

[54] SHEET HANDLING APPARATUS

[76] Inventor: **Howard W. DeMoore**, 3725 Bentley Ave., Los Angeles, Calif. 90034

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[51] Int. Cl. **B65h 29/20**

[58] Field of Search 271/51, 53, 82, 80, 79;
101/422, 420, 416; 106/2

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Primary Examiner—Evon C. Blunk

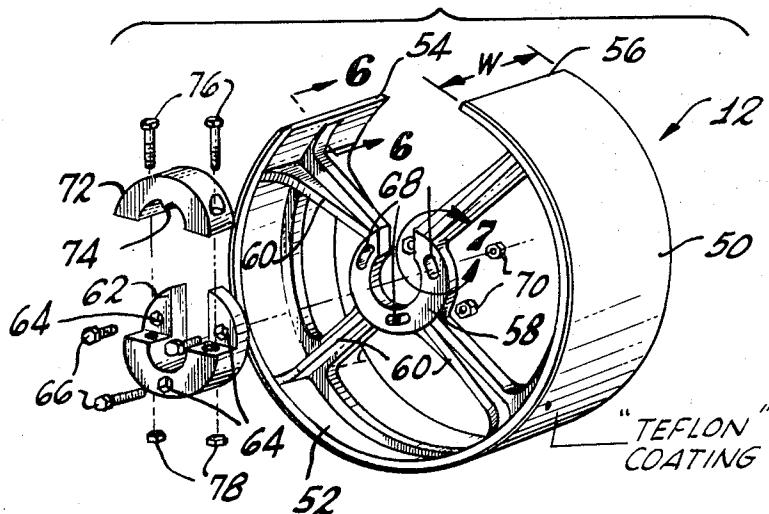
Assistant Examiner—Bruce H. Stoner, Jr.

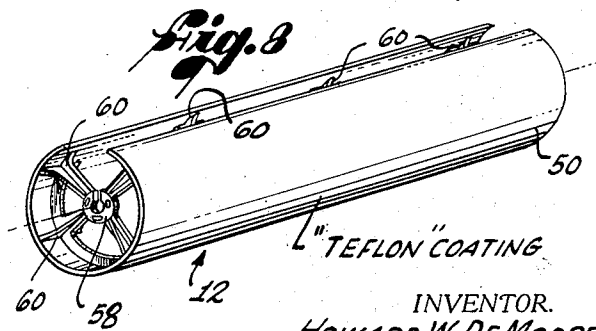
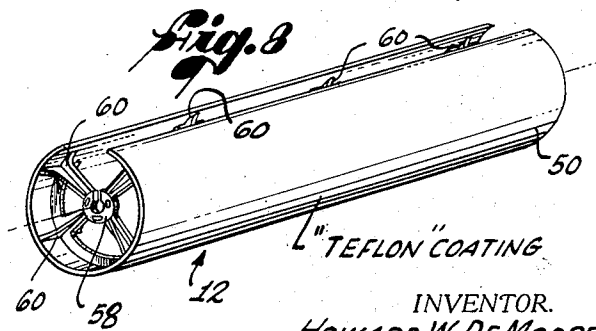
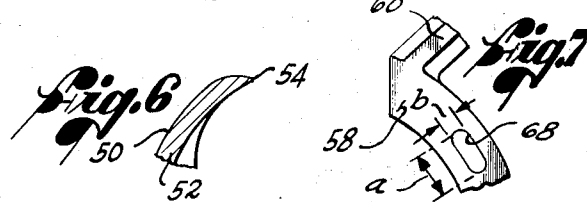
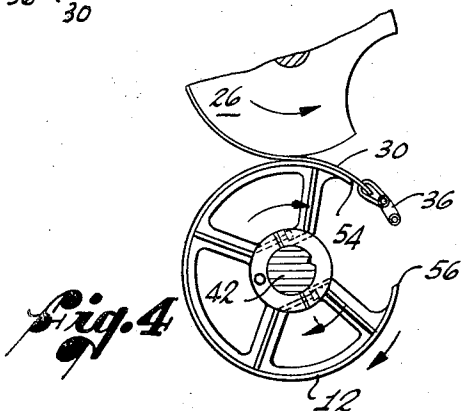
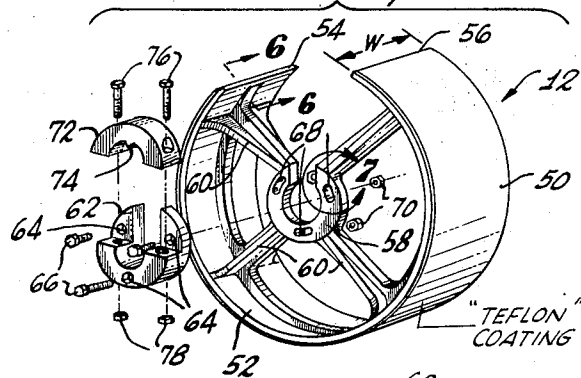
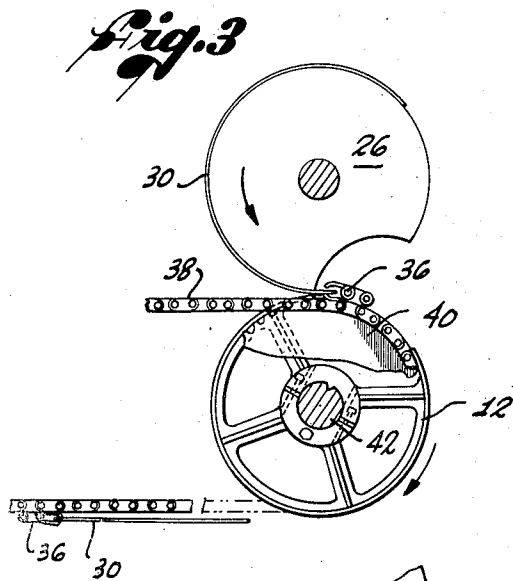
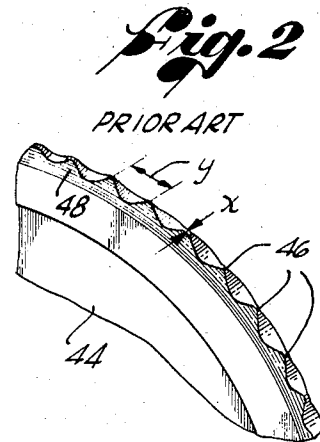
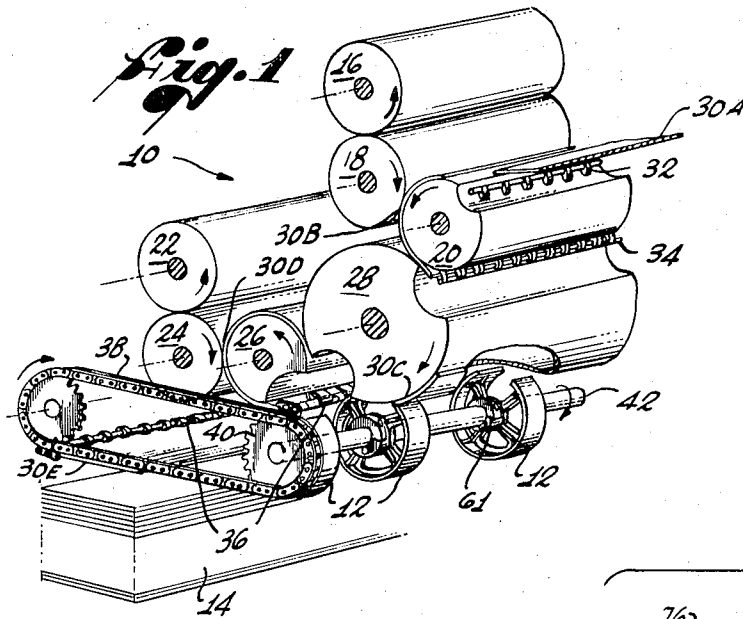
Attorney, Agent, or Firm—Fulwider, Patton, Rieber & Utecht

[57] **ABSTRACT**

A skeleton wheel for a printing press has an ink-repellent, circumferential surface formed of polytetrafluoroethylene, the surface having substantial width in the direction of the wheel axis.

7 Claims, 8 Drawing Figures





INVENTOR.
HOWARD W. DE MOORE
BY Fulwider, Patton, Rieber
Lee, and Utecht
ATTORNEYS

SHEET HANDLING APPARATUS

This application is a continuation-in-part of my co-pending application Ser. No. 141,681 filed May 10, 1971 and now abandoned.

BACKGROUND OF THE INVENTION

The invention relates generally to sheet handling apparatus and, more particularly, to apparatus for conveying printed sheets between successive processing stations. For example, one use for which the sheet handling apparatus is particularly well suited is the conveyance of freshly printed sheets from a printing station to the delivery section in a multicolor, offset printing press, the sheets being received and stacked in the delivery.

It has been traditional in the printing art to utilize delivery apparatus in the form of multiple delivery or skeleton wheels. Typically, a set of grippers pulls a printed sheet from an adjacent printing station across a rotating set of as many as seven or more skeleton wheels for subsequent stacking in delivery. The sheet is subjected to high tension and stresses as it is pulled by the grippers, and the skeleton wheels support the sheet to prevent it from buckling or warping. The freshly printed, undried sheets present their wet, inked surface to the skeleton wheels, and this contact between the inked surface and wheels has been a source of long-standing problems.

First, the skeleton wheels mark the sheets. Ink is deposited from each sheet onto the wheels and is subsequently transferred from the wheels to succeeding sheets. In addition, if the peripheral sheet contacting surface of the wheels is traveling at a different speed than the sheet, then it is likely that the inked sheet will be smeared. The problem is particularly acute in modern high-speed presses which have an output of between 6,000 and 10,000 sheets per hour. In any event, marked sheets must be rejected and the job redone, resulting in additional expense and aggravation.

There have been a variety of expedients developed in attempts to overcome the marking problem, the attempts typically directed toward minimizing the amount of surface area contact between the inked areas of each sheet and the wheels. In general, however, it is evident that a reduction in contact area between the wheels and sheet correspondingly reduces the amount of support provided each sheet by the wheels. As a result these prior attempts have inherent problems.

In one expedient, the skeleton wheels are in the form of thin discs having a fluted or serrated circumference presenting a series of very narrow, curved projections for engaging and supporting the printed sheet. However, these projections still mark and smear the printed surface as previously described. Moreover, the force of the narrow projections against the sheet often produces a corresponding series of concave depressions along the sheet. The depressions alone mar the printing job, but further can cause "fan-out" of the sheet and prevent its further processing. In "fan-out," the depressions cause slight changes in the dimensions of the sheet and in the relative location of its printing register marks. If the sheet is to be run through a press a second time, as is often the case in multicolor jobs, it must be accurately registered or else the second printing will be incorrectly aligned. "Fan-out" from the skeleton wheel depressions prevents this accurate registration.

Variations in the thin disc skeleton wheel have included wheels with radially retractable segments which can be retracted away from the inked sheet area as well as wheels with an integral air pressure system for maintaining an air space between the wheels and the inked area. Another prior expedient utilized a thin disc having radially extending bristles for engaging and supporting the sheets. However, the air pressure systems are relatively complex and expensive. Moreover, with the segmented discs, each segment must be individually set for each job. In addition, each prior approach provides only a minimal area of contact for sheet support. Also, time-consuming cleaning operations are required to remove ink and the like from the prior wheels.

To reduce the seriousness of the marking or smearing from prior skeleton wheels, it is common practice to adjust the lateral position of each wheel. In this manner, each wheel is presumably located to contact a relatively immaterial part of the printed sheet, so that any marking will be to this area rather than to the most significant printed portions. In fact, many jobs utilize oversized sheets having channels or gutters for receiving the skeleton wheels, there being no printing in the channels. It is evident that constant lateral adjustment of wheels is time-consuming and a nuisance. Moreover, even marking on less important printed areas is bad. In the case of oversized sheets with wheel channels, it requires a costly extra step to subsequently cut the sheets down to size, in addition to the added expense of oversized sheets themselves. Furthermore, in many jobs there often is simply no uninked sheet area for receiving the wheels so that, attempted lateral wheel adjustment is futile.

The skeleton wheel marking, adjustment, cleaning, and other problems have often rendered the printing press delivery apparatus as, in effect, the weak link of the press. In present sophisticated presses costing hundreds of thousands of dollars and often run on a round-the-clock basis, the resulting down time from skeleton wheel problems can cause serious inefficiency and economic loss.

Thus, there has clearly existed a need for delivery apparatus capable of conveying freshly printed sheets in a simple manner without marking the sheets. Moreover, the apparatus should provide the maximum desired support for the sheets, and should be easily cleaned, and should not require repeated adjustment for various printing jobs. The present invention fulfills these needs.

SUMMARY OF THE INVENTION

In its broad aspect the sheet handling apparatus of the present invention provides means for supporting printed sheets by engagement with a freshly printed side of the sheet. This supporting means has an ink-repellent surface which engages the sheet without leaving undesirable ink smears or marks on it or succeeding sheets. Significantly, the ink-repellent surface may have a relatively large sheet contacting area to provide maximum desired sheet support.

In the preferred embodiments of the invention, the sheet handling apparatus is embodied in delivery apparatus for a printing press and includes at least one rotatable skeleton wheel, the rim portion of which includes a generally cylindrical, ink-repellent, circumferential surface providing supporting contact with the printed side of a sheet while conveying the sheet toward the

press delivery. The ink-repellent surface is formed from a low-friction, inert, organic material such as polytetrafluorethylene, which may be coated on the wheel.

The skeleton wheel has substantial width in the direction of the wheel axis, typically ranging from about one inch up to the full width of the press and which may be as large as seventy eight inches or more, and has its supporting surface relatively smooth to insure a large area supporting contact for the sheet. The delivery apparatus may include a plurality of skeleton wheels or the wheel width can be increased to a point at which only one wheel is utilized in the press.

The wheel circumferential surface has leading and trailing edges, and the surface portion adjacent the leading edge has a lesser radius than does the remaining surface portion, so that the circumferential surface turns inwardly approaching the leading edge. In addition, the position of the wheel may be circumferentially adjusted to place the leading edge in an optimum location for receiving an incoming sheet. In this manner the sheet is not marked as it is received by the wheel.

The above invention provides simple and reliable sheet handling apparatus in the form of skeleton wheels which support the sheets, including inked areas thereof, without producing ink smears or marks and which are easily installed, operated and cleaned and which do not require time consuming adjustment for various jobs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic, perspective view of a two-color offset printing press including skeleton wheels of the present invention, the press being cut away in part to show the wheels.

FIG. 2 is a perspective view showing a partial, circumferential portion only of a prior art skeleton wheel.

FIG. 3 is a left side elevational view of part of the press of FIG. 1 showing a printed sheet, pulled by a chain-driven set of grippers, being received by the skeleton wheel of the invention, a chain driven cog wheel being cut away in part to show the skeleton wheel.

FIG. 4 is a view similar to FIG. 3, without the chain and cog wheel, showing the printed sheet after engagement with the skeleton wheel.

FIG. 5 is an exploded, perspective view of a single skeleton wheel according to the present invention and a collar therefor;

FIG. 6 is an enlarged sectional view taken along lines 6-6 in FIG. 5.

FIG. 7 is an enlarged left side elevational view taken along line 7 in FIG. 5; and

FIG. 8 is a perspective view of another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, and in particular to FIG. 1 thereof, the invention is shown embodied in sheet handling apparatus for use in conveying printed sheets within a conventional printing press 10. In this application the invention is embodied in delivery apparatus, including one or more rotatable skeleton wheels 12 around which freshly printed sheets are conveyed for subsequent stacking at 14 in the press delivery. The press is shown as a two-color type, though it will be understood that the invention is suitable for use with sin-

gle-color presses or with multi-color presses having any number of printing stations.

The press 10 includes two printing stations, the first represented by a plate cylinder 16, a blanket cylinder 18, and an impression cylinder 20, and the second represented by similar plate, blanket and impression cylinders 22, 24, and 26. Sheets are transported between the two stations by a transfer cylinder 28. A sheet 30 to be printed is shown as five different stages 30A through 30E in its travel through the press. In a conventional manner, the sheet at 30A approaches the impression cylinder 20 and is subsequently gripped by a set of grippers 32 secured to this cylinder. The sheet is first printed in passing between the impression and blanket cylinders 20 and 18 at 30B, and is then picked up by a set of grippers 34 on the transfer cylinder 28. After movement around the transfer cylinder at 30C, the sheet is transferred to the second impression cylinder 26 for a second printing against the second blanket cylinder 24 at 30D. A set of delivery grippers 36, secured at one end to a driving chain 38, grips the sheet in the position shown in FIG. 3, and subsequently pulls the sheet around the skeleton wheels 12 to the point 30E at which the sheet is dropped into the stack 14. The chain 38 drives a cog wheel 40 secured to a delivery shaft 42 to which the skeleton wheels are fastened, the axis of each wheel being coterminous with the shaft. The sheet 30, held by the grippers 36, is pulled against and around the rotating skeleton wheels, as shown in FIG. 4, with the sheet and the wheels moving at the same angular velocity so that there is little or no relative movement between them.

Each sheet 30 is conveyed by the skeleton wheels 12 with its freshly printed, undried, inked surface facing and making contact with the circumferential surface of the wheels. In an attempt to avoid skeleton wheel marking of the sheets, the prior art typically minimized the contact area between the wheels and the sheet. FIG. 2 shows a partial circumferential portion of a common prior wheel 44. This wheel is a thin disc having a plurality of very narrow, circumferentially spaced, curved projections 46 for engaging the printed sheet. The sides of the wheel are beveled toward these projections as at 48. With this arrangement, the width "x" of each projection in the direction of the wheel axis, is about one thirty-second of an inch, and the projections may be circumferentially spaced by a distance "y" of about 1/2 inch. The result is a minimal amount of surface area contact between the thin-disc skeleton wheel 44 and the sheet 30 with all the inherent disadvantages thereof.

In accordance with a primary aspect of the present invention, as shown in FIGS. 1 and 5, the skeleton wheel 12 has an ink-repellent, circumferential surface 50 for engaging and supporting the printed side of each sheet 30. In addition, this surface has a width "w", in the direction of the wheel axis, for providing maximum desired supporting contact for the sheet. As a result, each sheet is conveyed with adequate support by the wheels free of marks or depressions, even when there is direct contact between the wet, inked areas of the sheet and the circumferential surface 50.

More specifically, in the preferred embodiments of the invention, the skeleton wheel 12 includes a rim portion 52, with the surface 50 being of generally cylindrical circumference. The surface 50 includes a coating of low-friction, inert material. One suitable material for

this purpose is low-friction, self-lubricating polytetrafluoroethylene, known commercially by the DuPont Company trademark "TEFLON", the application of which is described hereinbelow.

The rim 52 extends circumferentially for less than 360°, so as not to interfere with the movement of the delivery grippers 36, as shown in FIG. 4. Thus, the surface 50 of the skeleton wheel has an opening extending the axial width of the wheel with a leading edge 54 and a trailing edge 56, the edges extending in the direction of the wheel axis. The rim 52 is supported radially outward of a central, annular hub 58 by a plurality of supports 60 extending between the hub and the rim. The skeleton wheel, including the hub, the supports, and the rim, may be a one-piece integral casting, and aluminum is one suitable material for this form of wheel.

The skeleton wheel 12 is rigidly secured for rotation on the delivery shaft 42 shown in FIG. 1. This attachment may be accomplished in any suitable manner, and one suitable means for installing a wheel in an existing press is a split collar 61 shown exploded in FIG. 5, the collar being rigidly attached around the shaft. A lower collar piece 62, having a plurality of bores 64 therein, is fastened to the annular hub 58 by plural bolts 66 extending through the bores and through corresponding slots 68 in the hub and secured with suitable nuts 70. An upper collar piece 72 has a key 74 extending from its interior surface for engagement in a keyway (not shown) in the delivery shaft 42. The upper and lower pieces are fastened together around the shaft by plural bolts 76 and nuts 78 to rigidly position the skeleton wheel.

To insure that the sheet 30 is not creased or marked as it is received by the skeleton wheel 12, the surface 50 of the wheel turns inwardly adjacent the leading edge 54, as shown in FIG. 6. The portion of the surface 50 adjacent this edge has a smaller radius than the remainder of the surface. In this manner, there are no sharp wheel edges to mar the sheets. In this connection, the circumferential position of the leading edge 54 can be adjusted, so that it is located in the optimum location relative to each incoming sheet. For this purpose, the slots 68 in the annular hub 58 (as shown in FIG. 7) have a circumferential length "a" greater than their radial width "b" and thus a length greater than the diameter of the bolts 66. Accordingly, prior to tightening the bolts, the skeleton wheel can be rotated circumferentially with respect to the collar 61 and the delivery shaft 42 to accurately position the leading edge.

It has been found that the width "w" of the ink-repellent, circumferential surface 50 can be extended any desired amount to provide the maximum desired support for the printed sheets 30. The optimum width "w" for wheels in any particular press will depend on many factors such as the type and width of press, the corresponding width of the printed sheets, the number of wheels utilized, and the like. In general, the larger wheel surface width "w", the less chance there is of marking or forming depressions in the sheets.

By way of example, in a six-color, 50 inch press, five skeleton wheels 12, each approximately 4 inches in width have been satisfactorily used. Similarly, on smaller offset presses such as the duplicating machine types having sizes in the range of 10 by 14 and 11 by 17 inches, several longitudinally spaced skeleton wheels 12 each having a width "w" on the order of one inch to two and a half inches can successfully be used.

Once the wheels are installed on the delivery shaft 42, there is no need to adjust their lateral position on the shaft to avoid the inked sheet areas of various jobs.

As shown in another embodiment in FIG. 8, the width "w" may be extended to the point at which the skeleton wheel extends substantially the full width of the printing press, as much as 78 inches or more. In this form only one wheel would be utilized to support and convey each sheet. The wheel of FIG. 8 is shown as having several axially spaced support and hub structures, 60 and 58.

The steps for applying polytetrafluoroethylene coatings are known in the art, and do not themselves form part of the present invention. The circumferential surface of the rim portion 52 was prepared and cleaned as by sandblasting or other appropriate method. After preheating at 200° F. for about three minutes, the surface 50 was sprayed with an adhesive containing primer coat of polytetrafluoroethylene, the primer sold commercially by the DuPont Company as "Teflon TFE, Non-Stick, Primer Green 850-204". The primer thickness was between 0.3 mils and 0.4 mils. The primer was cured at about 500° F. for 2 minutes. Thereafter, an enamel second coat between 0.8 and 1.0 mils thickness was applied and cured at 750° F. for about five minutes. The second coating of polytetrafluoroethylene is sold commercially as "Teflon TFE, Non-Stick High-Build, Enamel 851-221."

The surface 50 so prepared is ink-repellent. As the inked areas of the printed sheets 30 engage the surface, there is no transfer of ink from one sheet, to the skeleton wheel 12, and thereafter to one or more succeeding sheets. While there may be an extremely slight collection of ink on the surface 50, quite unexpectedly there is still no marking of subsequent sheets. Thus, the surface is ink-repellent in the sense that it prevents transfer of ink between sheets. Moreover, because of the substantial surface width "w", there are no depressions formed in the sheets.

The surface 50 is preferably substantially smooth to provide a large area of contact with each sheet and, thus, insure maximum sheet support. Again quite unexpectedly, this large area sheet contact does not result in marking.

Since polytetrafluoroethylene is inert and the surface 50 is smooth, it is a simple matter to clean the surface by wiping with any desired cleaning agent or solvent.

The present invention satisfies a long existing need in the printing art in handling and conveying freshly printed sheets without ink smearing or marking while giving maximum desired sheet support, even to the wet, inked sheet areas, without the operational drawbacks of the prior art.

It will be apparent from the foregoing that, while particular forms of the invention have been illustrated and described, various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited except as by the appended claims.

I claim:

1. A skeleton wheel for supporting and transferring a printed sheet having wet ink on one side between successive processing stations, and engaging said one side during the transfer operation without marring the ink thereon, said skeleton wheel having:

a generally cylindrical peripheral surface of an axial width within the range of about one inch up to

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about the width of said press for contacting said sheet, said surface having an opening extending the axial width of said wheel so that said surface extends circumferentially less than 360°;

and ink-repellent coating means on said surface comprising a layer of polytetrafluoroethylene for engaging said one side and the wet ink thereon and supporting said sheet without marring the ink.

2. A skeleton wheel as defined in claim 1 in which a plurality of said wheels each having an axial width less than one half the width of the press are secured to an axial shaft and spaced therealong to support said sheet along its length during transfer.

3. A skeleton wheel as defined in claim 1 in which said surface has an axial width substantially equal to the length of said sheet.

4. A skeleton wheel for use in supporting and transferring a printed sheet having wet ink on one side between successive processing stations, and engaging said one side during the transfer operation without marring the ink thereon, said skeleton wheel having:

a generally cylindrical peripheral surface of substantial axial width on the order of one to four inches for contacting said sheet, said surface having an opening extending the axial width of said wheel so that said surface extends circumferentially less than 360°;

and ink-repellent coating means on said surface comprising a layer of polytetrafluoroethylene for engaging said one side and the wet ink thereon and supporting said sheet without marring the ink.

5. A skeleton wheel for use in supporting and transferring a printed sheet having wet ink on one side between successive processing stations in a printing press,

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and engaging said one side during the transfer operation without marring the ink thereon, said wheel having:

a generally cylindrical peripheral surface of an axial width on the order of four inches for contacting said sheet, said surface having an opening extending the axial width of said wheel so that said surface extends circumferentially less than 360°;

and ink-repellent coating means on said surface comprising a layer of polytetrafluoroethylene for engaging said one side and the wet ink thereon and supporting said sheet without marring the ink.

6. A skeleton wheel as defined in claim 5 in which a plurality of said wheels are secured to an axial shaft and spaced therealong to support said sheet along its length during transfer.

7. A skeleton wheel for use in supporting and transferring a printed sheet having wet ink on one side between successive processing stations in a printing press, and engaging said one side during the transfer operation without marring the ink thereon, said wheel having:

a generally cylindrical peripheral surface of an axial width substantially equal to the width of said press for contacting said sheet over a substantial portion of said one side, said surface having an opening extending the axial width of said wheel so that said surface extends circumferentially less than 360°;

and an ink-repellent coating on said surface comprising a layer of polytetrafluoroethylene for engaging said one side and the wet ink thereon and supporting said sheet without marring the ink.

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