piston 9 is just enough to overcome the resistance to flow of the abrasive material through the pipe 14 and wheels 16 so that a very small flow of abrasive material is maintained to the polishing wheels. As the work is pressed against the polishing wheels the wheels are deflected as indicated at 66 in Fig. 1 and the abrasive material finds the easiest path of travel where the laminations of the wheel are thus separated. This delivers the abrasive material where it is most desired directly on the surface of the work. Note that the abrasive material is not exposed to the air until it reaches the periphery of the polishing wheel and thus will not harden and clog the supply system. By changing the plugs 62 in the spindle the delivery of abrasive can be localized or concentrated at selected axial portions of the wheel that are most heavily loaded in specific buffing or polishing operations.



Having thus described our invention what we claim to be new and desire to secure by Letters Patent is:

1. A polishing wheel and abrasive supply system therefor comprising, co-axial motor and pump cylinders, pistons in said cylinders connected by a piston rod, a source of hydraulic fluid under pressure, conduits and automatically reversible valves connected to direct fluid from said source alternately to opposite ends of said motor cylinder, a volume control valve interposed between said source and said motor cylinder, a manually operative by-pass valve connected around said volume control valve, a rotatable hollow spindle having a series of spirally arranged tapped apertures formed through its walls, ported plugs disposed in said apertures, a plurality of fabric discs clamped axially on said spindle and over said apertures, a plurality of rigid metal spacer discs interposed between said fabric discs and being of less diameter than said fabric discs, said rigid discs having radially extending axially offset ribs formed therein with the ribs opening alternately oppositely and axially of the discs, a delivery conduit having a running seal connection to the end of said spindle to deliver abrasive to the interior thereof, and pipes and check valves connected to open said delivery pipe and an abrasive intake pipe alternately to opposite ends of said pump cylinder.

2. A polishing wheel and abrasive supply system therefor comprising, co-axial motor and pump cylinders, pistons in said cylinders connected by a piston rod, a source of hydraulic fluid under pressure, conduits and automatically reversible valves connected to direct fluid from said source alternately to opposite ends of said motor cylinder, a volume control valve interposed between said source and said motor cylinder, a rotatable hollow spindle having a series of spirally arranged tapped apertures formed through its walls, ported plugs disposed in said apertures, a plurality of fabric discs clamped axially on said spindle and over said apertures, a plurality of rigid spacer discs interposed between said fabric discs and being of less diameter than said fabric discs, said rigid discs having radially extending axially offset ribs formed therein, a delivery conduit having a running seal connection to said spindle to deliver abrasive to the interior thereof, and pipes and check valves connected to open said delivery pipe and an abrasive intake pipe alternately to opposite ends of said pump cylinder.

3. A polishing wheel and abrasive supply system therefor comprising, a fluid motor and displacement pump interconnected mechanically for movement of said pump in proportion to movement of said motor, a source of fluid pressure connected to said motor, a volume control

valve connected between said source and said motor, a hollow rotatable spindle having a series of spirally arranged ports formed through its wall, plugs having passages formed therethrough and removably positioned in said ports, a multiplicity of flexible fabric discs disposed around said spindle over said ports and clamped axially together, a plurality of rigid spacer discs of smaller diameter than said flexible discs and interposed between axially spaced flexible discs, said rigid discs having radially extending grooves formed in the faces thereof, a delivery conduit having a running seal connection to said spindle to deliver abrasive to the interior thereof, and means connecting said pump between said delivery conduit and a source of abrasive.

4. A polishing wheel and abrasive supply system therefor comprising, a fluid motor and displacement pump interconnected mechanically for movement of said pump in proportion to movement of said motor, a source of fluid pressure connected to said motor, a volume control valve connected between said source and said motor, a hollow rotatable spindle having a series of spirally arranged ports formed through its wall, a multiplicity of flexible discs disposed around said spindle over said ports and clamped axially together, a plurality of rigid spacer discs of smaller diameter than said flexible discs and interposed between axially spaced flexible discs, said rigid discs having radially extending grooves formed in the faces thereof, a delivery conduit having a running seal connection to said spindle to deliver abrasive to the interior thereof, and means connecting said pump between said delivery conduit and a source of abrasive.

5. A polishing wheel and abrasive supply system therefor comprising, motor and pump cylinders, pistons in said cylinders, means mechanically connecting said pistons, a source of hydraulic fluid under pressure, conduits and automatically reversible valves connected to direct fluid from said source alternately to opposite ends of said motor cylinder, a volume control valve interposed between said source and said motor cylinder, a manually operative by-pass valve connected around said volume control valve, a rotatable hollow spindle having a series of tapped apertures formed through its walls, ported plugs disposed in said apertures, a plurality of fabric discs clamped axially on said spindle and over said apertures, a plurality of rigid spacer discs interposed between said fabric discs and being of less diameter than said fabric discs, said rigid discs having radially extending axially offset grooves formed therein, a delivery conduit having a running seal connection to the end of said spindle to deliver abrasive to the interior thereof, and pipes and check valves connected to open said delivery pipe and an abrasive intake pipe alternately to opposite ends of said pump cylinder.

6. A polishing wheel and abrasive supply system therefor comprising, motor and pump cylinders, pistons in said cylinders, means mechanically connecting said pistons, a source of hydraulic fluid under pressure, conduits and automatically reversible valves connected to direct fluid from said source alternately to opposite ends of said motor cylinder, a volume control valve interposed between said source and said motor cylinder, a rotatable hollow spindle having a series of ports formed through its walls, a plurality of flexible fibrous discs clamped axially on said spindle and over said ports, a plurality of rigid spacer discs interposed between said flexible discs and being of less diameter than said flexible discs, said rigid discs having radially extending axially offset grooves formed therein, a delivery conduit having a running seal connection to said spindle to deliver abrasive to the interior thereof, and pipes and check valves connected to open said delivery pipe and an abrasive intake pipe alternately to opposite ends of said pump cylinder.

7. A polishing wheel and abrasive supply system therefor comprising, a fluid motor and displacement pump



interconnected mechanically for movement of said pump in proportion to movement of said motor, a source of fluid pressure connected to said motor, a volume control valve connected between said source and said motor, a hollow rotatable spindle having a series of ports formed through its wall, plugs having passages formed therethrough and removably positioned in said ports, a multiplicity of flexible fibrous discs disposed around said spindle over said ports and clamped axially together, a plurality of rigid spacer discs of smaller diameter than said flexible discs and interposed between axially spaced flexible discs, said rigid discs having radially extending grooves formed in the faces thereof, a delivery conduit having a running seal connection to said spindle to deliver abrasive to the interior thereof, and means connecting said pump between said delivery conduit and a source of abrasive.

8. A polishing wheel and abrasive supply system therefor comprising, a fluid motor and displacement pump interconnected mechanically for movement of said pump in proportion to movement of said motor, a source of fluid pressure connected to said motor, a volume control valve connected between said source and said motor, a hollow rotatable spindle having a series of ports formed through its wall and disposed along a portion of the length of said spindle, a multiplicity of flexible discs disposed around said spindle over said ports and clamped axially together, a plurality of rigid spacer discs of smaller diameter than said flexible discs and interposed between axially spaced flexible discs, said rigid discs having radially extending grooves formed in the faces thereof, a delivery conduit having a rotatable sealed connection on said spindle to deliver abrasive to the interior thereof, and means connecting said pump between said delivery conduit and a source of abrasive.

9. A polishing wheel and abrasive supply system therefor comprising, a fluid motor and displacement pump interconnected mechanically for movement of said pump in proportion to movement of said motor, a source of fluid pressure connected to said motor, a volume control valve connected between said source and said motor, a hollow rotatable spindle having a series of ports formed through its wall and disposed along a portion of the length of said spindle, a multiplicity of flexible discs disposed around said spindle over said ports and clamped axially together, a delivery conduit having a rotatable sealed connection to said spindle to deliver abrasive to the interior thereof, and means connecting said pump between said delivery conduit and a source of abrasive.

10. A polishing wheel comprising, a hollow tubular spindle having a collar at its inner end adapted to fit closely around a machine spindle, an internally threaded portion of reduced diameter near the outer end of said spindle adapted to coact with the threaded end of a machine spindle, said reduced portion having axially extending passages formed therethrough and opening to the space between said reduced portion and said collar, another thread formed internally in the outer end of said tubular spindle and having a rotating seal coupling element received therein, a thread formed around the exterior of said tubular spindle at the outer end thereof, a clamp ring removably disposed around said tubular spindle and held in place by a nut on said exterior thread, a multiplicity of flexible fabric discs positioned around said tubular spindle and clamped axially together by said nut, a plurality of rigid discs of less diameter than said flexible dics disposed around said tubular spindle and between axially spaced flexible discs, said rigid discs having radially extending alternately oppositely facing corrugated ribs formed therein and extending between the radially inner and outer edges of the rigid discs, said tubular spindle having a plurality of spirally arranged tapped ports formed therethrough and positioned between said collar and said exterior

thread, and plugs having holes formed therethrough removably positioned in said ports.

11. A polishing wheel comprising, a hollow tubular spindle having a collar at its inner end adapted to fit closely around a machine spindle, an internally threaded portion of reduced diameter near the outer end of said spindle adapted to coact with the threaded end of a machine spindle, said reduced portion having an axially extending passage formed therethrough and opening to the space between said reduced portion and said collar, a rotating seal coupling element connected to the outer end of said tubular spindle, a thread formed around the exterior of said tubular spindle at the outer end thereof, a clamp ring removably disposed around said tubular spindle and held in place by a nut on said exterior thread, a multiplicity of flexible fabric discs positioned around said tubular spindle and clamped axially together by said nut, a plurality of rigid discs of less diameter than said flexible discs disposed around said tubular spindle and between axially spaced flexible discs, said rigid discs having radially extending corrugated ribs formed therein and extending between the radially inner and outer edges of the rigid discs, said tubular spindle having a plurality of spirally arranged ports formed therethrough and positioned between said collar and said exterior thread.



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