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Grommek

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[54] **DOCTOR BLADE CONTROL MECHANISM, PARTICULARLY FOR USE IN PRINTING PRESSES**

[76] Inventor: **Siegfried Grommek,** Luisenstrasse 11, D-7600 Offenburg, Germany

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[51] **Int. Cl.** **B41f 9/10**

[58] **Field of Search** ..... 101/154, 157, 161, 101/169, 350, 364, 93 C, 36 S; 15/256.5; 73/103, 172; 33/142, 147; 118/9

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—William Pieprz
Attorney-Flynn & Frishauf

[57] **ABSTRACT**

To control the application pressure of a doctor blade against a cylindrical surface, for example a cylinder used in rotogravure printing, a parallelogram support for the doctor blade is provided having resilient, parallel arms to hold the doctor blade to move in an essentially radial direction with respect to the cylindrical surface against which the doctor blade is adapted to bear, and a deflection meter is secured to the doctor blade support, measuring the resilient deflection of the doctor blade holder with respect to the support; the meter may be included in an electrical control circuit which re-sets the holder with respect to the support so that the application pressure of the doctor blade against the cylindrical surface will be uniform.

12 Claims, 5 Drawing Figures

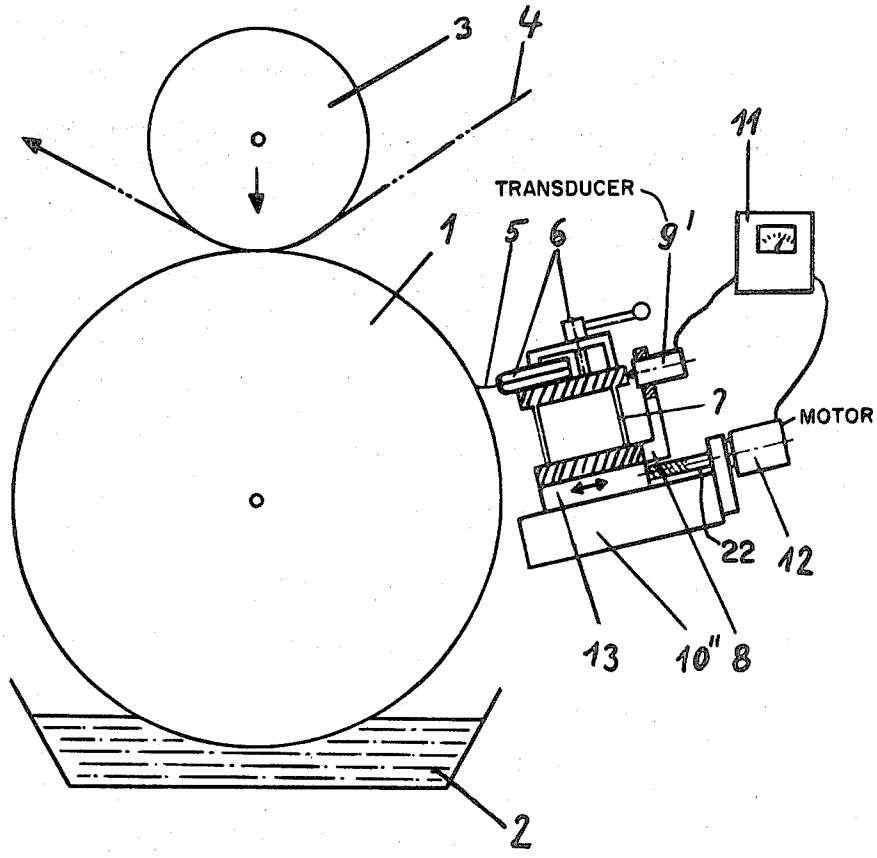
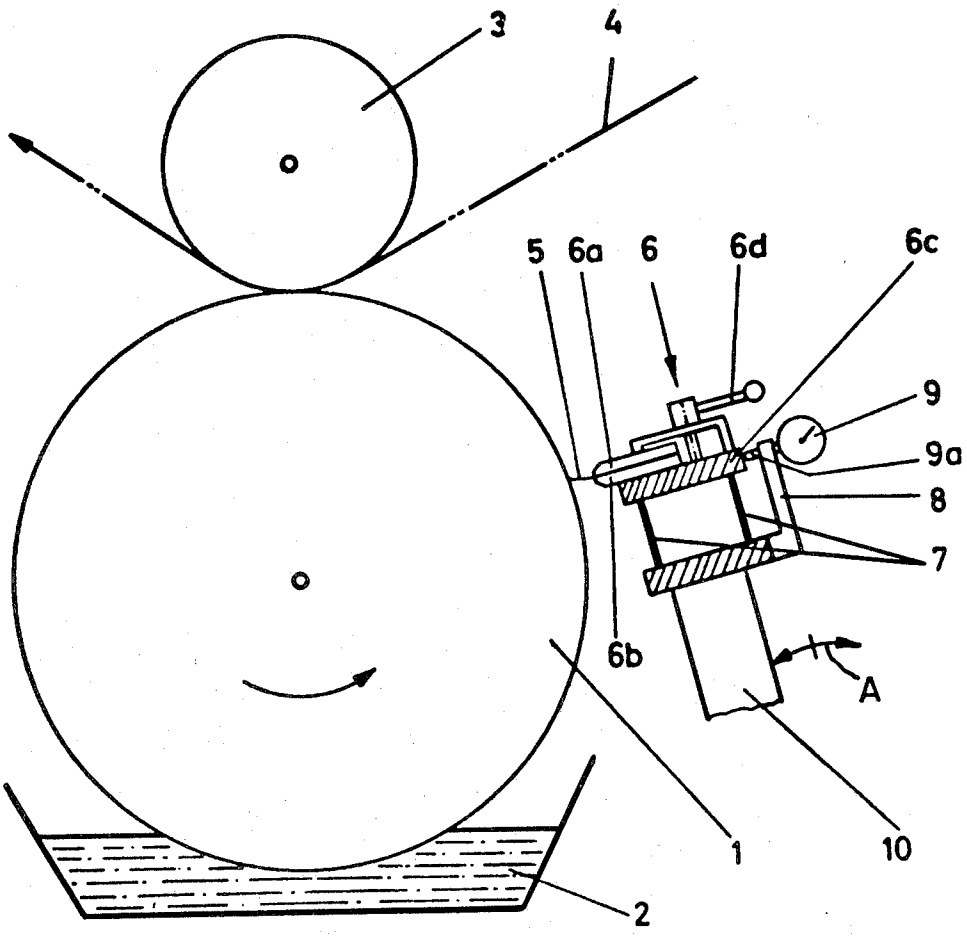


Fig. 1



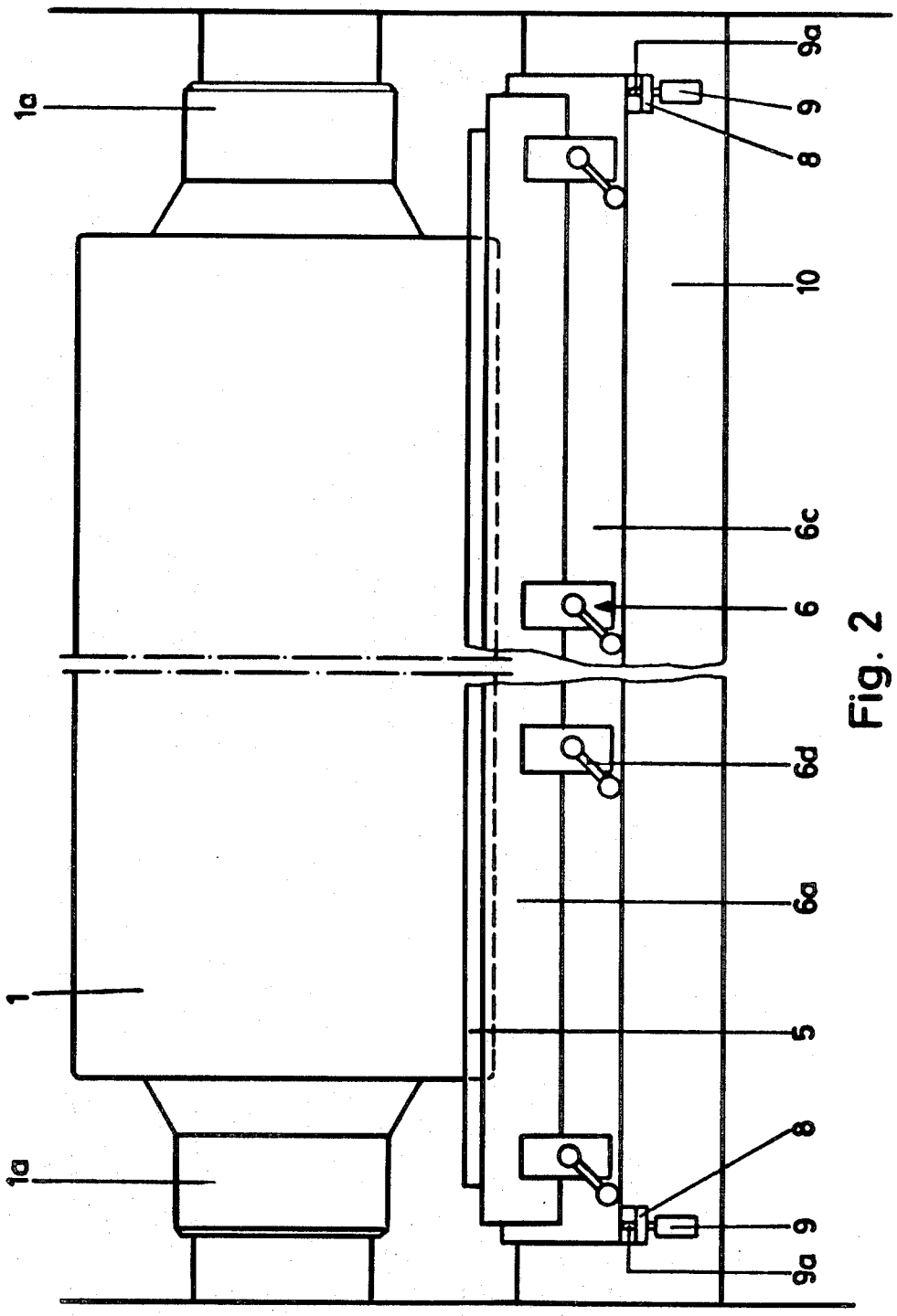


Fig. 2

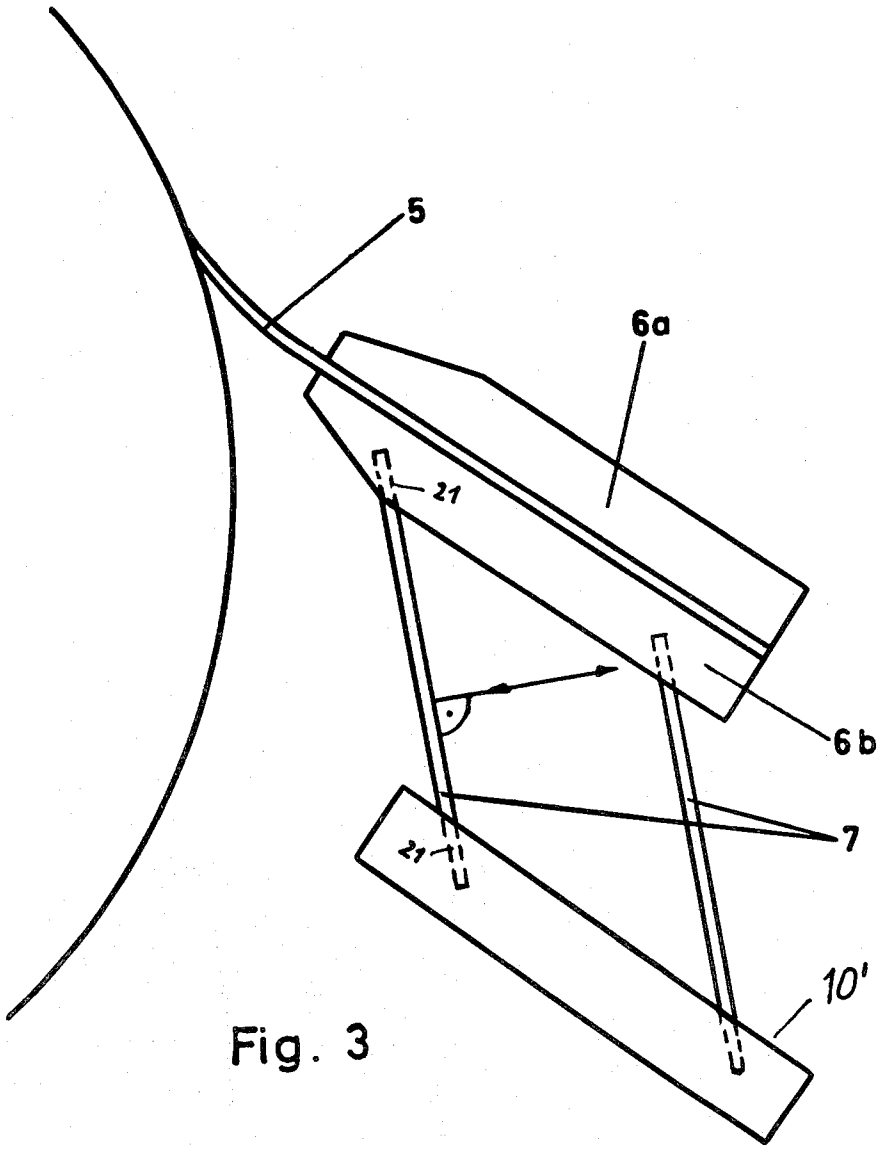


Fig. 3

Fig. 4

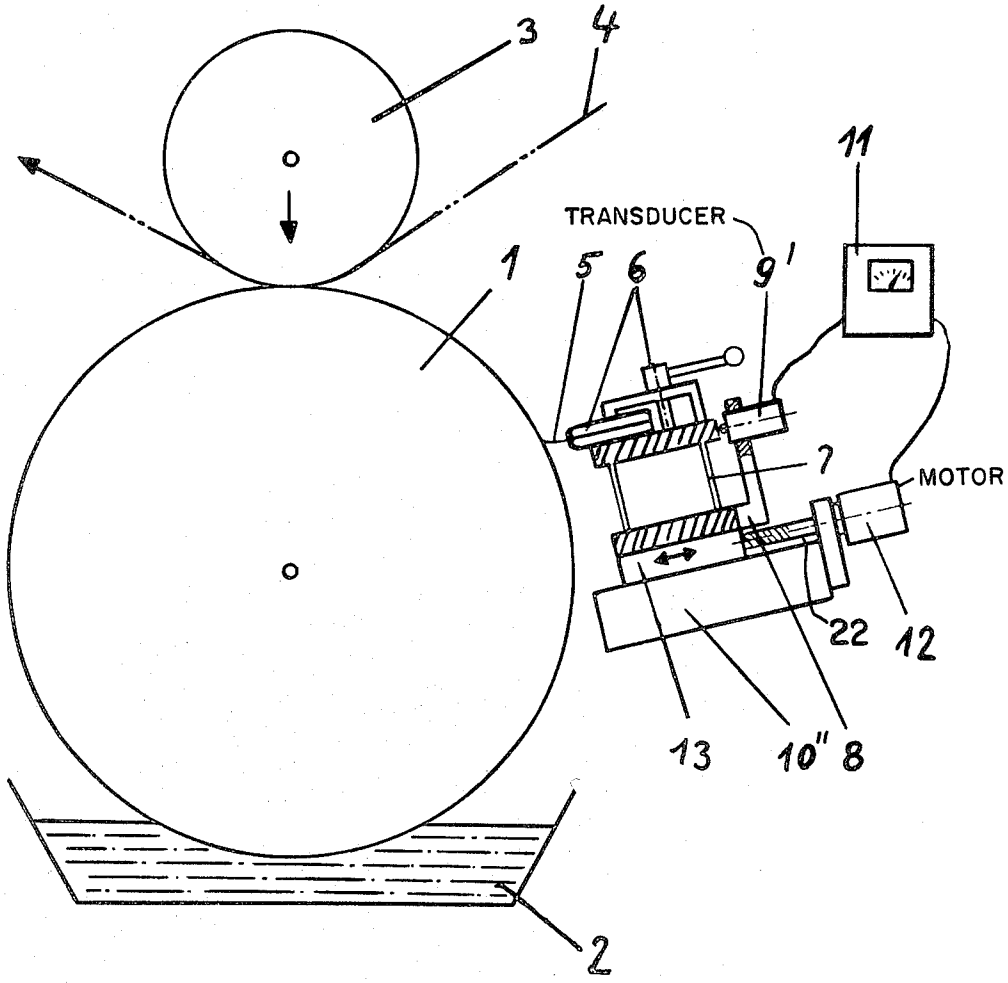
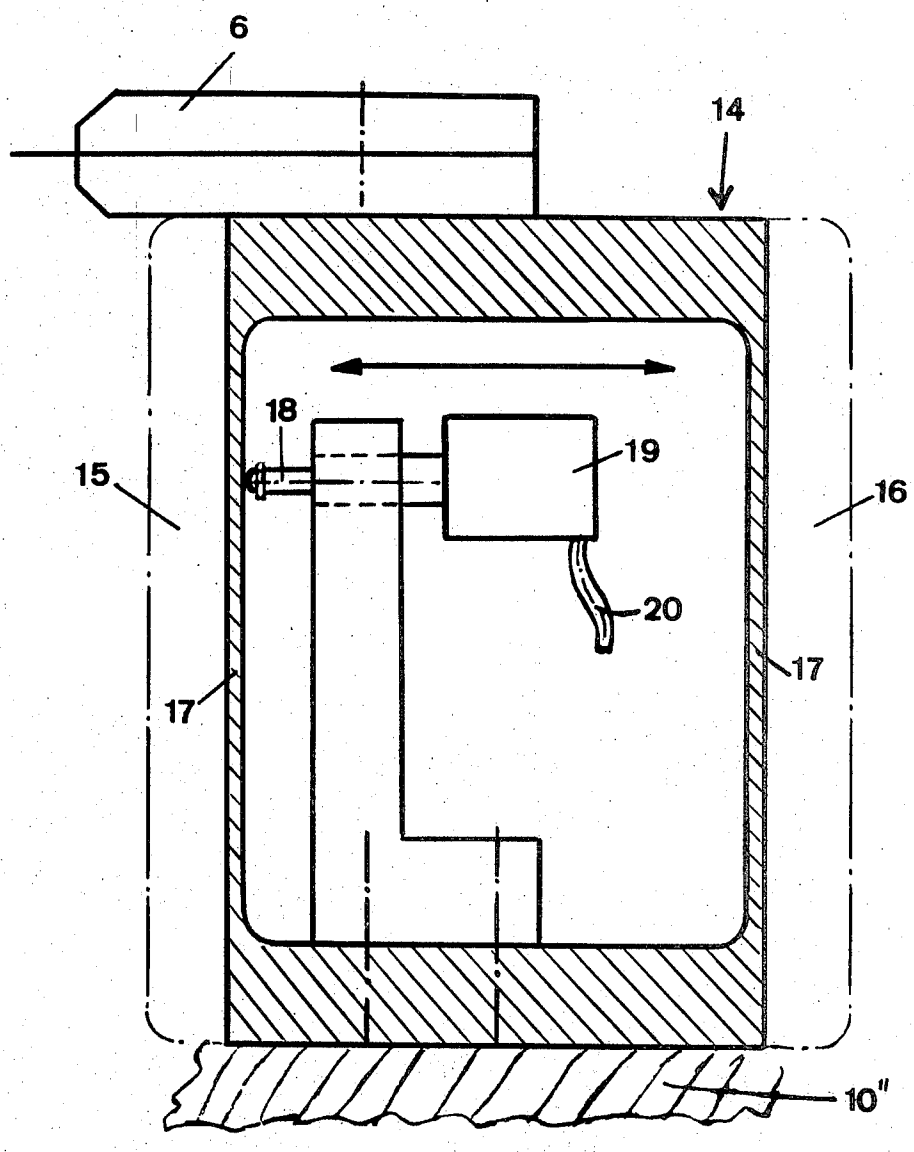


Fig. 5



DOCTOR BLADE CONTROL MECHANISM, PARTICULARLY FOR USE IN PRINTING PRESSES

The present invention relates to a doctor blade control arrangement, and more particularly to such an arrangement for use in printing presses, especially rotogravure presses.

Doctor blades are usually arranged with respect to a cylinder, which has an ink, or other material applied thereto, the doctor blade bearing against the cylinder with a predetermined pressure. It is customary to secure the doctor blade to a support and then to move the doctor blade mechanically, hydraulically, or pneumatically with respect to the cylindrical surface. The doctor blade holder itself can be fixed to the support, so that only the support need be moved, typically tilted, or the doctor blade holder may itself be movably connected to the doctor blade support, with a separate mechanism to move the doctor blade and the support being provided.

Doctor blades and holders therefor are known (see, for example, German Pat. Nos. 703,738 and 1,042,611). Pat. No. 1,042,611 shows a holder for a doctor blade which is resiliently supported on the doctor blade support by means of a spring, the doctor blade itself being movable towards the cylinder, and away therefrom, when the doctor blade is to be engaged or disengaged. Rotary springs are used in order to provide for good engagement of the doctor blade with the cylinder. As in other known doctor blade holders and application mechanisms, the problem remains that the pressure of application of the doctor blade cannot be accurately determined. It is customary, when in doubt, to increase the pressure of application of the doctor blade to the cylinder, which causes an excessive wear of the doctor blade itself. This excessive wear changes the area of engagement of the doctor blade with the cylinder which, in printing presses, causes variations in the amount of ink being supplied to specific areas on the cylinder, and thus variations in the toning of the print. A similar effect arises if an initially set pressure is interrupted; it is difficult to exactly reproduce the application pressure of the doctor blade on the printing cylinder, even if all spring and similar settings are maintained.

It is an object of the present invention to provide a mechanism which permits accurately reproducible engagement of a doctor blade with a cylindrical surface, by maintaining the pressure of engagement, so that the pressure of engagement can be controlled and maintained for optimum performance of the doctor blade itself.

Subject Matter of the Present Invention

Briefly, a holder is provided for the doctor blade which itself is resiliently connected to the doctor blade support, the doctor blade support being movable towards and away from the doctor blade. The holder is so arranged that the doctor blade bears radially against the cylinder with a resilient parallelogram, frictionless interconnection, the deflection of the resilient interconnection between support and doctor blade holder being measured by a pressure measuring device secured to the doctor blade support and engaging the resiliently secured doctor blade holder.

In accordance with a feature of the invention, an electrical measuring device can be used, providing an electrical output signal which can be fed back to an electrical control and set arrangement to maintain the pressure of application of the doctor blade constant at all times. The mechanism is particularly applicable to rotogravure presses.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic side view of a fairly steep angle doctor blade arrangement applied to a rotogravure or intaglio printing cylinder;

FIG. 2 is a schematic top view of the arrangement, with parts of the printing press, not necessary to an understanding of the invention, being omitted:

FIG. 3 is a schematic side view to an enlarged scale of an embodiment of the present invention;

FIG. 4 is a schematic side view of an embodiment having an automatic pressure adjusting arrangement; and

FIG. 5 is a transverse cross-sectional view, to an enlarged scale, of an embodiment of a doctor blade holder having a rectangular section with a built-in pressure measuring device.

The invention will be described in detail in connection with an intaglio or rotogravure press; the invention may be used, however, also with screen printing, for calendering of paper, to apply layers or coatings, and for other applications, wherever a doctor blade is used.

The cylinder 1 of FIGS. 1 and 2 is one of the cylinders in a printing press, journalled in bearings 1a and dipping partly into an ink reservoir 2. Material to be printed is schematically illustrated at 4, pressed against cylinder 1 by means of a counter cylinder or roller 3.

The doctor blade 5 is secured between a pair of clamping plates or clamping rails 6*a*, 6*b* forming part of a doctor blade holder generally indicated at 6. Clamping rails 6*a*, 6*b*, between which the doctor blade 5 is located, are clamped to a base plate 6*c* by means of clamping screws 6*d*, as best seen in FIGS. 1 and 2. Other clamping arrangements than those illustrated may be used, the particular form having been found suitable and easy to handle. The doctor blade holder 6, including parts 6*a*, 6*b*, 6*c* and 6*d* is secured to the doctor blade support by means of a pair of leaf springs 7, set on edge.

The leaf springs 7 extend over the entire length of the doctor blade device. The upper edges are set in grooves formed in bed plate 6*c* (not shown in FIG. 1 for clarity) and the lower edges are set in similar grooves in the doctor blade support 10. Movement of the doctor blade support 10 is in the direction of the double arrow A indicated in FIG. 1, by means of mechanical, hydraulic or pneumatic devices, not separately shown, and well known in the art. As seen in FIG. 2, a pair of pressure measuring devices 9 are used, secured by means of brackets 8 to the doctor blade support 10. Pressure measuring devices 9 have a plunger 9*a*, acting against a dial, the plunger extending in the direction towards the carrier plate 6*c* of the doctor blade holder 6. The doctor blade itself extends over essentially the entire length of cylinder 1. For effective attachment of the doctor blade, a plurality of clamping devices 6d are provided, located along the length of the doctor blade holder 6. The number of the clamps 6*d* depends on operating conditions; likewise, the number of pressure measuring devices 9 will depend on the stiffness of the assembly, the length of the cylinder, materials used, diameter of cylinder 1, operating speed and the like; the

number can readily be determined; if a single pressure measuring device **9** is used, and located in steps of several centimeters, say **10** cm or so, selectively along the length of the cylinder **1**, and differences in measurements are observed, then it is desirable to place more than one pressure measuring indicating device, preferably spread apart close enough to sense any deflection or deviation of pressure along the length of the doctor blade, which should be corrected at a particular point, consistent with costs of the apparatus used.

Operation

When the doctor blade **5** is applied against cylinder **1**, the carrier plate **6c** of the doctor blade holder **6** will contact plunger **9a** of measuring device **9**, the dial of the measuring device then indicating the pressure of the doctor blade **5** against the cylinder **1**. The application pressure of the doctor blade can then be adjusted, for example by hand, in accordance with the indicated pressure, by controlling the devices moving the doctor blade support **10**, for example (as known). If operation of the cylinder is interrupted and the doctor blade is removed from engagement with the cylinder, it can be reset with the same application merely by reading the pressure on the dial of indicating device **9**, and then setting the pressure of application of the doctor blade holder **10** accordingly. Of course, any desired pressure can readily be established. The pressure of application can be varied not only by setting the doctor blade support **10**, as known, but also for example by radially (with respect to cylinder **1**) shifting the location of the doctor blade holder **6** with respect to the support **10**, for example by securing the bottom plate of the holder **6** to support **10** by means of a screw-elongated hole interconnection.

The pressure of application can be automatically set to be maintained constant by use of an electrical measuring device. Referring to FIG. **4**, the pressure measuring device is there replaced by a deflection transducer **9'**. All elements common to those previously disclosed have been given the same reference numerals and will not be discussed again. An electrical indicator **11** is connected to transducer **9'**, indicator **11** also including an amplifier which amplifies the output signal from transducer **9'**, to control an adjusting motor **12**, to turn in the one or the other direction. Motor **12** is connected to a spingle **22** which engages a slider block **13**, to which the doctor blade holder is secured. Slider block **13** is slidably mounted on a doctor blade holder **10''**, to move the holder **6** in the direction of the double arrow, towards or away from cylinder **1**, as determined by the signal from transducer **9'**. A "normal" or pre-set pressure of application can be determined, for example by setting of a reference source and reference potentiometer, which provides an output signal representative of desired pressure; if the signal from transducer **9'** matches this pre-set signal, then no output will be delivered to motor **12**; if the signal from transducer **9'** deviates in either direction, a signal is applied to motor **12** to turn the motor **12** in the appropriate direction to reestablish balance. This is standard servo mechanism art and need not be discussed or shown in detail, since all components are well known and can be commercially obtained.

FIG. **5** illustrates another embodiment of the invention, in cross-sectional view, to an enlarged scale and particularly illustrates a holder element for the doctor blade **5**. The doctor blade clamp **6** is secured to a hollow rectangular profiled element **14**, normally having the dimensions indicated in the chain-dotted lines. The side walls **15, 16** of the profiled element are cut so that only thin blade-like sides **17** remain. Plunger **18** of deflection indicating transducer **19** engages one of the remaining side walls **17**, for example the inner one, as indicated in FIG. **5**. Transducer **19** supplies over a cable **20** a single representative of the deflection of the side walls, which will be a measure of the engagement pressure of the blade **5** against the cylinder **1**. The measuring direction is indicated again by the double arrow. Cable **20** can be connected to an indicator, to an automatic reset arrangement (as discussed in connection with FIG. **4**), to an amplifier, to remote control indicating apparatus, alarm apparatus or the like.

FIG. **2** illustrates a doctor blade **5** and a holder **6** which extends along the length of the cylinder **1**. Rather than using leaf springs **7** which extend over the entire length, in such a holder several shorter springs can be used, located at suitable distances along the length of the cylinder **1**. It is preferred that the reaction force between cylinder **1** and the blade **5** should be along a straight line which is at right angle to the surface to the springs **7**, since, under such force conditions, no transverse components of the force will act on the springs **7**, so that the pressure measured by the measuring device **9. 9'**, or **19**, respectively, is a measure of the actual engagement pressure of the doctor blade **5**.

Under certain operating conditions, it may be desired to have a flatter angle of engagement of the doctor blade **5** than that illustrated in FIGS. **1** to **4**. Under such conditions, the holder for the doctor blade, and the springs therefor can be arranged as indicated in FIG. **3**. Again, the force of the engagement pressure acts at right angles to the thickness of the springs **7**, so that engaging a pressure indicator with one of the springs **7**, at a direction normal to their thickness will give an actual indication of the engagement pressure of doctor blade **5**.

As illustrated in FIG. **3**, springs **7** are clamped along an edge directly to the lower clamping rail **6b** of the doctor blade, the other clamping rail being secured to a plate of the doctor blade support. The springs are preferably located on the support **10'** and on the rail **6b**, respectively, by being set in suitable matching grooves **21**, formed in the rail **6b** and in plate **10'**, respectively. The pressure measuring device is so arranged that the plunger engages along the direction indicated by the double arrow, that is, perpendicular to the thickness of springs **7**. The double arrow indicates the direction of the movement of the doctor blade, and thus the measuring direction.

As illustrated, a pair of leaf springs are preferred, the major plane thereof extending essentially at right angles to the direction of the reaction force resulting from pressing the doctor blade to the cylinder. Any suitable deflection indicator can be used, and application pressure can be directly indicated in a suitable unit if the deflection indicator is standardized with respect to the force-deflection characteristics of the leaf springs **7**. The doctor blade is held in a holder which does not have joints, or any other parts which may introduce sliding or rubbing friction; the doctor blade itself is pressed against the cylinder by a structure which is entirely spring suspended so that pressure of the doctor

blade against the cylinder can be directly indicated, without allowances for losses, which may vary with operating conditions, introduced by joints or other construction elements. This, also, permits automatic resetting of the pressure, see FIG. 4. The carriage 13 (FIG. 4) can be utilized directly to provide necessary motion of doctor blade 5 away from cylinder 1 to provide for clearance, for example for replacement or cleaning of the cylinder 1. Continuously measuring the pressure of application, as for example in accordance with the embodiment of FIG. 4, and deriving an error signal in case the pressure deviates from a predetermined set pressure, and utilizing the error signal to control a motor 12, provides for automatic setting of the desired pressure of doctor blade 5 against the cylinder. The pressure measuring device can additionally include a safety arrangement which, in case the pressure exceeds a certain limit, causes automatically removal of the doctor blade support 10 from the engagement position, and shutdown of the apparatus with which it is associated.

Variations in the doctor blade pressure during operation are constantly indicated. Thus, any eccentricity in the bearings of the cylinder against which the doctor blade bears can be rapidly detected by operating personnel; any out-of-round condition of the cylinder 1 likewise will be detected since, under such conditions, dials 9, 9' would swing back and forth in synchronism with the rotation of cylinder 1. Usually, the time lag of a mechanical servo system (FIG. 4) would be too great under ordinary operating conditions to provide for automatic re-setting of the doctor blade as out-of-round conditions are detected. It is thus preferred to include, additionally, an indicating instrument so that operating personnel will become alerted to make repairs.

The leaf springs can be secured along their longitudinal edges in any suitable manner, on a carrier plate, directly on the doctor blade, or on any other attachments in connection therewith; other attachments than the groove arrangement shown may be used; the particular arrangement permitting adaptation of the doctor blade pressure indicator to existing apparatus.

I claim:

1. In a rotary printing machine, apparatus having a doctor blade (5) and a press cylinder (1) against which the blade is applied under pressure and means (10) supporting the doctor blade, said apparatus comprising

a holder secured to said support means (10) resiliently holding the doctor blade and comprising

a blade carrier (6*a*, 6*b*, 6*c*);

two parallel leaf springs (7) the leaf springs being secured to the blade carrier, and to the support means (10) to resiliently connect the blade carrier to the support means and permit relative movement between the blade carrier and the support means, the parallel leaf springs retaining the doctor blade in parallel position during any movement against or away from the press cylinder;

means (A; 12, 22) pressing the support means to bias the ends of the leaf springs which are located adjacent the holder towards the press cylinder (1) to engage the doctor blade with said surface and apply said pressure;

and means (9) secured to the support means measuring the deflection of the blade carrier with respect to the doctor blade support means (10) as the result of the pressure force exerted by said pressing means, as a measure of said applied pressure.

2. Apparatus according to claim 1, wherein the leaf springs (7, 17) extend in planes essentially perpendicular to the reaction force due to resilient pressure of the doctor blade (5) against the press cylinder (1).

3. Apparatus according to claim 1, wherein the measuring means (9, 19) comprises a plunger (9*a*, 18) in contact with the holder and a pressure indicator measuring deflection of the plunger.

4. Apparatus according to claim 1, wherein the measuring means comprises a deflection transducer (9', 11' 19) measuring deflection variations of the blade carrier as a measure of pressure of the doctor blade against the cylinder and supplying an output signal indicative of doctor blade pressure against the press cylinder;

and means (12, 13) are provided responsive to the output signal to move the holder (6) on the support (10) in response to a signal indicative of deviation of deflection, and hence application pressure from a predetermined value, to re-establish a predetermined doctor blade position, and hence application pressure.

5. Apparatus according to claim 1, wherein the press cylinder and the doctor blade are elongated, the doctor blade extending along the whole axial length of the cylindrical surface; a plurality of holders (6) for the doctor blade are provided clamping the doctor blade at spaced positions along said length;

and a plurality of measuring means (9) are provided located along the length of the doctor blade.

6. Apparatus according to claim 1, wherein the holder for the doctor blade includes an elongated carrier plate (6*c*), the doctor blade being secured to said carrier plate;

an elongated plate secured to the support means;

and elongated leaf springs set on edge and interconnecting the elongated plates along their length.

7. Apparatus according to claim 6, wherein the plates are formed with grooves (21), the leaf springs being set along their edges into the grooves of the respective plates.

8. Apparatus according to claim 1, wherein the holder includes a hollow profiled member (14) having four opposed wall portions, the top and bottom wall portions being secured to the doctor blade (5) and the support means (10), respectively;

the front and rear side wall portions (17) being resilient and permitting relative deflection of the top and bottom wall portions in a parallelogram movement.

9. Apparatus according to claim 8, wherein the hollow profiled member has essentially rectangular cross-section, the front and rear wall portions being thin with respect to the top and bottom wall portions and being formed of the remainder of the front and rear wall portions, after removal of material from the front and rear wall portions to provide for resiliency of said front and rear wall portions.

10. Apparatus according to claim 1, wherein the measuring means engages the holder in a direction which is essentially radial with respect to the center of the cylindrical surface.

11. Apparatus according to claim 1, wherein the machine is in combination with a rotogravure press.

12. Apparatus according to claim 8 wherein the measuring means are located within the space defined by said wall portions.

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