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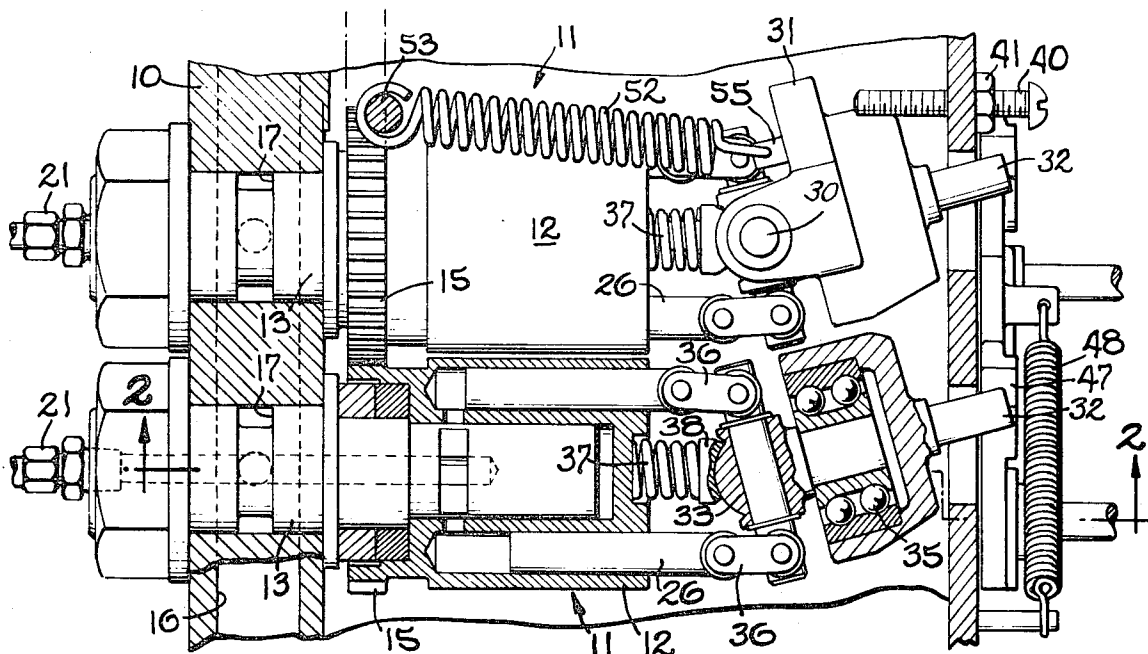
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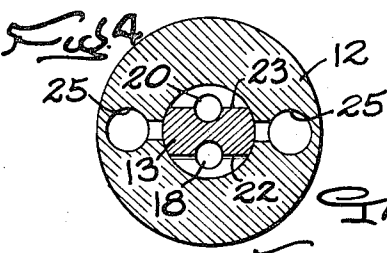
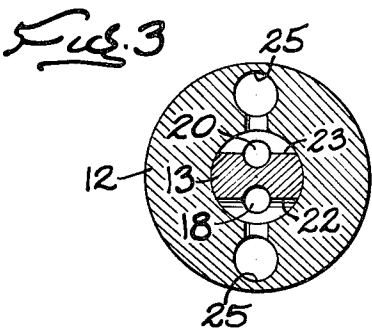
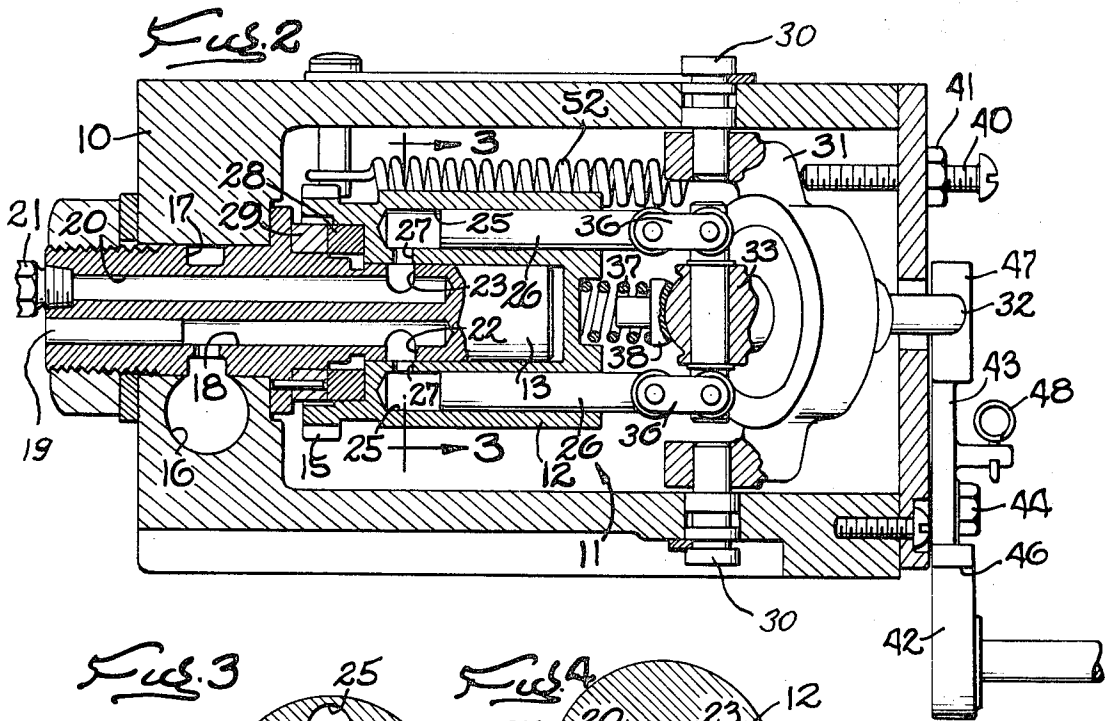
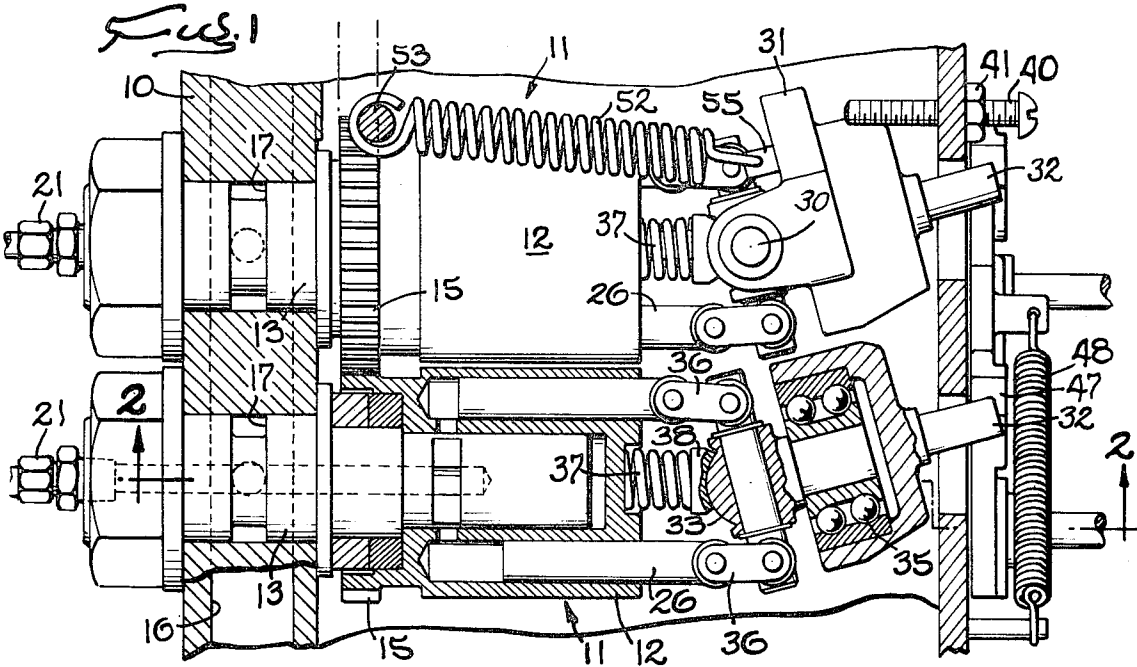
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[54] **INK INJECTOR PUMP OUTPUT CONTROL MECHANISM**
6 Claims, 13 Drawing Figs.

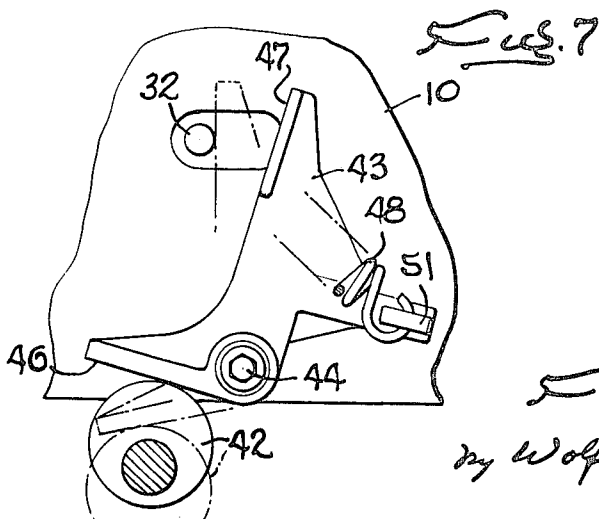
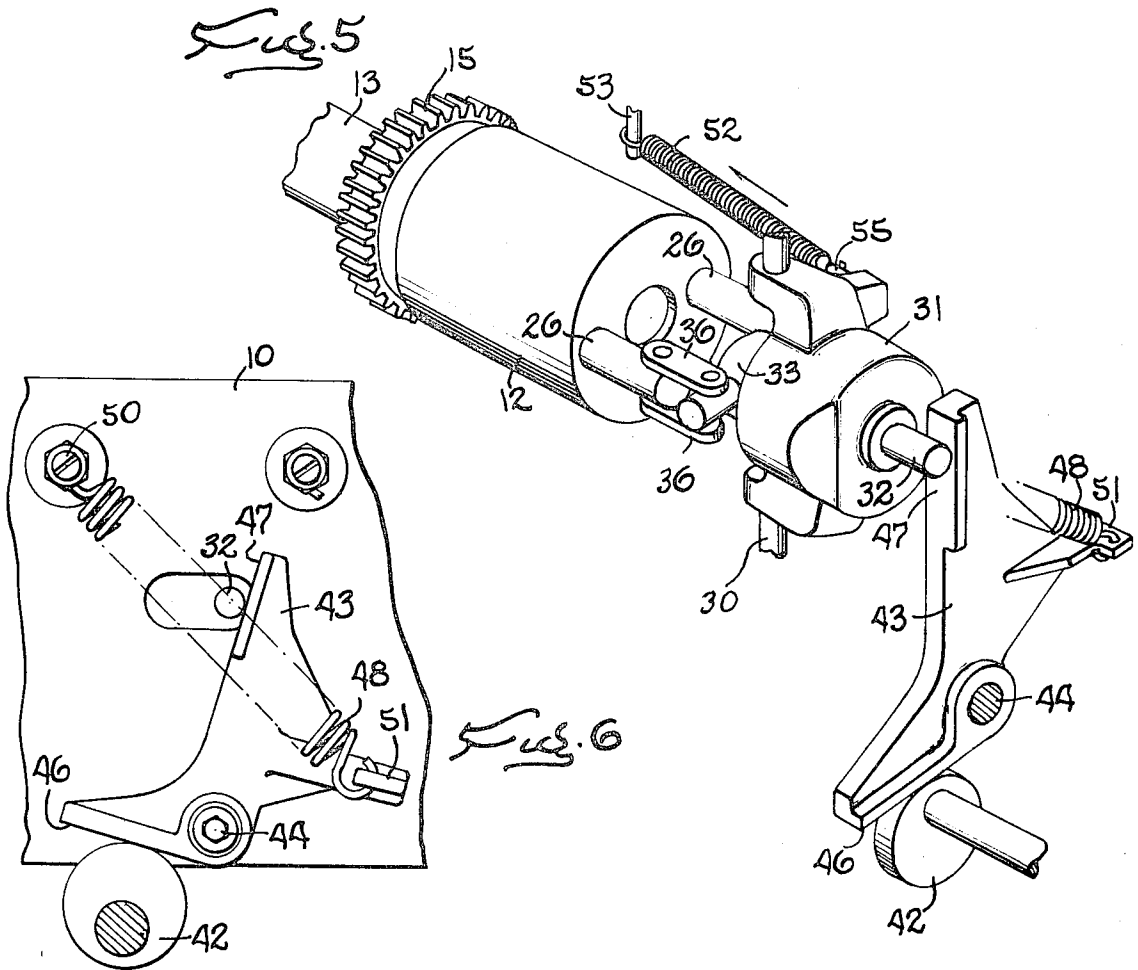
[52] **U.S. Cl.**..... **91/505,**
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ABSTRACT: A control mechanism and method of operation for a positive displacement ink injector pump is disclosed in which resiliently separable linkage connections enable displacement adjustments to be applied to the system while the pump displacement mechanism is stationary and immobilized due to fluid entrapped within the pumping chambers, and in which the adjustment is thereafter effected when the pump is again stated.

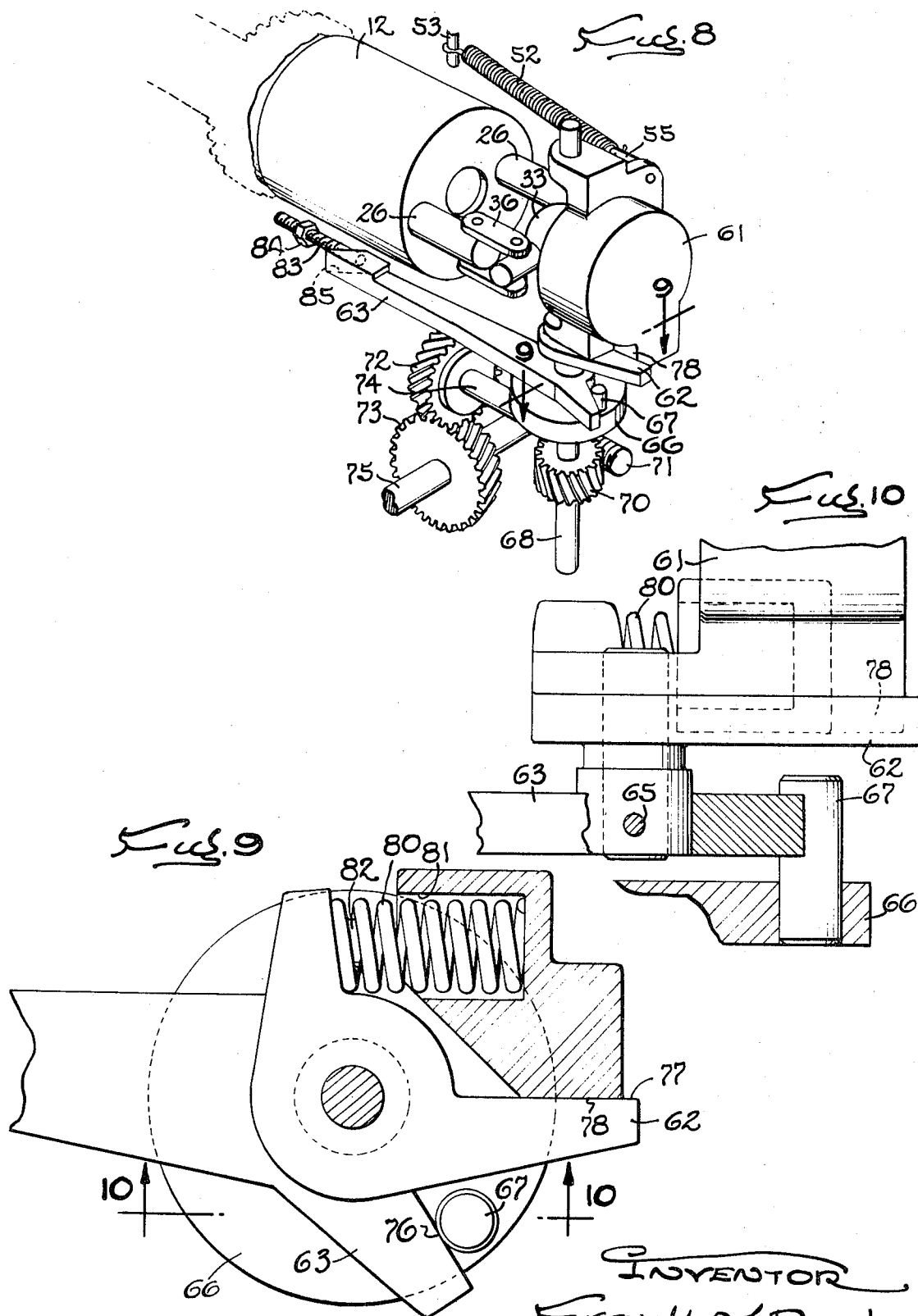




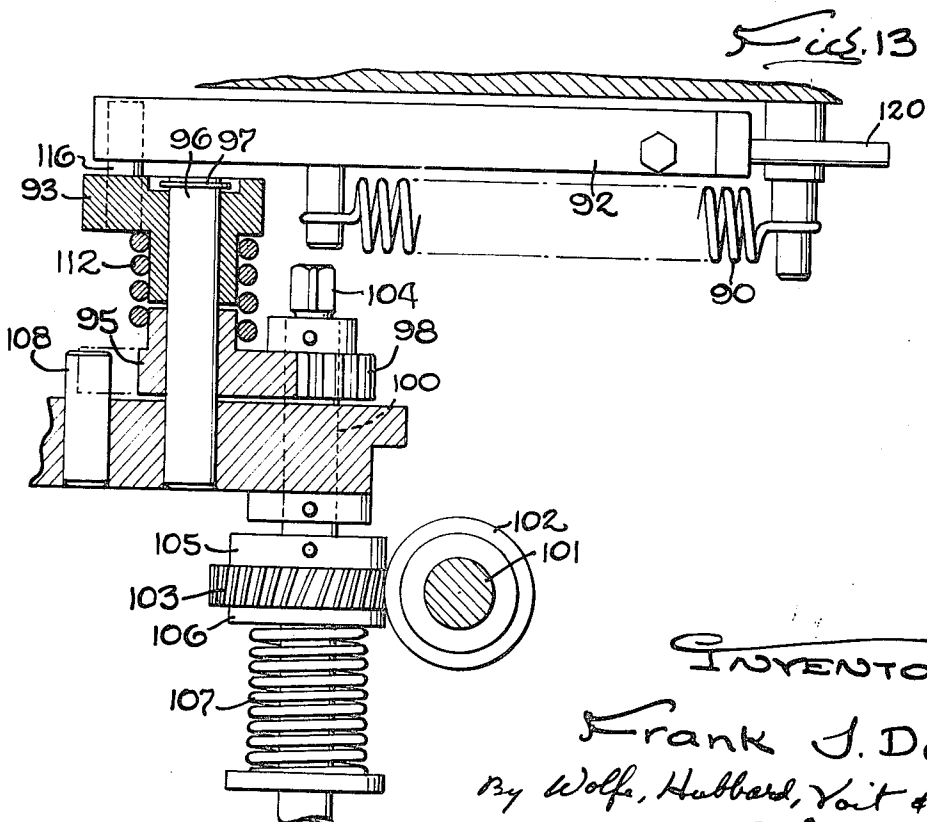
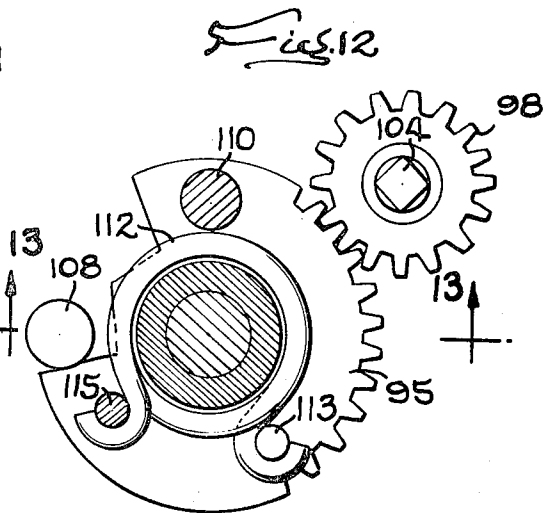
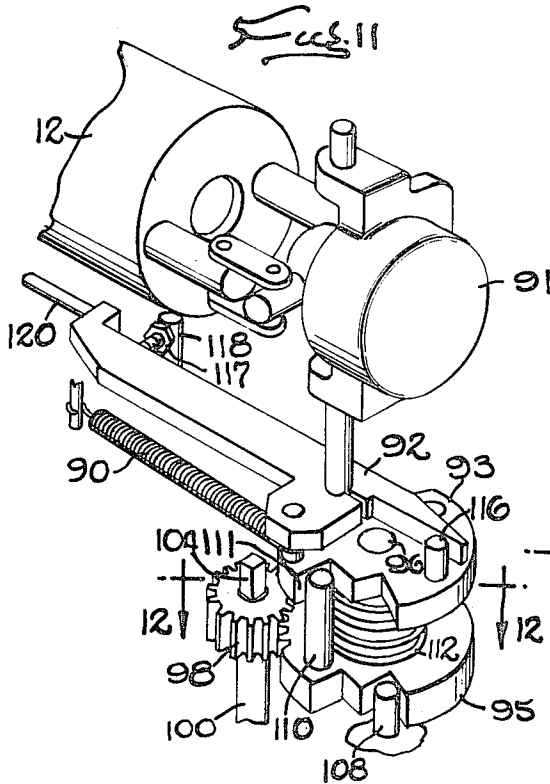
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INK INJECTOR PUMP OUTPUT CONTROL MECHANISM

The present invention relates to displacement control mechanisms for positive displacement pumps, and in its principal aspect relates to multiple-piston rotary swash plate type pumps in which displacement adjustments are applied while the pump is stationary as well as when it is in operation.

Rotary positive displacement pumps utilizing swash plate output adjustment means have been known and used for some time. One useful application of such pumps has been in ink supply systems for newspaper printing press units in which each portion of the width of a printed page may require a different amount of ink in order to maintain the proper scale of "color" or ink intensity for that portion of the page. Normally, a separate positive displacement ink pump with variable displacement means is used for each column area of page width so that each pump may be individually adjusted to correct the color or intensity of the corresponding portion of the printed page.

One disadvantage of the swash plate type output control mechanisms is that they are prone to lock up and become immovable due to entrapped ink when the pump is stopped. Thus, no change in displacement can be made when the press unit is not in operation, and any such changes must await restarting of the press so that the entrapped ink may be purged or flushed from the system. This is often the cause of considerable inconvenience when it is desired to change from black to colored ink, for example, or when it is desired to turn off or "silence" a page section of the ink pump system after a press run.

In view of the foregoing, it is a principal object of the present invention to provide a displacement control mechanism for use with a positive displacement ink pump having a variable delivery stroke, in which the adjustment of output displacement may be made at any time, whether the pump is running or not.

Another object is to provide an operating mechanism of the above type that is simple and inexpensive to build and maintain, and which will hold operating adjustments firmly and accurately.

A further object is to provide a positive displacement ink pump which may be quickly and efficiently purged of ink during cleaning or changeover to another color of ink through a simple adjustment of its operating mechanism.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIG. 1 is a plan view in section of a portion of an ink pump assembly exemplifying the present invention, showing two individual ink pump units;

FIG. 2 is a section taken in the plane 2-2 of FIG. 1;

FIG. 3 is a section taken in the plane 3-3 of FIG. 2;

FIG. 4 is a section similar to FIG. 3, with the pump barrel rotated 90° on its rotational axis;

FIG. 5 is a partial perspective of the main operating elements of the mechanism of the previous FIGS., with portions of the assembly frame being deleted for clarity;

FIG. 6 is an enlarged partial section of the cam and intermediate member shown in FIG. 4;

FIG. 7 is a partial view similar to FIG. 6 illustrating the various members in an alternate operational position;

FIG. 8 is a partial perspective of a second operating mechanism exemplifying the present invention, with portions of assembly being deleted for clarity;

FIG. 9 is an enlarged plan view of the intermediate and adjustment members of the mechanism of FIG. 8, taken in the plane 9-9;

FIG. 10 is an elevation taken in the plane 10-10 of FIG. 9;

FIG. 11 is a partial perspective of a third operating mechanism exemplifying the present invention, with portions of the assembly being deleted for clarity;

FIG. 12 is an enlarged plan view of the operating member of FIG. 11, taken in the plane 12-12; and

FIG. 13 is an elevation taken in the plane 13-13 of FIG. 12, with additional associated mechanism being illustrated.

While the invention will be described in connection with certain particular exemplary embodiments, it will be understood that it is not intended to so limit the invention, but it is instead intended to cover all alternative and equivalent constructions as may be included within the spirit and scope of the invention as defined by the appended claims.

Referring first to FIG. 1, there is shown a fragmentary portion of a first exemplary ink pump assembly frame 10 containing two individual ink pump units 11. Each ink pump unit 11 consists of a cylindrical pump barrel 12 journaled for rotation about a stub shaft 13 fixed to the frame 10. Gears 15 are affixed to one end of each of the pump barrels 12, and intermesh as a linear train which is driven from a drive gear (not shown) powered from the press drive.

Ink is received by each individual pump unit 11 from a common inlet channel 16 formed as a bore in the frame 10. An annular groove 17 cut in the stub shaft 13 intersects the inlet channel 16 and directs ink into an inlet bore 18 within the base section of the stub shaft 13 that is closed by a plug 19. Also within the base section is an ink discharge bore 20 which communicates with a fitting 21 leading to the particular column area of the printed page which that particular pump unit 11 is to supply. An inlet port 22 and an outlet port 23 are disposed 180° from one another and communicate with the inlet bore 18 and outlet bore 20, respectively. The rotating pump barrel 12 contains a plurality of pumping chambers, 25, each being formed as a cylinder in which a piston 26 reciprocates. Each pumping chamber 25 alternately communicates with the inlet and outlet bores 18, 20 by way of transfer ports 27. A bearing 28 made of solid antifriction material takes thrust forces from the barrel 12 and also acts as a seal, bearing against a like member 29 which is pinned to the frame 10.

Reciprocation of the pistons 26 in their pumping chambers 25 is accomplished by a tiltable swash plate means including a pivoted control member 31 pivoted on shafts 30 and having a control pin 32 protruding through an opening at the rear of the frame 10. The control member 31 includes a rotatable spider 33 mounted in a double row ball bearing 35 for rotation with respect to the control member 31. Attached to each end of the spider 33 is a chain link 36 which is joined at its opposite end to a piston 26.

Thrust force to keep the pump barrel 12 urged against the bearing 29 is furnished by a compression spring 37 which is received at one end within a central socket in the pump barrel 12, and includes a thrust button 38 at the other end which mates with a hemispherical surface formed on the end of the spider 33. In this way, the control member 31 may swing about its pivot shafts 30 without shifting the position of the thrust button 38 in relation to the pump barrel 12, or varying the amount of thrust force tending to seat the pump barrel 12 on the bearings 28, 29.

When the control member 31 is rotated by means of its pins 32 so that the rotational axis of the spider 33 is coaxial with the pump barrel 12, no ink is displaced by the pistons 26. This is true because the ends of the pistons attached to the spider 33 through the links 36 rotate in a plane parallel to the plane of rotation of the pump barrel 12. However, when the control member 31 is swung to one side, the rotational planes of the members are no longer parallel and the familiar swash plate action takes place. In the position shown in FIGS. 1 and 2, clockwise rotation of the pump barrel 12 of FIG. 2 (as seen from the swash plate end) ink will be drawn in to the lower pumping chamber 25 as its piston 26 follows the diverging portion of the rotational plane of the spider 33. This continues over a substantially 180° of rotation until the transfer port 27 no longer communicates with the inlet port 22 of the stub shaft 13. As the pump barrel 12 continues to rotate, the piston 26 follows the converging portion of the rotational plane of the spider 33, forcing the piston 26 into its pumping chamber. At this point, however, the transfer port 27 is aligned with the outlet port 23, and ink is discharged through the ink-outlet bore 20 and through the fitting 21 to the portion of the printing mechanism which that pump supplies.

It may thus be seen that when the control member 31 is aligned so that the plane of rotation of the spider 33 is parallel to that of the pump barrel 12, the member 31 is in a first limit position corresponding to piston displacement per barrel revolution, this being zero in the illustrated pump. This position may be adjusted by means of an adjustable stop means comprising a screw 40 and stop nut 41. At the other extreme, the control member 31 may be swung to a second limit position corresponding to a maximum piston displacement per barrel revolution. The distance between the first and second limit positions is desirably on the order of 15° of control member rotation.

As a principal feature of the invention, an improved operating linkage is provided for the control member 31 of each pump unit 11 in which the delivery stroke of the pistons 26 may be varied directly during pump operation, or as a preset adjustment when the pump is still, even though entrapped ink within one or more pumping chambers 25 causes the pistons 26 to be immobilized. It will be understood that such a frozen pump condition also rigidly locks the control member 31 against rotation about its pivot axis, causing the control pin 32 to be likewise locked in place. According to the invention, however, each pump unit 11 has a separable linkage which transmits adjustment motion from an adjustment cam 42, and resilient means are employed for connectively biasing the separable linkage in a manner which allows the position to which the member 31 will move as soon as it is freed when the pump unit 11 is restarted to be preset. In this way, the desired control member response is obtained immediately upon restarting the pump.

A first embodiment of the mechanism employed in accomplishing this object of the invention is shown in FIGS. 5—7 and includes an L-shaped intermediate member 43 pivoted to the frame 10 at a pivot point 44 and serving to interconnect the adjustment cam 42 and the control pin 32 of the associated ink pump unit 11. A separate cam 42 and intermediate member 43 is provided for each pump unit 11. The rotatable adjustment cam 42 serves as an operating member which transmits motion from its axis against a shoe 46 on one leg of the L of the intermediate member 43. At the other end, a similar shoe 47 contacts the control pin 32 of the control member 31. As provided by the invention, the point of contact between the cam 42 and the adjacent shoe 46 comprises a first separable connection acting in one direction and tending to rotate the intermediate member 43 in a clockwise direction as seen in FIGS. 6 and 7. The point of contact between the control pin 32 and its adjacent shoe 47 defines a second separable connection effective to transmit motion from the intermediate member 43 to the control pin 32 in an opposite direction, that is, counterclockwise as seen in FIG. 6.

The various links heretofore described are held in normally rigid relationship to one another by first and second resilient means. The first resilient means comprises a tensioned spring 48 for connectively biasing the first separable connection between the cam 42 and the shoe 46. The spring 48 is anchored at one end 50 to the frame 10, and at the other end to a lug 51 on the intermediate member 43. The second resilient means comprises another tensioned spring 52 mounted internally of the frame 10 to connectively bias the second separable connection between the control pin 32 and shoe 47 for positively transmitting motion. The spring 52 is anchored at one end to a pin 53 secured to the frame 10, and at the other to a lug 55 located off center from the pivot point on the control member 31.

In operation, it may be seen that the spring 52 tends to pull the control member 31 into a position of maximum displacement volume for each revolution of the pump barrel 12. This, in turn, tends to urge the control pin 32 against the shoe 47 and tends to rotate the intermediate member 43 in the previously defined clockwise direction. Without the spring 48, the spring 52 would be effective to lift the shoe 46 free of the cam 42, thus separating the linkage connection at that point. The spring 48, however, biases the intermediate member 43 in the

counterclockwise direction, tending to bias the first separable connection between the cam 42 and the shoe 46 into a solid, motion-transmitting connection. The first resilient means consisting of the spring 48 is predominant, exerting a relatively stronger biasing force than that of the second resilient means. The combined force of the two springs 48 and 52 thus tends to keep the linkage in a solid-motion-transmitting condition from cam 42 to pin 32 so long as the control member 31 is free.

Should the control member 31 become immobilized due to entrapped ink within the pumping chambers 25 when the pump is not in operation, the invention provides for a preset adjustment in which the cam 42 may be rotated in either direction, tending to either raise or lower the shoe 46 in respect to the pivot axis of the cam 42. If the control pin 32 is immobilized, the cam 42 may still be moved in a direction tending to transmit motion to the intermediate member 43 in one direction, the clockwise direction as seen in FIGS. 6 and 7. The second separable connection between the pin 32 and shoe 47 simply separates, relieving the linkage from excessive stresses and possible damage. When the pump is restarted, the pin 32 is freed and is drawn again into contact with its shoe 47 by the spring 52, thus rotating the control member 31 to the position preset by the initial cam adjustment.

For adjustments in the opposite direction, the cam 42 is rotated in a direction which would ordinarily allow the intermediate member 43 to move in the opposite, or counterclockwise direction, as seen in FIGS. 6 and 7. In this situation, immobility of the control pin 32 prevents the intermediate member 43 from following the cam motion, but the first separable connection between the cam 42 and shoe 46 simply separates, again relieving the system of excessive stresses and possible damage. When the pump is restarted, the superior biasing force of the spring 48, which predominates that of the spring 52, again closes the first separable coupling and makes operating contact between the cam 42 and the shoe 46 as before. The control pin 32 thus is immediately shifted to the preset position which has been fed into the linkage through the cam 42 while the pump unit 11 was immobilized.

A second embodiment of the present invention is illustrated in FIGS. 8, 9 and 10. The same pump barrel 12, pistons 26, links 36 and spider 33 are used in conjunction with a modified control member 61 rather than being operated by a pin 32 as in the first embodiment. The control member 61 of the second embodiment is rotated around its vertical axis by an intermediate member comprising two parts, an L-arm 62 and a lever 63, solidly pinned together by a pin 65 (FIG. 10). Below the lever 63 is a disk 66 having an upraised pin 67 which engages the short end of the lever 63. The disk 66 is connected by a shaft 68 to a gear 70 from a worm gear 71 on a cross-shaft 74 which is in turn driven by a set of gears 72, 73 from a main operating shaft 75.

In the linkage of this second embodiment, a first separable connection 76 is formed at the point of contact of the pin 67 with the short leg of the lever 63. Motion is thereby transferred to the intermediate member composed of the pinned lever 63 and L-arm 62 to the control member 61 through a second separable connection 77 between the longer side of the L-arm 62 and a flat 78 on the lower surface of the control member 61.

Resilient means are employed to hold each separable connection 76, 77 in the closed condition when the pump pistons 26 are not immobilized by entrapped ink. A first resilient means consists of the spring 52 which tends to draw the control member 61 into one of its two limit positions. A second resilient means consists of a compression spring 80 operatively connected between the control member 61 and the L-shaped arm 62 of the intermediate member. For this purpose the spring 80 is received within a socket 81 in the control member 61 and is retained on the short arm of the L-arm 62 by a round boss 82. In this second exemplary embodiment, the second resilient means (the spring 80) is stronger than the first resilient means (the spring 52) and is therefore predominant thereto.

Should the pistons 26 become immobilized in the pump barrel 12, adjustment can still be effected by rotation of the main shaft 75. Motion from the shaft 75 is transmitted through the gears 72, 73 and 70, 71 to the vertical shaft 68 and the disk 66. The lever 63 is drawn against the upraised pin 67 of the disk 66 by the force of the spring 52. The intermediate member, comprising the lever 63 and L-arm 62, would normally transfer motion to the control member 61 but if the latter is rigid the second separable connection 77 opens as the spring 80 compresses. Should motion from the main shaft 75 be in the opposite direction, the second separable connection 77 remains closed while the first separable connection 76 between the pin 67 and the lever 63 opens. When the control member 61 is again free to move, the various springs 52, 80 move it to the position which has been preselected by rotation of the main shaft 75.

Zero adjustment in the second embodiment is provided by a threaded adjustable stop 83 retained by a lock nut 84 in a threaded hole in the frame of the machine. The stop 83 has a round tip which bears against an angled surface 85 at one end of the lever 63, thus allowing the limit position of the lever 63 to be selectively adjusted.

A third embodiment of the present invention is illustrated in FIGS. 11, 12 and 13. Again, the pump barrel 12, pistons 26, links 36, and spider 33 are used. A control member 91 similar to the control member 61 of the second embodiment transfers motion from the operating linkage to the spider 33. A lever 92 is rigidly connected to the control member 91 for transferring motion thereto.

An intermediate member and an adjustment member are used as in the preceding embodiments. The intermediate and adjustment members consist of rotatable plates 93, 95, respectively, journaled on a common axis about a post 96 and retained by a circle clip 97. The lower plate 95, being the adjustment member, has a partial gear section engaging a pinion gear 98 mounted on a vertical shaft 100 through gears 102, 103. In this embodiment, the vertical shaft 100 is provided with two additional features. First, a squared end 104 is provided to allow manual adjustment of the mechanism through the pinion 98. Second, a slip clutch is included between the gear 103 and the shaft 100, taking the form of a drive plate 105, a compression plate 106, and a spring 107 which compresses the gear 103 between the plates 105, 106 to frictionally drive the drive plate 105 and thereby drive the vertical shaft 100.

The adjustment member, the plate 95, rotates about the post 96 within the limits provided by a limit pin 108 which is received within an open segment of the lower plate 95. Approximately 75° of rotation is allowed. Motion is transferred from the lower plate 95 to the upper plate 93 by a dog 110 which consists of a round pin pressed into a corresponding hole in the lower plate 95. The upper end of the dog 110 engages a similar cutout section in the upper plate 93, and is normally urged against one face 111 of this plate by a helical spring 112. Spring retainer pins 113, 115 are provided in the plates 95, 93, respectively, to allow the spring 112 to exert a torque tending to urge the upper plate 93 and its operating face 111 against the dog 110, thus forming a first separable connection urged together by a first resilient means.

Motion from the intermediate member, the plate 93, is transferred to the control member 91 through a pin 116 in the upper plate 93 which bears on the short edge of the lever 92. The spring 90 provides a second resilient means tending to urge the lever 92 against the pin 116, thereby providing a second separable connection with the spring 90 serving as a second resilient means. In this embodiment, as in the second embodiment, the first resilient means (the spring 112) is stronger than and predominant to the second resilient means (the spring 90).

Operation of this third embodiment is much the same as the preceding embodiments. Motion from the main shaft 101 is transmitted to the adjustment member (the lower plate 95). Should the control member 91 be immobilized because of en-

trapped ink behind the pistons 26, the dog 110 is free to move away from the face 111 of the upper plate 93 in one direction or to urge the plate 93 in rotation against the spring 112, thus opening the second separable connection between the pin 116 and the lever 92. When the impediment to movement has been removed, the control member 91 is free to occupy the position which has been preselected by rotation of the adjustment member (the lower plate 95) through operation of the main shaft 101.

A zero adjustment is provided in this embodiment by an adjustable bolt 117 which abuts a fixed pin 118 fixed to the frame of the machine. An extension handle 120 is also provided so that the pump mechanism may be manually adjusted for cleaning and the like.

I claim:

1. In combination with a positive displacement pump having a variable delivery stroke controlled during pump operation by a control member which becomes immovable under certain conditions because of entrapped fluid within the pump, an improved operating linkage comprising an adjustment member, an intermediate member connected for receiving motion in one direction from the adjustment member through a first separable connection and connected for transmitting motion in an opposite direction to the control member through a second separable connection, first resilient means for connectively biasing the first separable connection, and second resilient means for connectively biasing the second separable connection, whereby the adjustment member may be actuated with the control member in an immovable condition with control member response being effected by the said resilient means upon freeing of the control member.

2. A positive displacement pump having a variable discharge capability comprising, in combination:

a frame;

a pump barrel journaled for rotation within the frame;

power means for rotating the pump barrel, said pump barrel having a pumping chamber containing a piston mounted for reciprocation therein, said frame having an inlet port and an outlet port communicating with said pumping chamber substantially 180° of pump barrel rotation apart from each other;

tiltable swash plate means for varying the reciprocation stroke of the piston;

a control member carrying said swash plate means and being pivoted to the frame for movement between a first limit position corresponding to minimum piston displacement per barrel revolution and a second limit position corresponding to maximum piston displacement per barrel revolution;

an intermediate member separably connected to the control member for positively transmitting motion thereto in one direction;

an adjustment member separably connected to the intermediate member for positively transmitting motion thereto in an opposite direction;

first biasing means for resiliently urging said intermediate member into operating contact with said adjustment member; and

second biasing means for resiliently urging said control member into operating contact with said intermediate member.

3. Apparatus as defined in claim 2 including adjustable stop means carried by said frame for selectively adjusting the first limit position of said control member.

4. Apparatus as defined in claim 2 in which said first biasing means comprises a spring operatively connected between said intermediate member and said frame, and said second biasing means comprises a spring operatively connected between said control member and said frame, said first biasing means being predominant over said second biasing means whereby the separable connection between said control and intermediate members is closed when said control member is in a movable condition.

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5. Apparatus as defined in claim 2 in which said first biasing means comprises a spring operatively connected between said control member and said frame, and said second biasing means comprises a spring operatively connected between said intermediate member and said control member, said second biasing means being predominant over said first biasing means whereby the separable connection between said control and intermediate members is closed when said control member is in a movable condition.

6. Apparatus as defined in claim 2 in which said first biasing

means comprises a spring operatively connected between said adjustment member and said intermediate member, and said second biasing means comprises a spring operatively connected between said control member and said frame, said first biasing means being predominant over said second biasing means whereby the separable connection between said control and intermediate members is closed when said control member is in a movable condition.

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