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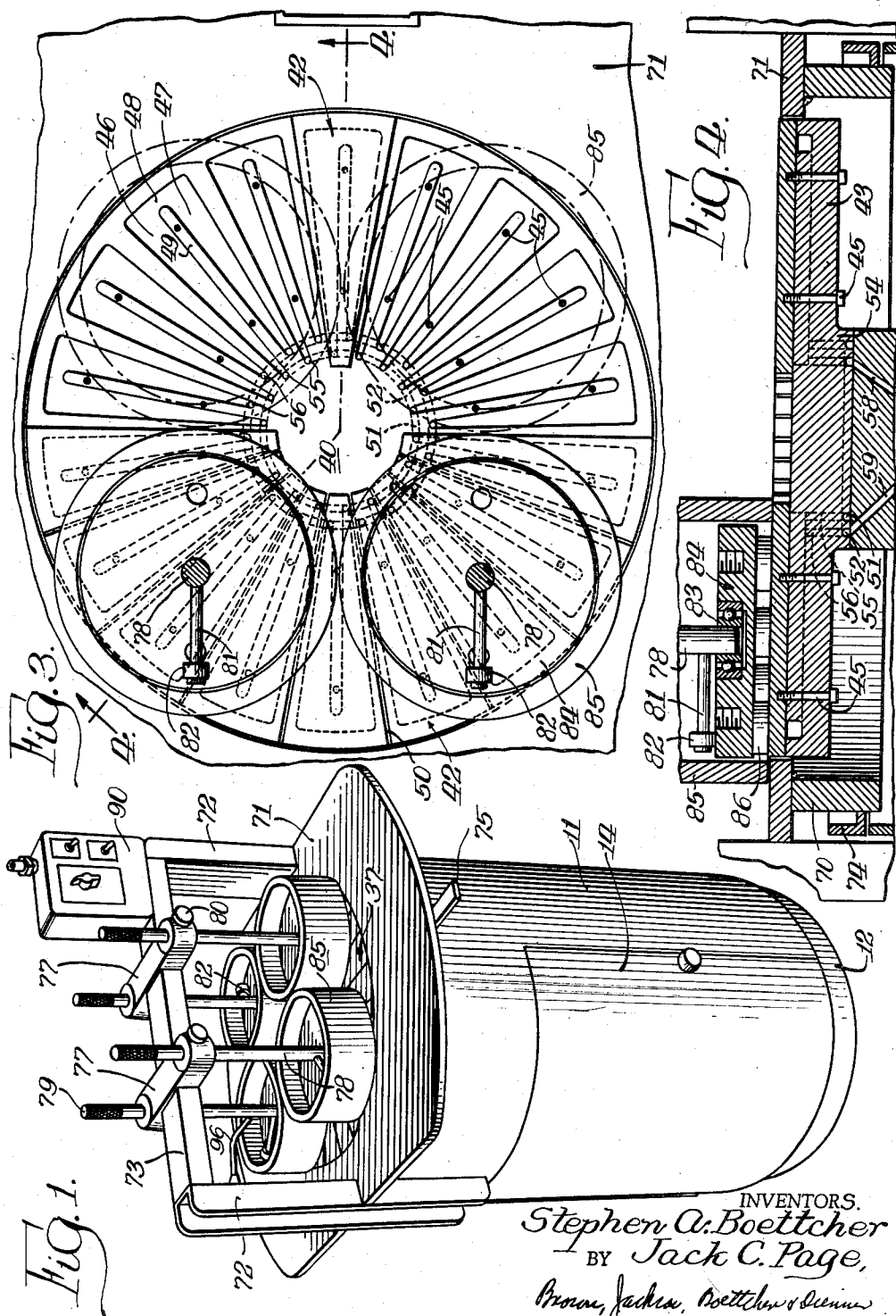
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LAPPING MACHINE

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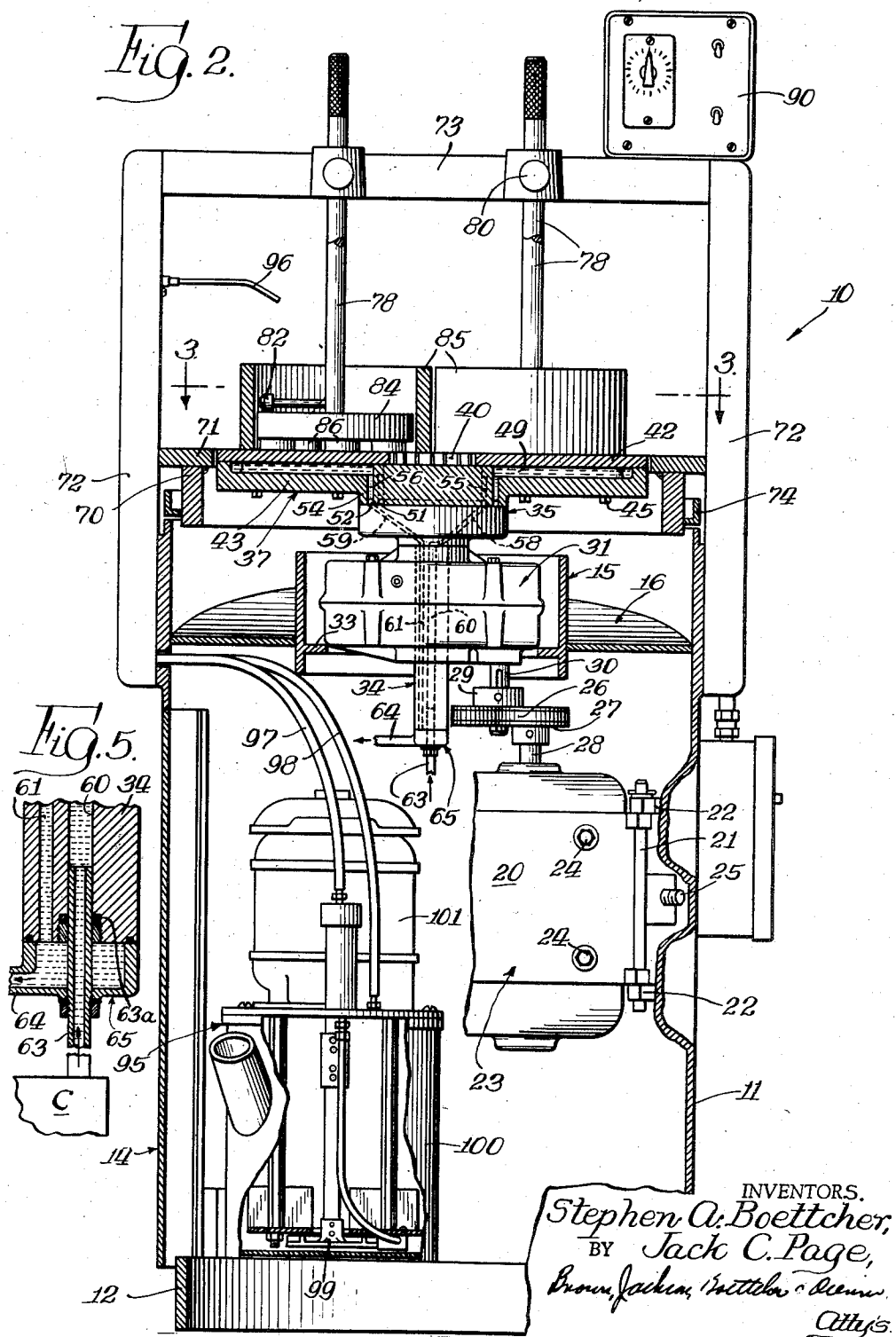
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LAPPING MACHINE

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7 Claims. (Cl. 51-266)

Our present invention concerns improvements in lapping machines.

A lapping machine to which the present invention is directed, includes a lapping wheel, annular in configuration, which is rotatably driven about a vertical axis and on which work pieces are loaded in confined arrangement for the abrasive lapping of a surface by movement relative to the wheel.

The surface produced on the work piece is a reflection or reverse of the moving lapping wheel surface which it engages. Abrasive engagement of the lapping wheel surface with the work pieces, however, tends to wear the lapping wheel unevenly and thus such wheel must be corrected, preferably constantly, to maintain a flat lapping surface if it is to function as intended.

Of further importance in lapping is the provision of a suitable lapping grit carried by a vehicle, such as oil. The abrasive particles are desirably maintained in suspension in the vehicle, since the removal of stock from a work piece is dependent not only on the period of abrasion, but also on its uniform engagement with the abrasive substance. Thus, it is desirable to keep the lapping mixture homogeneous and of substantially uniform viscosity as a control measure.

In addition to the above-noted factors relating to the lapping surface of the lapping wheel and control of homogeneous suspension of the lapping grit, we have found that maintaining the work pieces and the lap wheel at substantially uniform temperature is also important for uniform control of the lapping operation. It is important that the lap wheel be maintained at substantially a uniform temperature throughout the operation in order to avoid distortion by heat, which in many instances serves to destroy the necessary condition of the lap surface. If such distortion is present, correction is necessary for successful lapping operation.

Distortion of the work parts must also be avoided. This latter factor becomes particularly important in lapping work parts having a thin cross section. In this latter respect, it is not uncommon to encounter working temperatures of 140° F. and upwards at the surface of the lapping wheel. Since in most instances the work pieces are confined in a defined area of the rotating lapping wheel and held in engagement with the lapping surface by a weight plate or the like, the existence of high lap surface temperatures becomes particularly likely to cause distortion of the work pieces. This distortion is caused by the high temperature on one face of the work piece and the relatively cool or lower temperature of the weight plate on the opposite face thereof. Thus, a thin cross section work piece having different temperatures on its opposite faces is particularly subject to distortion, and unsatisfactory lapping follows.

The elimination of extreme lapping wheel temperatures is also important from the standpoint of maintaining uniform viscosity of the vehicle carrying the lapping grit. Additionally, dangers are encountered when using lapping vehicles having a low flash point, for example, in the

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area of 150° F. Thus, if a lapping wheel temperature of 150° F. is approached, noxious and explosive vapors may ensue and such hazards are to be avoided.

The above-listed items are but a few of the more serious factors to be considered in practicing a successful lapping operation. It is our intention and purpose to provide a means for eliminating many of these difficulties by maintaining the temperature of the lapping wheel substantially uniform throughout the lapping operation and preferably within a normal room temperature range of 70 to 80° F. We accomplish this desirable result by providing a system for cooling the rotating lapping wheel and maintaining it at substantially uniform temperature.

The main object of our invention lies in providing a cooling system for the lapping wheel.

A further object lies in the particular manner in which we provide the cooling ducts in the lapping wheel to the end of practicality.

In the drawings:

Figure 1 is a perspective view of a lapping machine to which the features of this invention are directed.

Figure 2 is a cross-sectional view taken substantially on the longitudinal center line of the lapping machine shown in Figure 1;

Figure 3 is a plan view of the lapping wheel employed in the machine;

Figure 4 is a cross-sectional view taken substantially along line 4-4 of Figure 3; and

Figure 5 illustrates a detail of the cooling system.

Major portions of the machine illustrated are substantially as illustrated and described in the copending application of Stephen A. Boettcher, Serial No. 594,416, filed June 28, 1956. The machine has a substantially cylindrical pedestal 11 which is supported on a concentrically related base ring 12, the pedestal 11 including a door 14 giving access to its interior.

As seen in Figure 2, a cylindrical collar 15 is mounted within the upper end of the pedestal 11, slightly off center with respect to the longitudinal axis of said pedestal and held in such position by an inclined drip pan 16 welded or otherwise fixed at its outer periphery to the inside surface of pedestal 11. The inner periphery of the drip pan is securely fixed to the outside surface of collar 15, and such pan serves to catch abrasive and vehicle mixture used in the lapping operation. Vertical downspout means (not shown) leads from the lower end of the drip pan to a removable tank (not shown) located within the pedestal housing.

Mounted within the pedestal 11 is a motor bracket plate 20 carried by a vertical shaft 21 which is supported in ear brackets 22, 22 fastened securely to the inside of the pedestal 11. With this arrangement, the motor 23, fixed to bracket 20 by bolt means 24, 24, is pivotal about the vertical axle 21. Adjustment bolt means 25 engages the interior side walls of pedestal 11 for tensioning a drive belt 26 trained between a sheave wheel 27 mounted on armature shaft 28 of the motor 23 and a second sheave wheel 29 fastened to input shaft 30 of a conventional gear reducer, indicated generally by numeral 31.

The gear reducer 31 is mounted within the ring 15 whereat it rests on and is bolted to an inside flange portion 33. An output shaft 34 of the gear reducer unit 31 is formed with an enlarged hub portion 35 at its upper end, which has secured thereto the rotatable lapping wheel assembly, indicated generally by 37 and the details of which will now be described.

As seen in Figures 2-4, the lapping wheel assembly 37 is formed to provide an annular lapping surface having a central well-bore 40. A plurality of wedge-shaped replaceable wear segments 42 form the lapping surface and are mounted on top of a base plate portion 43 of the lap wheel assembly as by bolts 45, 45. The base 43 is pref-

erably formed of cast iron, or a similar material, and is provided with a plurality of wedge-shaped depressions or wells 46 and 47 related in pairs by a cross connecting passageway 48 and partially separated by an intervening wall or web portion 49 through which the holding bolts 45, 45 extend. This construction is best seen in the right-hand portion of Figure 3, where the wheel is illustrated with the wear segments removed.

Each of the wear segments 42, preferably of a long wearing alloy, forms a closure member for passageways 46, 47, and 48 formed in the base plate 43. It will be understood that each set of related passageways 46, 47, and 48 is covered by a removable wear segment 42, sealing connection between the segments and the base plate being effected by shellac or suitable gasket means while pressure is applied by holding bolts 45, 45. Between adjacent segments 42, 42 is a radial slot 50 which serves to convey used abrasive and oil and stock particles to the drip pan 16.

In addition to the passageways 46, 47 and 48 on its upper face, the base plate 43 of the lapping wheel assembly has a pair of annular grooves or passageways 51 and 52 concentrically located in the lower face of its central hub portion 54, such passageways being completed by the enclosing upper face of the hub portion 35 of the gear reducer unit. The radially innermost annular passageway 51 communicates by means of vertical risers 55, 55 with the longer of each of the wedge-shaped passageways 46 in the upper face of the base plate 43. Similarly, each annular passageway 52 communicates with the shorter of each of the wedge-shaped passageways 47 through a vertical riser 56. This relationship will be understood from Figures 3 and 4 of the drawings.

From Figure 2, it will be seen that the hub portion 35 at the upper end of the output shaft 34 of the gear reducing unit 31 is provided with two angularly inclined bores or passageways 58 and 59 which communicate respectively with the annular passageways or grooves 51 and 52. Passageways 58 and 59, in turn, communicate respectively with vertical passageways 60 and 61 formed lengthwise in the output shaft 34. Passageways 60 and 61, in turn, communicate with inlet and outlet conduits 63 and 64, respectively, through a rotating joint fixture indicated generally by numeral 65. This fixture, of which the output shaft 34 is an operative part, is illustrated, in vertical cross-section, in Figure 5. The passageway 60 is axial in the shaft 34, and the inlet conduit 63 is set into it, packed by a compressible O-ring 63a. The passageway 61 is off-center and leads into the stationary fixture chamber 65. Inlet conduit 63 is supplied with cold water or other fluid coolant from a source c.

From the foregoing, it will be understood that coolant entering inlet conduit 63 passes upwardly through passageways 60, 58, 55, 46, 48, and 47 in that order for return circulation through passageways 56, 59 and 61 and the outlet conduit 64. Thus, each set of wedge-shaped passageways formed in the base plate 43 and sealed over by a wedge-shaped wear segments 42 is provided with a constantly circulating cooling fluid, maintaining the lapping plate at a preselected and uniform temperature, the velocity of flow and the temperature of the coolant being regulated, as required, to keep the desired thermal condition.

Surrounding the lapping wheel assembly 37 is a ring 70 upon which is mounted a planar staging table 71, riding vertically along channel columns 72, 72 mounted in upright position at diametrically opposite sides of pedestal housing 11 and cross connected by a horizontal bridge member 73. Channel members 72 act as guide means for the vertical elevation and depression of the staging table 71, which is effected by shifting a camming shifting ring 74, operated by a handle 75 for rapid loading and unloading of work pieces.

The bridge member 73 carries a pair of cross-arms 77, 77, the outer ends of each being vertically bored to receive a vertically adjustable spindle 78. Each spindle

has a knurled upper end 79 for manually gripping the same, and is held in place by a set screw 80 as required. Each spindle, at its lower end, is provided with a radially extending arm 81 (see Figure 4) at the outer end of which is a roller or friction member 82. The lower end of each spindle enters a ball bearing 83 mounted centrally of a circular weight plate 84 which lies upon the work pieces 86 in a related truing-retainer ring 85 on the lapping surface of the lapping wheel. Vertical positioning of the spindles and their arms 81 serves to regulate the amount and location of pressure applied to the weight plate in addition to that imposed by gravity.

In operation, each ring and associated weight plate may rotate about the axis of the associated spindle 78, altogether serving to lap the bottom surface of the work pieces and to dress the lapping wheel for maintaining the same planar, in the manner set forth in the above-referred-to copending application, Serial No. 594,416.

The machine 10 also has an electric timer 90 controlling the motor 23 for predetermining the rotating period of the lap assembly 37.

A pump 95 is mounted in the pedestal 11 to circulate and agitate the grit and carrying vehicle to be delivered to the surface of the lapping wheel by a discharge spout 96 and circulating connection lines 97, 98. The pump means 95 includes an impeller 99 housed within the cylindrical tank 100 and a driving motor 101.

We claim:

1. In a lapping machine, a lapping plate base rotatable on a vertical axis, plural wedge-shaped segment members superposed on said plate and presenting, when assembled, an annular lapping surface, interconnected chamber means formed by the opposing faces of said base and segments to form fluid conductive passageways, means for rotating said plate, and means for circulating coolant through said passageway means to cool said lapping surface.

2. In a lapping machine, a lapping plate base mounted for rotation on a vertical axis, plural wedge-shaped segments removably mounted on said plate and presenting an annular planar lapping surface, chamber means formed in said plate beneath said segments, the latter when mounted on said plate serving to close over said chamber means to form passageways, additional passageway means formed in said plate and interjoining said chambers, means for circulating coolant through said passageway means and chambers to cool said segments, and means for rotatably driving said plate.

3. A lapping machine comprising a drum-like pedestal, a circular lapping plate rotatable on a vertical axis at the upper end of said pedestal, plural wear resistant segment members mounted on the upper face of said plate and forming an annular planar lapping surface, a plurality of interconnected chamber passageways formed in said plate and communicating with said segments, means for rotatably driving said plate, and means for circulating coolant through said chamber passageways while rotatably driving said plate.

4. A lapping plate assembly for use in a lapping machine comprising a circular lapping plate base mounted for rotation about a vertical axis, a plurality of removable segment members on the upper face of said base to present an annular lapping surface, plural interconnected chamber means formed in the upper face of said plate and covered by said segments to form passageways internally of the assembly, additional passageway means in said plate communicating with said chamber means, and means for circulating cooling fluid through said passageways and chamber means to cool the lapping plate assembly during lapping operation.

5. In a lapping machine, a circular rotatable member having a lapping surface, a plurality of passageways formed internally of said member in proximity to said surface, a common duct connected to one end of each of said passageways for supplying a cooling fluid

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simultaneously to said passageways, and another common duct connected to the other end of each of said passageways, for discharging said fluid therefrom during rotation of said member.

6. In a lapping machine, a circular planar lapping plate rotatable on a vertical axis, a plurality of U-shaped passageways formed internally of said plate and radially positioned therein with their ends toward the center thereof, means for rotatably driving said plate, and centrally located supply and discharge passages respectively connected with said ends for circulating coolant through said passageways.

7. In a lapping machine, a rotatable planar lapping plate having a plurality of loop-shaped passageways

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formed internally of said plate, a central cooling fluid supply passage and a discharge passage, said first named passageways being connected in parallel across said supply passage and discharge passage.

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