

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO THE CONTROL OF INK SUPPLY IN PRINTING PRESSES

(71) We, HEIDELBERGER DRUCKMASCHINEN AKTIENGESELLSCHAFT, a body corporate organised under the laws of the Federal Republic of Germany of Alte Eppelheimer Strasse 15-21, Postfach 102940, 69 Heidelberg, Federal Republic of Germany, 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:—

The invention relates to apparatus for controlling the ink supply of rotary printing presses with an inspection table, with adjusting members in individual ink zones and with a device for adjusting the total ink quantity.

The object of the invention is, within the context of progressive automation of the printing process, to simplify the control of the ink supply of a printing unit and to make it easier to supervise and more reliable in operation.

German Offenlegungsschrift 2 115 653 describes a method and apparatus for the remote control of adjusting and driving members in printing presses, which make it possible to control remotely the entire ink supply by modifying sectional rotary movement of an ink doctor and zonal ink supply by modifying individual adjusting members of an ink knife, either manually or from a central control point through the intermediary of electric stepping motors. The position of the adjusting members can be indicated visually by means of an impulse counter or of a coding wheel. The inclusion of such a control system for the adjusting members or stepping motors in closed control circuits, e.g., by automatic measurement of the actual ink layer thickness on a printed image carrier and its comparison with a desired layer thickness for the purpose of an automatic initiation of the corresponding control impulses has been found to be extremely

onerous by its construction and is uneconomic, e.g., for sheet-fed rotary printing presses, more particularly for those of small format, when considered from the standpoints of technical outlay and of production costs.

In the ink dosing method on a printing press described in German Offenlegungsschrift 24 34 680, individual ink zone adjusting members can be remotely adjusted during the printing process on the basis of visual assessment by the operator of an edition sheet on an observation table using manually-operable switches. In this case the positions of the individual adjusting members on the ink knife can be read off on a picture screen.

With both types of apparatus, the adjustment of the individual adjusting members, e.g. those of the ink knife, is left exclusively to the sense and experience of the operator, both as regards the required direction of adjustment and the magnitude of the adjustment, because no concrete guide values as to magnitude and direction of adjustment are prescribed. The adjustment of the adjusting members themselves which influence the ink supply can thus only be performed on the basis of rough visually estimated values. As a result of erroneous and mistaken assessment of the printed product by the operator, corresponding repeated recorections of the adjusting elements influencing the ink supply to an ink layer thickness profile which corresponds to an optimum ink density of a printed product, are unavoidable.

According to the present invention there is provided apparatus for controlling the ink supply of a rotary printing press, comprising an inspection table not forming part of the rotary printing press said inspection table including a densitometer device for measuring the density of ink at any part of a printed product, located on the inspection

tion table, said inspection table incorporating means for evaluating the measured ink density in relation to desired density values, and a tendency display for displaying ink density deviations from said desired values, said display indicating the direction of required correction of the zonal supply and/or of the total ink quantity.

Apparatus in accordance with the invention can be made at low cost for controlling the ink supply of rotary printing presses, which in order to facilitate the operation, indicates to the operator at a central control point of the operating station the steps according to direction and position which are required for a rapid optimisation of the ink supply during the printing process.

Tendency displays are used to indicate ink density deviations from desired values of a printed product, the indication showing the direction of correction for the adjustment of adjusting members and/or of devices for adjusting the total ink quantity, associated with ink zones associated according to scale with the sheet. By such a display of the direction of adjustment of ink quantity from ink density variations during the printing process, an operator can be relieved of incorrect evaluation of a printed product and consequently uncorrected adjustment of the ink supply, the work of the operator is thus considerably simplified. Furthermore, required make-ready times are considerably reduced compared with hitherto arrangements.

In order to achieve an optimisation of the ink supply in the shortest time, so as to achieve a better quality of print, and thereby reduce wastage to a minimum, intensity displays of ink density deviations are advantageously superimposed within the context of selective tolerances upon the tendency displays serving for the direction of correction, from which an operator can infer the value of the magnitude of the required modification.

An example of a method for remote control of the ink supply to inking units of rotary printing presses using apparatus according to the invention will now be described. Difference values between prescribed stored desired values of ink density and actual values of ink density of a printed product detected by means of an ink density measurement, which are obtained on the basis of an arithmetical comparison value formation, are rendered visible in a common display. Selective tolerances are taken into consideration, as a tendency display for the modification of the ink distribution of the zonal ink quantity and/or of the total ink quantity and are used as a value for the amount of modification. Such a method enables the operator to rely upon the fact that his intervention in the ink sup-

ply will be effective only in the correct ink zone, or more particularly in the required modification quantity across the total width of the ink supply.

Apparatus embodying the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:—

Figure 1 is a plan view of basic control apparatus according to the invention with an inspection table; and

Figure 2 is a plan view of preferred apparatus embodying the invention.

It should be explained initially that the illustration and description of the invention are limited solely to its most essential constituents, and means such as ink supply devices, controls, drives and adjustment means and their associations are assumed as known.

As shown in Figure 1, the illustrated basic apparatus has three sections,

an inspection table 1 with an ink density measuring device or meter 2,

a display device 3 located at the top end of the test bench 1 or above the same, and an electronic evaluator device 4 arranged at the left-hand side of the inspection table 1.

The inspection table 1 can be mounted directly on a rotary printing press, or it can be arranged as a self-contained unit independently of the same. The inspection table 1 is connected through the intermediary of control wires, in a manner not shown nor described in detail, to driving and adjusting members of the elements of an ink supply apparatus which determine both the zonal ink supply and also the total ink quantity. An ink duct with doctor roller and continuous and also subdivided ink knife, an ink spray device, or a centrifugal inking unit etc., may be provided as ink supply apparatus. As adjusting members *inter alia* the stepping motors known from remote control devices may be adopted.

The inspection table 1 is provided for the precisely fixed reception and for measuring a printed product 5 by means of the ink density device or meter 2. The ink density meter 2 in this basic construction consists of an individual densitometer 6 which, considered transversely to the direction of travel of the printed product 5, is slidable across the total width of the latter in a test beam 7. The test beam 7 is mounted directly above the inspection table 1 and is slidable longitudinally of the printed product 5 on two lateral slideways 8, so that any desired part of the printed product 5 can be measured with the densitometer 6.

The electronic evaluator device 4 is connected by means of wires (not shown) to the densitometer 6 and to the display instrument 3 located at the top end of the test

bench 1. It is also equipped with an operating keyboard 9 and with a numerical display 10.

The display instrument 3 located at the top end of the inspection table 1 is equipped with any desired number of luminous displays 11 across its total width, in conformity with selected division of its display. The individual luminous displays 11 consist in each case of three light-emitting diodes (LED's) 12, 13, and 14 arranged mutually superposed. In the display instrument 3 illustrated in the basic construction of Figure 1, a luminous display 11 is associated with each ink adjustment zone 22 of the inking unit (not shown) so that in this case the number of ink adjustment zones 22 corresponds to the number of zonal luminous displays 11.

The principle of operation with this apparatus is described more fully hereinbelow.

During a printing run, a printed product 5 is removed from the printing press and placed in alignment on the inspection table 1. Now, by means of the densitometer 6, and utilizing a print monitor strip 15 printed on the printed product 5, ink density values on the product 5 are detected metrologically, compared in the electronic evaluator device 4 with desired values previously fed into the latter, and colour density deviations of the printed product 5 with reference to the prescribed desired values beyond the scope of permitted and pre-selected tolerances are made visible on the display instrument 3.

The luminous display 11 of the display instrument 3 associated with each ink adjusting zone permits, by its three mutually superimposed LED's 12 to 14, both a tendency display for ink density deviations to be modified with reference to the direction of ink supply of the zonal ink quantity and/or of the total ink quantity, and also superordinately thereto, in a number of multiple possible combinations, sorted into different preselective tolerance classes, an intensity display as a quantitative value for the necessary modification.

The tendency, whether more or less ink is to be supplied, is indicated by the lighting up of the top or bottom LED's 12 or 14 of the luminous display 11.

Various possible combinations of tendency and intensity displays are now possible;

In a first combination stage, only the central LED 13 of the luminous display 11 lights up. This signifies that the measured value of the full tone ink density of the printed products 5 coincides with the prescribed desired value of the full tone ink density within a permitted and preselected tolerance. Since no deviation in ink density exists, no tendency and also no intensity is displayed. In this case no interven-

tion with the ink supply is required.

In a second possible combination, the central and the bottom LED's 13 and 14 of the luminous display 11 light up simultaneously. In this case, the lighting up of the bottom LED 14 indicates a minus tendency of the deviation of the measured actual value of the full tone ink density with reference to the prescribed desired value of full tone ink density. The simultaneous lighting up of the central LED additionally provides information as to the intensity of the existing ink density deviation. In such a case, i.e., in the case of the simultaneous lighting up of the central and bottom LED's 13 and 14, a slight minus deviation of the measured value of full tone ink density exists, which exceeds a prescribed tolerance class and range in the minus range up to a deviation, for example of three tolerance classes with reference to the prescribed desired value of full tone ink density.

In a third display possibility, the lighting up exclusively of the bottom LED 14 of the luminous display 11 indicates a minus tendency, i.e., a minus deviation of the measured actual value of full tone ink density from a prescribed desired value of full tone ink density, but which already exceeds, for example, the three prescribed tolerance classes.

In a fourth combination, the two upper LED's 12 and 13 of the luminous display 11 light up simultaneously. The lighting up of the top LED 12 indicates a positive tendency, i.e., a plus deviation of the measured actual value of full tone ink density with reference to the prescribed desired value of full tone ink density. The simultaneous lighting up of the central LED 13 also indicates the intensity of the existing ink density deviation. This is greater than one prescribed tolerance class and lies, for example in the range between one and three plus tolerance classes.

In a fifth possible combination, where a plus deviation of the measured value of full tone ink density is, for example, more than three prescribed plus tolerances, the top LED 12 of the luminous display 11 lights up. From this it is possible to infer a positive tendency and large intensity of ink density deviation.

A sixth luminous combination for the luminous display 11, in which all three LED's 12 to 14 light up simultaneously, indicates a faulty measurement of the full tone ink density. The measured value of the full tone ink density for the printed product 5 is irregular and unsatisfactory e.g., due to a dirty measurement field, misprint, blotches, etc., i.e., the measurement must be checked.

When none of the three LED's 12 to 14 of the luminous display 11 light up, no de-

sired value is present.

On the basis of the tendency and intensity displays of the luminous display 11, when unacceptable ink density deviations are present, the zonal ink supply can be corrected by adjusting the ink zone adjusting members (not shown) whilst the tendency display serves as a guide for more or less ink supply and the intensity display superimposed thereon indicates the quantitative value of the required variation.

If all the luminous displays 11 distributed across the entire width of the display instrument 3 simultaneously indicate too great or too low an ink density, whilst the LED's lit up lie roughly on a level, then this can be effectively remedied in a particularly simple manner by a single modification of the total ink quantity superimposed upon the zonal ink supply.

The tendency display for the ink supply may also, within the ambit of the invention, occur in a different manner from that above described. It is thus possible to indicate the tendency by a blinking or by brightness variations of the LED's. Instead of this, an analog scale display or a digital display, e.g. in the form of a pulse counter to count adjustment steps or gear steps of the ink zone adjusting members, can, of course, be provided.

Each of the prescribed and stored desired values of full tone ink density, e.g. of a matching sheet, each of the measured actual values of full tone ink density of the printed product 5, and each of the ink density deviations both in direction and also in magnitude detected by a desired value comparison in the electronic evaluator device 4, can additionally be summoned by means of the operating keyboard 9 of the electronic evaluator device 4 and rendered visible in its numerical display 10.

A preferred embodiment of the invention extended with reference to the basic construction of Figure 1 has, in addition to the three principal elements the inspection table 1 with the ink density measuring device 2, the display device 3 for displaying the ink density deviation tendency and the deviation intensity, and the electronic evaluator device 4, an LED display 19 at the bottom end of the test bench to display the ink layer thickness profile and with corresponding operating elements 20 located therebeneath for modifying the same, and also a doctor remote control 21 on the right-hand side of the inspection table 1. The ink density measuring device 2 of this embodiment is substantially modified compared with that of the basic construction.

The LED display 19 with the display of ink layer thickness profile extends across the total width of the test bench 1 and it is sub-divided into thirty-two ink adjustment

zones 22. To display the positions of the individual zonal adjusting members, likewise thirty-two rows, each of sixteen LED's 23 arranged mutually superposed is provided, so that one vertical row of LED's is associated with each ink adjustment zone 22 to indicate the position of the adjustment member.

Beneath the LED display 19, in accordance with the ink adjustment zones 22, are operating elements 20 for controlling the zonal ink quantity. The operating elements 20 consist of thirty-two plus keys 24 for increasing the zonal ink quantity, and thirty-two minus keys 25 for reducing the same.

Adjustment members for adjusting the zonal ink quantity are actuated by the operating elements 20 through the intermediary of control wires (not shown or described in detail). With each ink zone adjusting member there is associated, in a manner known *per se* and therefore not illustrated, a potentiometer for reverting the position or for reverting the position of the adjustment member to the display of the ink layer thickness profile of the LED display 19.

The doctor remote control 21 for modifying the total ink quantity has a feed-in keyboard 26 and with a digital display 27. As already mentioned in connection with the ink zone remote adjustment the ink stripe width on the ink doctor (not shown) can be increased or reduced by modifying its angle of rotation by means of a plus or minus key of a feed-in keyboard 36. The relative angle of rotation of the ink doctor, referred to its maximum stroke, can then be read off as a percentage in a digital display 37.

The test beam 7 of the ink density measuring device 2 is subdivided into thirty-one individual measurement zones. Of these, sixteen measurement zones arranged at respective mutual intervals, are provided as full tone measurement zones for the measurement of full tone ink densities of the printed product 5, and the fifteen remaining spaces respectively located between the full tone measurement zones are reserved as screen tone measurement zones for the measurement of screen tone ink densities for the printed product 5.

Accordingly, the test beam 7 of Figure 2 has sixteen stationary full tone measurement heads 28 arranged at mutual intervals for measuring ink density values in the full tone of the printed product 5. In order to measure ink density values in screen tone, four so-called jumper measurement heads 29 are provided which can be inserted at will into the screen tone measurement zones between the full tone measurement heads 28.

The measurement beam 7 can be adjusted

and corrected to a limited extent in the lateral direction, i.e. considered transversely of the direction of travel of the printed product 5, from a basic position 30 into three further test positions 31 to 33 for measuring the three basic colours cyanogen, magenta and yellow and also for the colour black, of a four-colour printing system. For this purpose, it has a rack 34 which is engaged by an adjusting pinion 35 which is fixed to a stationary projection 36 arranged on the slideway 8 of the test beam 7 and can be rotated through the intermediary of a handwheel 37.

Also present on the movable test beam 7 is a four-part colour index display 38 which co-operates with a colour marking 39 which is arranged on the projection 36. The colour index display 38 serves to adjust and monitor the basic position 30 and the various test positions 31 to 33 of the test beam 7.

Also in this embodiment, division of the display instrument is modified so that a tendency and intensity display in the form of the luminous display 11 is associated with each two ink adjustment zones 22. The tendency display 11 is then located in coincidence with the full tone test heads 28 of the full tone test zones of the test beam 7.

The mode of operation with this embodiment is explained more fully hereinbelow.

Four measurements are performed successively using the test beam 7 with the full tone test heads 28 arranged at intervals and with the four jumper test heads 29 located between them. The measurements are for each colour of the four-colour printing process, whilst after each measurement a lateral transverse displacement of the test beam 7 is effected by rotating the handwheel 22. The colour being tested at any instant can be read off on the colour index display 38 on the test beam in conjunction with the colour marking 39 of the projection 36.

At each measurement, therefore, sixteen test values for the full tone ink densities of a printing ink are obtained from the sixteen full tone test heads 28, whilst there is one full tone ink density measured value for each two of the thirty-two ink adjustment zones 26. Thus, after the test beam 7 has been displaced laterally (transversely) three times, sixteen full tone ink density measurement values for all four printing ink are available.

The values of screen tone ink densities for the four printing colours are determined with the four so-called jumper test heads 29, measuring screen test fields of the printing monitoring strip 15, so that additional information is obtained for increasing the print by sliding and/or doubling due to negative influences affecting the pro-

cess, such as reeling errors.

The full tone measured values are stored as ink densities in the evaluator device 4 and are automatically compared with the desired values of ink density in the full tone of a printed sheet fed in at the start of the printing process, within the context of preselected tolerances. The ink density deviations thereby detected are then, as already explained in connection with the mode of operation of the basic apparatus illustrated in Figure 1, rendered visible automatically and as a routine by means of the sixteen zonal luminous displays 11 of the display instrument 3 in the form of tendency and intensity displays. Corresponding to the observed ink density deviations, corrective interventions in the zonal ink supply can be performed by means of the operating elements 20, or in the case of need the overall ink quantity can be correspondingly modified by means of the feed-in keyboard 26 of the doctor telecontrol 21.

The invention is naturally not restricted to the basic construction and the preferred embodiment illustrated in Figures 1 and 2 respectively, both of which are regarded solely as examples and not as limiting the invention. It is self-evident that other embodiment with numerous variations as regards structural details are conceivable, which lie within the ambit of the invention.

It is thus, for example, possible to display the ink layer thickness profile of the LED display 19, and also the tendency and intensity display, by means of valves, liquid crystals, scale displays with corresponding needles, and digital displays. A different division of the display instrument 3 or of the LED display 19, and also of the test beam 7, can be chosen or different ink density measuring devices can be used. An arrangement of the display instrument 3 with tendency and intensity displays for simultaneous ink density deviations for a plurality of presses can also be provided.

WHAT WE CLAIM IS:—

1. Apparatus for controlling the ink supply of a rotary printing press, comprising an inspection table not forming part of the rotary printing press, said inspection table including a densitometer device for measuring the density of ink at any part of a printed product, located on the inspection table, said inspection table incorporating means for evaluating the measured ink density in relation to desired density values, and a tendency display for displaying ink density deviations from said desired values, said display indicating the direction of required correction of the zonal supply and/or of the total ink quantity.

2. Apparatus according to claim 1,



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and corrected to a limited extent in the lateral direction, i.e. considered transversely of the direction of travel of the printed product 5, from a basic position 30 into three further test positions 31 to 33 for measuring the three basic colours cyanogen, magenta and yellow and also for the colour black, of a four-colour printing system. For this purpose, it has a rack 34 which is engaged by an adjusting pinion 35 which is fixed to a stationary projection 36 arranged on the slideway 8 of the test beam 7 and can be rotated through the intermediary of a handwheel 37.

Also present on the movable test beam 7 is a four-part colour index display 38 which co-operates with a colour marking 39 which is arranged on the projection 36. The colour index display 38 serves to adjust and monitor the basic position 30 and the various test positions 31 to 33 of the test beam 7.

Also in this embodiment, division of the display instrument is modified so that a tendency and intensity display in the form of the luminous display 11 is associated with each two ink adjustment zones 22. The tendency display 11 is then located in coincidence with the full tone test heads 28 of the full tone test zones of the test beam 7.

The mode of operation with this embodiment is explained more fully hereinbelow.

Four measurements are performed consecutively using the test beam 7 with the full tone test heads 28 arranged at intervals and with the four jumper test heads 29 located between them. The measurements are for each colour of the four-colour printing process, whilst after each measurement a lateral transverse displacement of the test beam 7 is effected by rotating the handwheel 22. The colour being tested at any instant can be read off on the colour index display 38 on the test beam in conjunction with the colour marking 39 of the projection 36.

At each measurement, therefore, sixteen test values for the full tone ink densities of a printing ink are obtained from the sixteen full tone test heads 28, whilst there is one full tone ink density measured value for each two of the thirty-two ink adjustment zones 26. Thus, after the test beam 7 has been displaced laterally (transversely) three times, sixteen full tone ink density measurement values for all four printing inks are available.

The values of screen tone ink densities for the four printing colours are determined with the four so-called jumper test heads 29, by measuring screen test fields of the printing monitoring strip 15, so that additional information is obtained for increasing the print by sliding and/or doubling due to negative influences affecting the process, such as reeling errors.

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The full tone measured values are stored as ink densities in the evaluator device 4, and are automatically compared with the desired values of ink density in the full tone of a printed sheet fed in at the start of the printing process, within the context of preselected tolerances. The ink density deviations thereby detected are then, as already explained in connection with the mode of operation of the basic apparatus illustrated in Figure 1, rendered visible automatically and as a routine by means of the sixteen zonal luminous displays 11 of the display instrument 3 in the form of tendency and intensity displays. Corresponding to the observed ink density deviations, corrective interventions in the zonal ink supply can be performed by means of the operating elements 20, or in the case of need the overall ink quantity can be correspondingly modified by means of the feed-in keyboard 26 of the doctor telecontrol 21.

The invention is naturally not restricted to the basic construction and the preferred embodiment illustrated in Figures 1 and 2 respectively, both of which are regarded solely as examples and not as limiting the invention. It is self-evident that other embodiment with numerous variations as regards structural details are conceivable, which lie within the ambit of the invention.

It is thus, for example, possible to display the ink layer thickness profile of the LED display 19, and also the tendency and intensity display, by means of valves, liquid crystals, scale displays with corresponding needles, and digital displays. A different division of the display instrument 3 or of the LED display 19, and also of the test beam 7, can be chosen or different ink density measuring devices can be used. An arrangement of the display instrument 3 with tendency and intensity displays for simultaneous ink density deviations for a plurality of presses can also be provided.

WHAT WE CLAIM IS:—

1. Apparatus for controlling the ink supply of a rotary printing press, comprising an inspection table not forming part of the rotary printing press, said inspection table including a densitometer device for measuring the density of ink at any part of a printed product, located on the inspection table, said inspection table incorporating means for evaluating the measured ink density in relation to desired density values, and a tendency display for displaying ink density deviations from said desired values, said display indicating the direction of required correction of the zonal supply and/or of the total ink quantity.

2. Apparatus according to claim 1,



wherein intensity displays for ink density deviations in the context of selective tolerances are superimposed upon the tendency displays serving for the direction of correction.

3. Apparatus according to either of claims 1 and 2, wherein a common display device extends across the total width of the printed product, and the common display device has means for indicating deviations in the visual tendency and intensity display of the ink density.

4. Apparatus according to any one of claims 1 to 3, wherein the display device has a luminous display.

5. Apparatus according to any one of claims 1 to 4, wherein the display comprises a plurality of rows of light-emitting diodes which provide a luminous display.

6. Apparatus according to any one of claims 1 to 5, having light-emitting diodes and a numerical display for selectively indicating measured values visually.

7. Apparatus according to any one of claims 1 to 6, having a tendency and intensity display associated with each ink adjustment zone.

8. Apparatus according to any one of claims 1 to 7, having a tendency and intensity display associated with each two ink adjustment zones.

9. Apparatus according to any one of claims 1 to 8, wherein the zonal adjusting members and the device for adjusting the total ink quantity are remotely controllable and have a feed-back device for

feeding back the position of an ink doctor to the inspection table, and a digital display.

10. Apparatus for controlling the ink supply of a rotary printing press, the apparatus being substantially as herein described with reference to Figure 1 or Figure 2, of the accompanying drawings.

11. A method of controlling the ink supply to the inking units of a rotary printing press using apparatus according to any one of the preceding claims which comprises detecting difference values between prescribed stored desired values for ink density and actual values of ink density of a printed product using an ink density measurement and ascertained on the basis of an arithmetical comparative value formation, making the differences visible in a common display, and taking selective tolerances into consideration, as a tendency display in order to modify the ink distribution of the zonal ink quantity and/or of the total ink quantity, as a value for the magnitude of the variation.

12. A method of controlling the ink supply to inking units of a rotary printing press, the method being substantially as herein described with reference to Figure 1 or Figure 2 of the accompanying drawings.

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