

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO PRINTING APPARATUS

(71) We, **COLORFLO LIMITED**, of Bessemer Works, Whinbush Road, Hitchin, Hertfordshire, a British Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to printing apparatus of the type in which printing ink or like printing liquid is fed into the recessed design or engraving of an intaglio printing plate through the thickness of the plate.

A problem arises with such apparatus as it is difficult properly to regulate the amount of ink fed through the plate in accordance with printing requirements. Clearly it is very undesirable for either too much or too little ink to be fed and it is also desirable to control the point in the printing cycle at which ink is fed to the plate.

These problems are satisfactorily solved according to the invention by printing liquid feed mechanism for a printing apparatus of the type described above, the mechanism comprising at least one pump chamber adapted to be contracted by the application of pressure from the printing apparatus on the printing plate during printing and to expand when the printing pressure is released, the or each chamber having an outlet, which, when printing is taking place, with one or more ink passages extending through the printing plate, and an inlet which communicate when printing is taking place with an ink supply, the inlet being controlled by a valve device which is closed automatically by the application of printing pressure to the printing plate, the outlet being also controlled by a valve device which is biased to a closed position but which is opened when the chamber is pressurised beyond a limit predetermined by the biasing means.

The printing plate or the portion of the unit carrying the plate has a limited movement towards and away from a support plate which

receives pressure during printing under the control of one or more springs which constantly tend to move the plate away from the support but allow the support to approach the plate and thereby compress the or each pump chamber when the pressure of the springs is overcome by the printing pressure applied.

The inlet valve device is preferably arranged to be actuated by the relative displacement of the portion to be connected to the printing plate, relatively to the support member. The outlet valve may be actuated by the hydraulic pressure of the printing ink in the pump chamber generated by increased pressure in the chamber after the inlet valve has been closed.

With such a construction, as the printing plate begins to receive the full printing pressure, the inlet valve is closed and the outlet valve is opened so that ink is forced through the printing plate only when the printing plate is being pressed onto the surface to be printed with a reasonable pressure. The printing surface is then printed with ink under pressure. When sufficient ink has been supplied to service the intaglio printing plate excess ink is preferably returned to the supply by the opening of a pressure relief valve. The outlet valve is closed as the printing pressure is relaxed and the plate is being lifted from the surface.

The pump chamber then expands so as to cause a further supply of printing ink to be sucked into the chamber ready for the next printing operation.

Each inlet opening for the supply of ink preferably communicates with its pump chamber through a port formed in an auxiliary or "relief" piston which works in a cylindrical bore in the main piston, the relative movement of the auxiliary and main pistons acting to open or close the ports and they then act as a valve device. One end of this auxiliary piston may carry at least one valve which controls the outlet leading from the pump chamber to the recesses of the printing plate. The auxiliary piston is controlled by a spring which constantly

tends to press the auxiliary piston in a direction to close the outlet. Further it may incorporate a relief passage for the pump chamber the relief passage being controlled by a valve which opens when the pressure in the chamber exceeds a safe limit.

The means to relieve excess pressure in the printing liquid during a printing operation forms the subject of our co-pending application No. 9389/71 (Serial No. 1241794).

An embodiment of one part of the ink feed mechanism of a printing machine in accordance with the invention will now be described by way of example with reference to the accompanying drawing which is a cross-section through the mechanism.

The mechanism comprises a member 2 the interior chamber 4 of which constitutes a "pump" chamber and is intended to communicate with a recessed design or engraving on the printing surface of an intaglio printing plate (not shown) through an outlet passage 6. A piston 8 works in the chamber 4 and is provided with a sliding seal member 10 to provide a seal between the piston and the chamber. The upper portion of the piston rod 12 is secured to a support member 14 having a head 15 which is arranged for limited sliding movement in a cylinder 16 which rests on the top of the walls of the member 2. As pressure is applied to the piston rod during printing for example by means of a member secured at 18 to the piston rod, the member 14 moves down within the cylinder 16 compressing a spring 20 which is located between the head 15 of the member 14 and bottom wall 22 of the cylinder so as to apply pressure to the member 2 through the spring and consequently to press the printing plate attached to the member 2 against the surface to be printed.

The piston 8 and its rod 12 are formed with an internal passage 24 communicating at the upper end with an opening 25 through the member 14 for connection to a supply of printing ink. The lower portion of the passage 24 is of larger diameter to provide a cylinder 26 carrying a relief or auxiliary piston 28 which is hollow and which communicates with the cylinder 26 through an opening 30 and with the chamber 4 through chamber inlet openings 32.

The piston 28 which is a sliding fit in the cylinder 26 carries a ball valve 34 at its lower end which is normally biased by means of a spring 36 within the piston to a position in which it closes a relief passage 38 from the piston to the chamber 4. The piston itself is biased by means of a spring 40, located within the cylinder 26 to a position in which the ball valve 34 closes communication between the chamber 4 and its outlet passage 6.

During use of the mechanism, pressure is applied by a standard printing apparatus (not shown) to the piston rod 12 and support

member 14 causing, through the spring 20, the member 2 and the printing plate carried thereby to be pressed against the surface to be printed. Further, when the spring pressure is overcome further pressure causes the piston 8 to move to contract the chamber 4 and hence apply pressure to the printing ink in the chamber. During the initial movement of the piston in the chamber the outlet 6 remains closed by the outlet valve 34 and the inlet valve 32 is open so that ink within the chamber 4 can flow back through the relief piston 28 and up through the passage 24 in the main piston to the ink supply. However, as the pressure increases and the piston 8 moves downwards in the chamber 4 over the relief piston 28 overcoming the pressure of spring 40, the head of the piston 8 acts as a valve device to close the ports 32 so that communication between the chamber 4 and the ink supply is cut off. By this time the printing plate is pressed firmly down on the surface to be printed and when the pressure in the chamber 4 has built up sufficiently the pressure acting on the tapered nose 42 of the relief piston 28 causes this piston to move up into the cylinder 26 against the pressure of the spring 40 so as to open the passage 6 through the printing plate to the chamber 4 allowing printing ink to reach the intaglio surface of the plate.

When sufficient ink has been supplied to service the intaglio plate excess ink is returned to the supply via the relief passage 38 on lifting of the ball valve 34 from its seat by the excess pressure of the ink in the chamber 4.

As the printing pressure is relaxed the pressure on the relief piston 28 within the chamber 4 is also relaxed allowing the spring 40 to move the piston 28 back to the position in which the passage 6 is closed by the ball valve 34. In this position ink is no longer fed to the intaglio recess thus avoiding the possibility of excess ink being supplied as the plate is lifted from the surface which has just been printed.

As the pressure is further relaxed the spring 20 moves the main piston 8 upwardly within the chamber 4 to the position shown in the drawings in which it abuts against the stop 44 and as the chamber 4 is expanded and as the ports 32 are now open ink is drawn through the supply opening 25 the passage 24 the cylinder 26 and the opening 30 into the chamber 4 ready for the next printing operation.

Thus the ink required for printing is controlled automatically.

It will be appreciated that a plurality of chambers and pistons such as that described and illustrated in the drawings would normally be provided for a single printing plate.

The spring 20 which is used to apply pressure to the printing plate could of course be replaced by subsidiary pistons and cylinders coupled to a hydraulic accumulator.

The mechanism can be used for example to feed coloured paint or like liquid to be printed rather than coloured ink into different parts of an intaglio surface each chamber being supplied with paint of one particular colour so that coloured patterns can be printed. Alternatively two or more pump units such as that described can be connected to a common outlet into an intaglio relief so that by using different colours of ink or paint one for each pump unit, marbled effects can be obtained.

Equally adhesives could be used for the printing liquid instead of paint or coloured printing inks, as could thermoplastic material.

If a plate is supplied with more than one pump unit then the outlets from the chambers of each unit can be made of different cross section so that the quantity of each coloured ink or paint can be regulated.

WHAT WE CLAIM IS:—

1. A printing apparatus of the type in which printing ink or like liquid to be printed is fed into the recessed design or engraving of an intaglio printing plate through the thickness of the plate comprising a printing liquid feed mechanism having at least one pump chamber adapted to be contracted by the application of pressure from the printing apparatus on the printing plate during printing and to expand when the printing pressure is released, the or each chamber having an outlet, which communicates when printing is taking place, with one or more ink passages extending through the printing plate, and an inlet which communicates when printing is taking place with an ink supply, the inlet being controlled by a valve device which is closed automatically by the application of printing pressure to the printing plate, the outlet being also controlled by a valve device which is biased to a closed position but which is opened when the chamber is pressurised beyond a limit predetermined by the biasing means.

2. An apparatus as claimed in Claim 1 in which a portion of the mechanism which is adapted to be connected to and apply pressure to the printing plate is connected to a support member to which pressure is to be applied by the apparatus, through one or more springs or hydraulic piston devices.

3. An apparatus as claimed in Claim 2 in which the inlet valve device is arranged to be actuated by the relative displacement of the said portion relatively to the support member.

4. An apparatus as claimed in Claim 2 or 3 in which relative movement of the support member towards the said portion, when the bias of one or more springs or hydraulic piston devices is overcome, causes a main piston working in the or each pump chamber to contract the chamber.

5. An apparatus as claimed in Claim 4 in which movement of the main piston in the pump chamber actuates the inlet valve device.

6. An apparatus as claimed in any of the

preceding claims in which the outlet valve is actuated by the hydraulic pressure of the printing ink or like liquid to be printed generated by increased pressure in the chamber after the inlet valve device has been closed.

7. An apparatus as claimed in any of the preceding claims in which a relief passage connects with the or each pump chamber through a relief valve device which is arranged to open against a bias when the pressure in the chamber exceeds a predetermined limit.

8. An apparatus as claimed in any of the preceding claims having an auxiliary piston in a bore in a main piston, working in the or each pump chamber, (or the main piston when appendant to claim 4 or any one of claims 5—7 when appendant to claim 4), the pump chamber inlet passing through the auxiliary piston.

9. An apparatus as claimed in Claim 8, in which the pump chamber inlet comprises a port or ports formed in the auxiliary piston, movement of the main piston relatively to the chamber being also relative to the auxiliary piston so that the inlet port(s) are closed by the inner wall of the main piston the arrangement constituting the inlet valve device.

10. An apparatus as claimed in either of Claims 8 or 9 wherein the outer end of the auxiliary piston includes a valve device to control the pump chamber outlet.

11. An apparatus as claimed in Claim 10 in which the auxiliary piston is biased by a spring or equivalent biasing means which tends constantly to press the auxiliary piston to close the outlet opening, the auxiliary piston being formed with a surface open to the pump chamber below the main piston and on which pressure of ink or like liquid to be printed in the pump chamber can act.

12. An apparatus as claimed in any of Claims 8—11 wherein the auxiliary piston is formed with a relief passage open to the pump chamber and controlled by a relief valve device tending to close the passage but opening when the pressure in the chamber exceeds a safe limit.

13. A printing apparatus having a plurality of mechanisms as claimed in any of the preceding claims the various pump chambers being provided for a single printing plate, each chamber connecting with a different part of the intaglio design so as to produce multi-coloured prints.

14. A printing apparatus as claimed in Claim 13 in which two or more pump units are connected to a common outlet connecting with the intaglio design of a printing plate whereby if each chamber contains differently coloured ink or like liquid to be printed, marbled effects can be printed.

15. A printing apparatus as claimed in either Claim 13 or 14 in which two or more pump units are provided for a single printing plate, the outlet from the chambers of each

The mechanism can be used for example to feed coloured paint or like liquid to be printed rather than coloured ink into different parts of an intaglio surface each chamber being supplied with paint of one particular colour so that coloured patterns can be printed. Alternatively two or more pump units such as that described can be connected to a common outlet into an intaglio relief so that by using different colours of ink or paint one for each pump unit, marbled effects can be obtained.

Equally adhesives could be used for the printing liquid instead of paint or coloured printing inks, as could thermoplastic material.

If a plate is supplied with more than one pump unit then the outlets from the chambers of each unit can be made of different cross section so that the quantity of each coloured ink or paint can be regulated.

WHAT WE CLAIM IS:—

1. A printing apparatus of the type in which printing ink or like liquid to be printed is fed into the recessed design or engraving of an intaglio printing plate through the thickness of the plate comprising a printing liquid feed mechanism having at least one pump chamber adapted to be contracted by the application of pressure from the printing apparatus on the printing plate during printing and to expand when the printing pressure is released, the or each chamber having an outlet which communicates when printing is taking place, with one or more ink passages extending through the printing plate, and an inlet which communicates when printing is taking place with an ink supply, the inlet being controlled by a valve device which is closed automatically by the application of printing pressure to the printing plate, the outlet being also controlled by a valve device which is biased to a closed position but which is opened when the chamber is pressurised beyond a limit predetermined by the biasing means.

2. An apparatus as claimed in Claim 1 in which a portion of the mechanism which is adapted to be connected to and apply pressure to the printing plate is connected to a support member to which pressure is to be applied by the apparatus, through one or more springs or hydraulic piston devices.

3. An apparatus as claimed in Claim 2 in which the inlet valve device is arranged to be actuated by the relative displacement of the said portion relatively to the support member.

4. An apparatus as claimed in Claim 2 or 3 in which relative movement of the support member towards the said portion, when the bias of one or more springs or hydraulic piston devices is overcome, causes a main piston working in the or each pump chamber to contract the chamber.

5. An apparatus as claimed in Claim 4 in which movement of the main piston in the pump chamber actuates the inlet valve device.

6. An apparatus as claimed in any of the

preceding claims in which the outlet valve is actuated by the hydraulic pressure of the printing ink or like liquid to be printed generated by increased pressure in the chamber after the inlet valve device has been closed.

7. An apparatus as claimed in any of the preceding claims in which a relief passage connects with the or each pump chamber through a relief valve device which is arranged to open against a bias when the pressure in the chamber exceeds a predetermined limit.

8. An apparatus as claimed in any of the preceding claims having an auxiliary piston in a bore in a main piston, working in the or each pump chamber, (or the main piston when appendant to claim 4 or any one of claims 5—7 when appendant to claim 4), the pump chamber inlet passing through the auxiliary piston.

9. An apparatus as claimed in Claim 8, in which the pump chamber inlet comprises a port or ports formed in the auxiliary piston, movement of the main piston relatively to the chamber being also relative to the auxiliary piston so that the inlet port(s) are closed by the inner wall of the main piston the arrangement constituting the inlet valve device.

10. An apparatus as claimed in either of Claims 8 or 9 wherein the outer end of the auxiliary piston includes a valve device to control the pump chamber outlet.

11. An apparatus as claimed in Claim 10 in which the auxiliary piston is biased by a spring or equivalent biasing means which tends constantly to press the auxiliary piston to close the outlet opening, the auxiliary piston being formed with a surface open to the pump chamber below the main piston and on which pressure of ink or like liquid to be printed in the pump chamber can act.

12. An apparatus as claimed in any of Claims 8—11 wherein the auxiliary piston is formed with a relief passage open to the pump chamber and controlled by a relief valve device tending to close the passage but opening when the pressure in the chamber exceeds a safe limit.

13. A printing apparatus having a plurality of mechanisms as claimed in any of the preceding claims the various pump chambers being provided for a single printing plate, each chamber connecting with a different part of the intaglio design so as to produce multi-coloured prints.

14. A printing apparatus as claimed in Claim 13 in which two or more pump units are connected to a common outlet connecting with the intaglio design of a printing plate whereby if each chamber contains differently coloured ink or like liquid to be printed, marbled effects can be printed.

15. A printing apparatus as claimed in either Claim 13 or 14 in which two or more pump units are provided for a single printing plate, the outlet from the chambers of each



unit being of varying cross-sectional size so that the quantity of the different inks or liquid to be printed fed to the intaglio design can be regulated.

- 5 16. A printing apparatus comprising a pump unit substantially as hereinbefore described with reference to the accompanying drawings.

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