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ARTICLE TO FACILITATE FEEDING OF IMAGE RECEIVING SHEETS

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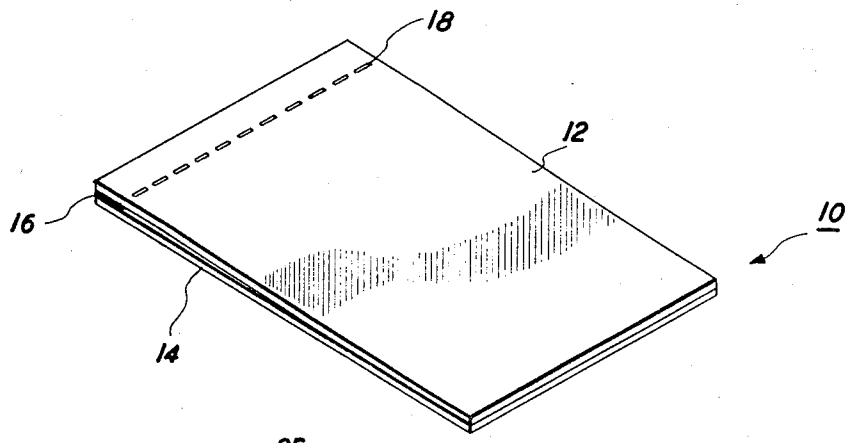

FIG. 1

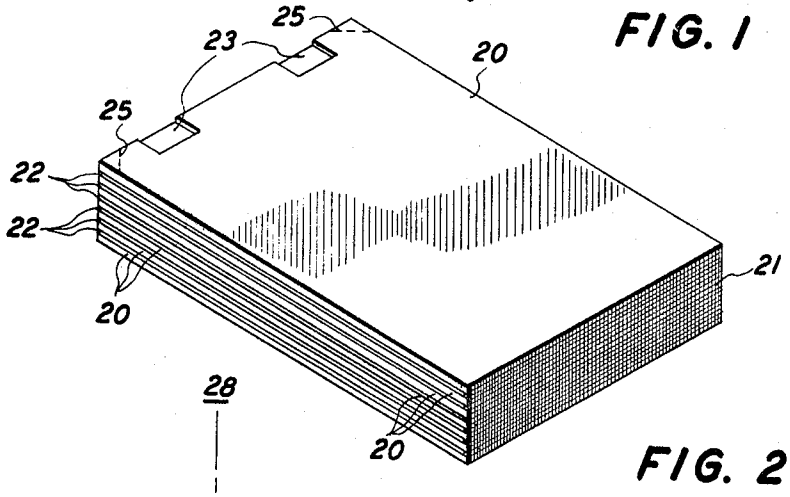

FIG. 2

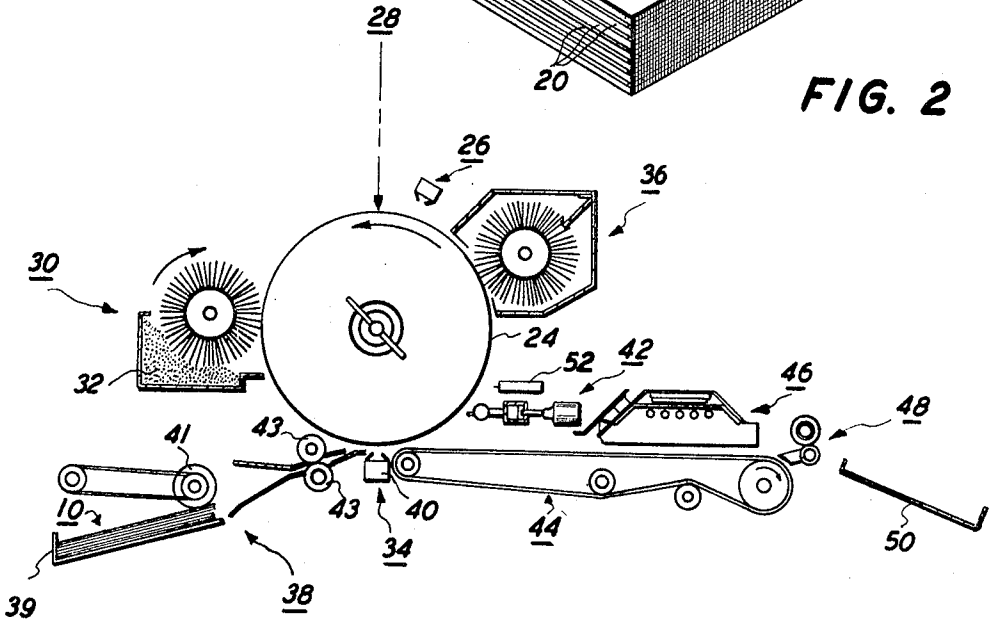

FIG. 3

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ARTICLE TO FACILITATE FEEDING OF IMAGE RECEIVING SHEETS

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U.S. Cl. 206—57 7 Claims

ABSTRACT OF THE DISCLOSURE

Paper backing or interleafing to facilitate the feeding seriatim of non-fibrous, flexible sheets from a stack. In one preferred embodiment a paper backing is secured to at least one corresponding edge of a non-fibrous sheet and the unit is fed. In a second preferred embodiment a stack of non-fibrous sheets is interleafed by a stack of paper sheets bound along a common edge, for example in tablet form, each paper sheet including a cut out portion adapted to permit contact of sheet separating and advancing means to successive non-fibrous sheets to feed same.

This invention relates to articles and methods to feed non-fibrous, flexible sheets.

Ever since the early 1800's with the advent of the rotating cylinder printing press which greatly increased the number of impressions per hour over prior art sheet feed imaging systems, those skilled in the art have been concerned with advancing the art of sheet feeding in order to keep up with sheet fed automated presses which can presently produce from 2500 to 5000 impressions per hour. In addition, in the last decade, there has been a revolution in office copying with the advent of new imaging processes and automatic imaging machines many of which call for automated sheet feeding. For example see The Revolution in Office Copying, Chemical and Engineering News, 114, July 13, 1964.

Although paper is commonly used as an image receiving member, certain non-fibrous, flexible sheet materials which may be relatively plastic, polymeric materials generally characterized by having a high surface gloss and a smooth surface are being increasingly employed as an image receiving member for certain imaging applications. These non-fibrous, flexible sheet image receiving members are often more durable than paper and transparent non-fibrous, flexible sheets after receiving the image have great utility for example as transparencies used in conventional projectors to project images on a screen for example for group presentation. However, a problem has arisen in that many currently available imaging machines are peculiarly adapted to feed seriatim stacked paper and certain operational difficulties have arisen when non-fibrous, flexible image receiving sheets are substituted for paper in such systems.

For example in feeding seriatim non-fibrous, flexible sheets from the top of a stack of said sheets into an automatic imaging machine it is found that feeding of the top sheet often causes creep or advancement of the sheets immediately beneath the top sheet resulting in misfeeds and jams within the machine thus greatly increasing the amount of imaging material wasted which increases the cost of operation. Also machine down time, necessary to clear the machine of jams, is increased. It is thought that creep is at least partially caused by the relatively high coefficient of sliding friction of many non-fibrous, flexible materials relative to each other and also by the electrically insulating nature of many non-fibrous, flexible materials which permits electrostatic charges to accumulate on said sheets and electrostatically attract contiguous

sheets when a sheet is removed from a stack of said sheets.

The building up of electrostatic charges on non-fibrous, flexible sheets also makes removal of the leading edge of such a sheet from a flat surface, for example to change the routing of the sheet in processing, more difficult since the charged sheet adheres more tenaciously to the surface than would paper or a relatively uncharged sheet. These problems in a business where cost, ease and efficiency of operation are of utmost significance could not long be endured in any commercially offered imaging machine.

Another problem has been that feeding and processing of non-fibrous, flexible sheets alone through some copiers employing heat fusing to permanentize the image on the sheet is found to cause distortion and buckling of the sheet with resultant charring of portions of the sheet.

Also, as illustrated by copending application Ser. No. 403,844 filed Oct. 14, 1964, now Pat. No. 3,360,652, entitled Sheet Sensing Device, there are devices employed in commercially available imaging machines which employ a photocell to detect the presence or absence of a sheet of light reflecting transfer material, for example, paper to determine whether the transfer material has been routed in the proper path within the machine. Commonly an improper routing will cause the device to deactivate the machine to avoid costly paper jams within the machine and to facilitate dejamming procedures. It is found that a misrouted transparent or translucent non-fibrous, flexible image receiving sheet will often not activate such a device.

Thus there is a continuing need for smoother, more trouble-free feeding and processing of non-fibrous, flexible image receiving sheets particularly into those imaging machine adapted to process more conventional type image transfer material, such as paper.

It is therefore an object of this invention to provide articles and methods to feed seriatim non-fibrous, flexible sheets which overcome the above noted disadvantages and satisfy the above noted wants.

It is another object of this invention to provide an automatic feed system especially suited for feeding seriatim non-fibrous, flexible sheets from the top of a stack or supply thereof.

It is a further object of this invention to provide a non-fibrous, flexible sheet feed system adapted to feed the top most or bottom most non-fibrous, flexible sheet from a stack of said sheets without causing appreciable creep or advance of contiguous sheets in order to provide more trouble-free feeding and image processing.

It is a still further object of this invention to provide a non-fibrous, flexible sheet feed and processing system capable of activating a photocell detection device within an imaging machine to detect misrouting of sheets within the machine.

It is a still further object of this invention to provide an embodiment of a non-fibrous, flexible sheet feed system, wherein transfer images are more readily fused especially by heat radiation fusing techniques.

The foregoing objects and others are accomplished in accordance with this invention by providing according to a first article embodiment, an image transfer member comprising a non-fibrous, flexible image receiving sheet backed by a sheet of paper substantially coextensive with the area of the non-fibrous, flexible sheet, the sheet of backing paper attached only to at least one of a common leading or side edge of the non-fibrous, flexible sheet.

As used in the specification and claims herein the directional describers, leading, side and back edges are intended to refer to sheet edge positions with respect to the direction of advancement of generally rectangular sheets for example in a sheet feeding operation. Thus the leading

edge is the edge which first advances into the machine and is generally perpendicular to the direction of advancement. The side edges are generally parallel to the direction of advancement, and so on. Each transfer member according to this first embodiment is automatically fed from a stack of members and processed as a unit i.e. with the paper backing attached to only at least one common leading or side edge throughout the image processing operation, the paper backing to be removed or not as desired after the non-fibrous, flexible sheet has received the image and the unit has been discharged from the machine.

According to a second article embodiment of the invention, a stack of non-fibrous, flexible image receiving sheets is interleafed by a stack of paper sheets bound only along at least one common side or back edge each non-fibrous, flexible sheet being separated from immediately adjacent sheets of similar material by at least one interleafed sheet of paper. The area of the paper sheets is substantially coextensive with the area of the non-fibrous flexible sheets except for cut out portions of each paper sheet corresponding to the point of contact of non-fibrous, flexible sheet separating and advancing rollers or other sheet separating and advancing means of a sheet feed mechanism. The cut out portions permit the sheet separating and advancing rollers or other sheet separating and advancing means to contact and advance each successive non-fibrous, flexible image receiving sheet into the machine to be processed by the machine absent the paper interleafing which is left behind as a stack of bound paper. The paper interleafs minimize the contact area between immediately adjacent non-fibrous, flexible sheets thus greatly reducing the creep of said sheets when immediately adjacent non-fibrous, flexible sheets are advanced into the machine.

The advantages of the articles and methods of feeding seriatim non-fibrous, flexible sheets according to this invention will become apparent upon consideration of the following detailed disclosure of the invention especially when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an isometric view of a preferred configuration of an image transfer member according to a first embodiment of the invention;

FIG. 2 is an isometric view of a preferred configuration of an article for feeding seriatim stacked non-fibrous, flexible sheets according to a second embodiment of the invention;

FIG. 3 is a partially schematic side view of an exemplary automatic xerographic copying apparatus for utilizing either embodiment of the multi-feed articles of this invention.

Referring now to FIG. 1 there is illustrated according to a first article embodiment of the invention, a novel image transfer member **10** comprising non-fibrous, flexible sheet **12** the free surface of which is to bear the image and paper backing sheet **14** attached to a common peripheral leading or side edge of sheet **12** by an adhesive material **16**. Of course a wide variety of means are available to secure common edges such as stapling, taping, gluing and other means known in the art. Optionally, and preferably sheet **12** may be creased or scored, the crease **18** positioned to facilitate the tearing away of the imaged portion of sheet **12** from the adhesively secured portion of the sheet to give an imaged non-fibrous, flexible sheet absent the paper backing **14**.

Although it is found to be preferred to secure the image receiving sheet **12** to the paper backing **14** along the common leading edge, it is found that securing sheet **12** to backing sheet **14** along either side edge alone or in combination with securing of the lead edge is also suitable for use in the various machines tested. Perforation or crease **18** is preferred but is not a requirement of the invention since after imaging the transfer sheet **12** may be separated from the backing by a wide variety of ways for example by merely cutting as with a scissors to free the transfer sheet **12** from the backing **14** and any secured peripheral edge portions. Before separation the paper backing allows an imaged transparency to be more easily viewed and protects the adjacent surface of sheet **12** from dirt and other ambient influences which may tend to degrade the image projection qualities of sheet **12**.

A multiplicity of members **10** may be stacked in the paper feed tray of many sheet feed mechanisms for feeding a stack of ordinary paper sheets seriatim and each member may be fed as a unit smoothly while non-fibrous, flexible sheets **12** if stacked and fed without paper backing **14** attached as shown would not feed without frequent jams caused by creep of underlying sheets as top most or bottom most sheets are fed off the stack. Member **10** is easily and cheaply manufactured and eliminates any special carriers and hand manipulations in multi-feeding. In addition it has been found that especially in radiant heat systems of fusing or fixing the image to sheet **12** to render the imaged sheet indefinitely useable, the paper backing aids in converting radiant energy to heat the non-fibrous, flexible surface to fuse images including loose toner images deposited in the process of xerography when deposited on translucent or transparent non-fibrous, flexible sheets. Absent the backing much of the radiant energy might pass through the transparency with minimal heating of the non-fibrous, flexible material itself.

Referring now to FIG. 2 there is shown a second article embodiment for feeding seriatim image receiving non-fibrous, flexible sheets from a supply thereof comprising a stack of said sheets **22**, immediately adjacent sheets being interleafed with sheets of paper **20** bound along a common edge by binding **21** and having cut away portions **23** to permit separating and advancing means for example rollers **41** in FIG. 3 to contact and advance seriatim non-fibrous image receiving sheets **22** into the imaging machine. As will be understood by those skilled in the art binding **21** is illustrative and many others are available for use herein. The cut out areas **23** correspond to the contact positions of the separating and advancing means and therefore will vary depending upon the spacing used in the particular sheet feed device. It is found that by so interleafing non-fibrous image receiving sheets **22**, the contact area between immediately adjacent non-fibrous sheets is minimized to make it possible to multi-feed said sheets seriatim from the top or bottom of a stack with a minimum of creep of contiguous non-fibrous sheets. Of course in utilizing this embodiment of the invention in those machines with a photocell misrouting detector the leading edges of substantially non-reflective image receiving sheets **22** may readily be made light reflective by a wide variety of means for example by equipping the leading edge of each sheet with a strip of paper or other light reflective material which may be detachable from the remaining portion of the image receiving sheet after imaging if desired.

The paper interleafs **20** with binding **21** after feeding of the non-fibrous sheets may be discarded or utilized for example as a tablet of paper. The cut out portions **23** may be removed from each sheet by cutting or severing along a crease or perforation included as a part of each sheet.

Ordinarily it is advantageous to have as much paper interleaf as possible between adjacent non-fibrous sheets to reduce actual contact of said sheets to a minimum but it may be expedient for example to adapt the invention to a particular imaging machine to further cut away portions of each sheet of paper interleaf. For example it is found to be expedient to diagonally trim corners of paper interleafs along lines **25** to adapt the second embodiment of the invention for use with the separating and advancing means of the Xerox 813 office copier more fully described in Trumbull Pat. 3,148,601.

Non-fibrous, flexible sheets **12** and **22** illustrated in FIGS. 1 and 2 may be almost any film formable, non-fibrous flexible material possessing sliding friction and

electrostatic properties such that when multi-fed seriatim from the top or bottom of a stack of said sheets there is substantially less creep of underlying sheets as a result of a paper backing associated with the sheets as described herein and shown in FIGS. 1 and 2, to effect more trouble and jam free operation of the particular imaging machine. The non-fibrous, flexible imaging sheets for use herein should preferably be less than about 6 mils in thickness in order to permit feeding as a unit with paper backing **14**, according to the first embodiment of the invention, through the sheet feed mechanism and the processing apparatus of a wide variety of imaging machines. According to the second embodiment because the sheet is fed and processed without any paper backing the non-fibrous sheets **22** may be up to about 10 or 12 mils in thickness and still be fed and processed by a wide variety of imaging machines.

Film formable polymeric materials are perhaps the most prominent group of materials useful as non-fibrous transfer sheets as described herein, which because of their sliding friction and electrostatic characteristics show markedly improved feeding characteristics when interleafed or backed with paper as described herein.

A preferred polymeric non-fibrous, flexible image transfer material for use in imaging machines has been found to be a polysulfone thermoplastic available in sheets of roughly 4 mils thickness under the trademark Rowlox from Rowland Products, Inc., Kensington, Conn. This material in sheet form is very transparent and may be fed seriatim and processed satisfactorily to receive a high quality image when interleafed or backed with paper as described herein.

A second preferred polymeric non-fibrous material for use herein is polyethylene terephthalate polysters transparent sheet material available under the trademark Mylar from the E. I. du Pont de Nemours & Co. and available in a wide range of thicknesses.

Many transparent as well as opaque polymeric materials are available in the art which may be formed into films to form image receiving sheets for use herein. Any suitable film formable polymeric material may be used. Typical transparent film formable polymeric materials include cellulose acetate, acrylics for example alphamethyl styrene copolymer, cellulose nitrate, epoxy resins, phenolics, phenol-formaldehyde, silicones, urethanes, urea-formaldehydes, polyesters for example polyethylene terephthalate, polycarbonates, cellophane, polychlorotrifluoroethylene copolymers, polyvinyl-butyral, polymethyl methacrylate, polystyrenes, polyethylene and others. Typical film formable polymeric materials which form films which are not necessarily clear or transparent include cellulose acetate (which may be clear, translucent or opaque), fluorohalocarbon, cellulose triacetate, cellulose acetate butyrate, polyurethane elastomer, cellulose propionate, ethyl cellulose, polypropylene, polyvinyl fluoride, vinyl-chloride-acetate copolymers, vinylidene chloride-vinyl chloride copolymer, tetrafluoroethylene available under the trademark Teflon from E. I. du Pont de Nemours & Co., copolymers of hexafluoropropylene and polytetrafluoroethylene, polyvinyl chloride, polyacrylonitrile, celulose nitrate plasticized with camphor, hard rubber such as ebonite and chlorinated rubber, nylons or polyamides, polyvinyl alcohol, polyvinylidine-fluoride, copolymers of chlorotrifluoroethylene and vinylidine fluoride, casein, polyglycols, alkyds and others.

Paper sheets utilized herein are of substantially the same area as the non-fibrous, flexible image receiving sheets and may comprise any conventional paper material.

Referring now to FIG. 3 there is illustrated partially schematically a xerographic type imaging machine of the type wherein the articles shown in FIGS. 1 and 2 have shown to have great utility.

In the imaging process of xerography for example as disclosed in Carlson Pat. 2,297,691 a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity that reaches them and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic powder image is usually transferred to a support surface, for example paper, to which it may be affixed by any suitable means.

The xerographic apparatus illustrated shows a xerographic plate comprising a photoconductive insulating light receiving layer on a conductive backing and formed in the shape of a drum **24** which is mounted on a shaft journaled in a frame of the machine to rotate in a counterclockwise direction to cause the drum surface sequentially to pass a plurality of xerographic processing stations. At charging station **26** a uniform electrostatic charge is deposited on the photoconductive layer of the drum for example by a corona discharge device as illustrated. Examples of typical corona discharge devices may be found in Vyverberg Pat. 2,836,725 and Walkup Pat. 2,777,957.

At exposure station **28** a light or radiation pattern for example of an image is projected onto the drum surface to dissipate the charged drum surface in light struck areas and thereby form a latent electrostatic image of the copy to be reproduced.

At developing station **30** a xerographic developer material **32** comprising electroscopic marking particles called "toner" of the type for example as described in Insalaco Pat. 3,079,342, 2,891,011 or Carlson Reissue Pat. 25,136 is caused to be contacted with the latent electrostatic image on the drum surface whereby the toner particles adhere to the electrostatic latent image to form a loose xerographic powder image on the drum in the configuration of the copy to be reproduced.

At transfer station **34** the loose powder image is contacted and electrostatically transferred from the drum surface to an image transfer member for example a non-fibrous, flexible image receiving sheet fed as described herein.

Thereafter the drum in its rotation passes drum cleaning station **36** whereat the drum surface is brushed to remove residual toner particles remaining thereon after image transfer to ready the drum and the machine for another image reproducing cycle.

At image transfer station **34** there is shown a sheet feeding mechanism more particularly described in Eichler et al. Pat. 2,945,434 adapted to feed seriatim non-fibrous, flexible sheets according to this invention to the xerographic drum in coordination with the presentation of the developed image on the drum at the transfer station. This sheet feeding mechanism generally designated **38** includes an image receiving member source such as a tray **39** to hold a stack of members, a separating and advancing roller or rollers **41** adapted to feed seriatim the top sheet or member of the stack to feed rollers **43** by frictional contact of rollers **41** with the top most sheet or member in the stack which directs the sheet material into contact with the rotating drum at a speed about equal to or slightly in excess of the rate of travel of the surface of the drum in coordination with the appearance of the developed image at the transfer station. To effect proper registration of the image receiving member with the feed rollers **43** and to direct the sheet transfer material into contact with the drum, guides are positioned on opposite sides of the feed rollers.

It is understood that the invention hereof may be em-

ployed with a wide variety of sheet separating and advancing means other than rollers **41**, such as vacuum gripper means for example as described in Williams Pat. 2,819,074 or Wagner Pat. 3,241,830, and other suitable sheet separating and advancing means known in the art.

The transfer of the powder image from the drum to the image receiving member is aided by means of corona charging device **40** which may be substantially similar to the device at charging station **26**, which is located adjacent the point of contact between the image receiving member and the rotating drum. The corona device creates an electrostatic field which is effective to attract the toner particles comprising the image from the drum and cause them to adhere electrostatically to the surface of the image receiving member.

Immediately subsequent to the point of transfer is positioned an image receiving member stripping apparatus or pickoff mechanism **42** for removing the image receiving member from the drum surface. As illustrated the device includes a plurality of small diameter multiple outlet conduits of a manifold that is supplied with a pressurized gas for example air by a pulsator operated by a suitable power means. The pulsator is adapted to force jets of pressurized gas through the outlet conduits into contact with the surface of the drum slightly in advance of the image receiving member to strip the leading edge of the member from the drum surface and to direct it onto an endless conveyor **44** whereby the member is carried to a fixing device for example heat fuser **46** whereby the developed and transferred xerographic powder image on the image receiving member is permanently fixed thereto.

After fusing the finished copy is discharged by rollers **48** to copy holder **50**.

Illustrated immediately subsequent to stripping apparatus **42** in the drum rotational sequence is photocell mispuff detector **52** which operates as previously described herein to receive sufficient light reflected back to the photocell from the paper backing **14** of an image transfer member according to a first embodiment of this invention or the light reflective surface of a non-fibrous member or a reflective leading edge of a translucent or transparent non-fibrous, flexible sheet according to a second embodiment of the invention to stop operation of the machine or to otherwise alert the operator to the mispuff.

The sheet feeding and imaging system illustrated in FIG. 3 is representative of the type employed in one of the most commercially successful imaging machines, the Xerox 914 office copier. According to a first embodiment of the invention members comprising polysulfone sheets of about 4 mils in thickness available from Rowland Products, Inc. and backed by a thin onionskin paper of about 1.5 mils in thickness or a standard copy paper supplied for use in the 914 copier of about 3.0 to 3.5 mils in thickness were stacked according to both article embodiments hereof in tray **39** of the 914 copier and were fed satisfactorily with no adjusting of the machine from the setting employed for paper transfer material.

It is to be noted that Rowland Products, Inc., expressly instructs that the polysulfone sheets it sells should be fed only a single sheet at a time and as intimated from these instructions it is found that said sheets do not multi-feed satisfactorily if fed from a stack of said sheets without employing the articles and methods of this invention.

Many other imaging machines employ sheet feed mechanisms for feeding sheets seriatim from a stack of sheets which makes them suited for employing the inventive embodiments disclosed herein. One such machine besides the Xerox 914 copier is the Xerox 813 copier wherein the thicker paper backings, greater than about 3 mils according to the first embodiment of the invention were found to be preferred with a combined non-fibrous sheet, paper backing thickness of not more than about 10 mils.

Any suitable imaging machine which employs a sheet feed mechanism for feeding sheets seriatim from a stack may utilize this invention to advantage to multi-feed non-fibrous, flexible sheets which do not feed satisfactorily without interleafing between adjacent non-fibrous sheets to decrease the coefficient of sliding friction and the electrostatic forces retarding advancement of sheets.

Although specific materials, dimensions and apparatus have been described in the above description of preferred embodiments of an article to feed seriatim non-fibrous, flexible sheets, other suitable materials and configurations as listed herein may be used with similar results. In addition other materials may be added to the non-fibrous, flexible materials or other materials listed herein or variations may be made in the various steps of sheet feeding or feeding apparatus described to enhance, or otherwise modify the invention. For example colorants may be added to non-fibrous, flexible sheets, for example films comprising polystyrenes to lend a colored hue to the imaged sheet.

It will be understood that various other changes in the details, materials, steps and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention will occur to and may be made by those skilled in the art upon a reading of this disclosure and such changes are intended to be included within the principle and scope of this invention.

What is claimed is:

1. An article to facilitate the feeding seriatim of image receiving non-fibrous, flexible sheets from a supply thereof comprising a plurality of generally rectangular sheets of paper of about the same size and in register in stack form, each sheet having at least one cut out portion adjacent one end thereof, the cut out portion and the sheets of said stack being aligned to permit contact of sheet separating and advancing means of a sheet feed apparatus with a non-fibrous, flexible sheet immediately beneath each sheet of paper, at least one common edge but less than all common edges of said sheets of paper secured by a binding, that end of said sheets having at least one cut out portion being free of said binding, immediately adjacent sheets of paper encompassing therebetween a single unsecured non-fibrous, flexible sheet of about the same size and in register with other non-fibrous, flexible sheets and with said sheets of paper whereby said sheet separating and advancing means contact and advance seriatim said non-fibrous, flexible sheets thereby separating seriatim said sheets from encompassing sheets of paper.

2. An article according to claim **1** wherein said non-fibrous, flexible sheets are equipped along at least their leading edges with a light reflective material.

3. An article according to claim **2** wherein said light reflective material is detachably secured to said sheets so that it may be removed after imaging, if desired.

4. An article according to claim **3** wherein said non-fibrous, flexible sheet is transparent.

5. An article according to claim **4** wherein said non-fibrous, flexible sheet is a material selected from the group consisting of polysulfone and polyethylene terephthalate polyester resins.

6. An article according to claim **2** wherein each sheet of paper, at that end of said sheet having at least one cut out portion, has diagonally trimmed corners.

7. An article according to claim **1** wherein said non-fibrous, flexible sheets have a thickness of not greater than about 12 mils.

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