Process Control Requirements for Combining the Printing Process and the USPS - Mail Requirements for Inline Direct-mail Production

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Abstract

Direct-mail produced directly off the end of a printing press has dramatic implications for direct-mail production. Recently inkjet printing has become more common creating a hybrid press. Hybrid-printing combined with inline finishing produce completed products ready to ship out the door. The most popular use of inkjet printing on press is addressing pieces that go in the mail. It is now commonly believed the majority of printing is mail that goes in the postal service mail steam. Individually addressed mail pieces directly off a hybrid-press seems like a process workflow improvement. But in contrast, with the United-States-Postal-Service (USPS) requirements for mail, addressing on press without automatic traying has not lived up to expectations and arguably it can be said it has been a productivity setback. Taking addressed mail pieces off press and traying in a separate area mail department area causes delays and allows for mistakes.

Combining the press department, which is a craft, with the mail department, which is procedural, into the small area at the end of the press, has many challenges. These challenges and the technical problems that had to be solved will be discussed in this paper. The reason it has taken many years to achieve the production of addressed mail directly off press will be investigated. Five or more different departments in the printing/mailing plant are affected by this process of Traying-On-Press-System (TOPS™). The traying of mail has many little known nuisances that complicate the entire process. The results are that rather than taking days to tray addressed mail in another department, mail is produced on press and in the mail trucks within the hour. Labor costs are dramatically reduced. TOPS is not a machine but an entirely new way of running a printing plant.

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Introduction

The combination of the Press-Department and the Direct-Mail department, Figure 1, is similar to other printing process combinations such as: bringing prepress in-house, acquiring trade-binderies and incorporating letter-shops. All this merging of talent, equipment and processes require mavens of many specialities to acquire new areas of expertise. Conflicting production requirements have to be resolved. Combining the press department, which is a craft, with the mail department, which is procedural, into the small area at the end of the press, is perhaps the greatest challenge to the printing process to date.

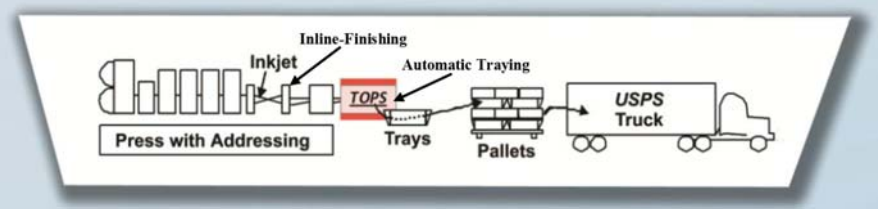


Figure 1: *USPS mail prepared on press*

Equipment

The equipment design challenges were not technically difficult given the background of the development team. The automation design was a combination of technology that had been developed for interfacing to digital printers throughout the 1990's and the combination of the interconnecting the islands of computer automation on web presses.

Beginning in the 1980's a new workflow was developed for web presses that allowed 100% monitoring and disposition of the good and the waste. Various features of digital equipment were incorporated into the traditional press equipment to provide all of the features needed by those two different printing process perspectives.

Figure 2: *Mail-trays, inline finishing on web press*

The new automation of mail production on press equipment also needs to accommodate the reality of today's market. This included the ability to handle large and varied types of direct-mail formats both in size, thickness, and construction. USPS mail is perhaps the most challenging paper handling components since they are often lumpy and bumpy and irregular in all aspects. The web press provides a unique opportunity with its formats of several products around the printing cylinder of the press and several products across the width of the web. All of these products need to be brought into a single stream, Figure 2, so they can merge into a single mail tray. Versions of this new architecture provide for dual stream outputs, for example a left and right traying system built into one common frame, provides for two separate product streams. And then of course two of these dual stream systems can be put side-by-side at the end of the press to accommodate four separate traying streams etc. Figure 3.

Figure 3: *Finished Mail-trays, and pallets*

Inserter Cassette

The equipment also needs to be mobile. It can quickly be moved press-to-press. Most direct-mail press production is only partly finished and needs to be combined with other pieces and inserted into an envelope. Only some jobs can be finished enough to go out the door with no further processing. A substantial amount of direct-mail pieces are needed for feeding mail envelope-inserters, which collate several products together before stuffing into an envelope.

To provide for work going to mail inserters, there is a patented cassette design (Patent: 6,663,100) which provides a bulk-feed mechanism for the envelope mail-inserters. Our equipment design made the traying end of the system modular so it could be undocked and moved away and an inserter-cassette filling system can be moved in and docked to the stacker. This allows quick changeover between product that is ready for the mail trucks and product that needs to go in mail-inserters.

Segregating waste

Printing processes would be delightfully boring if there were no waste. Dealing with waste is the central challenge. Process waste exists in two broad categories, product with and product without addressing. Addressed mail must be fully accounted for to achieve the goal of 100% of "everything addressed is mailed". There's really no technical or operational reason not to achieve this goal. All the means are available to allow this to be a reliable process.

Not-addressed product waste is caused by the various press functions such as: paper splicing, ink, water, registration, drying, slit ribbons, folding and cut off, Figure 4. Additional waste is design-waste including inspection and QC samples, all of which can be automatically diverted; so that they no longer become significant for the operators to account for or to be concerned about. The EFI AutoCount™ weighing of waste systems was one of our earlier patented solutions to this problem.

There's also a need for diverting of finished address products for the pressmen's need such as to inspect samples, to ensure that quality remains high. There are other requirements such as saving samples as per customer specific requirements. One of the solutions we have today is that the on-web inspection systems, Patent: 4,951,223 - are now of sufficient quality to accommodate inspection online without pulling individual pieces. This combined with the ability of adaptive process software to automatically sense and correct defects, significantly minimizes a difficult problem.

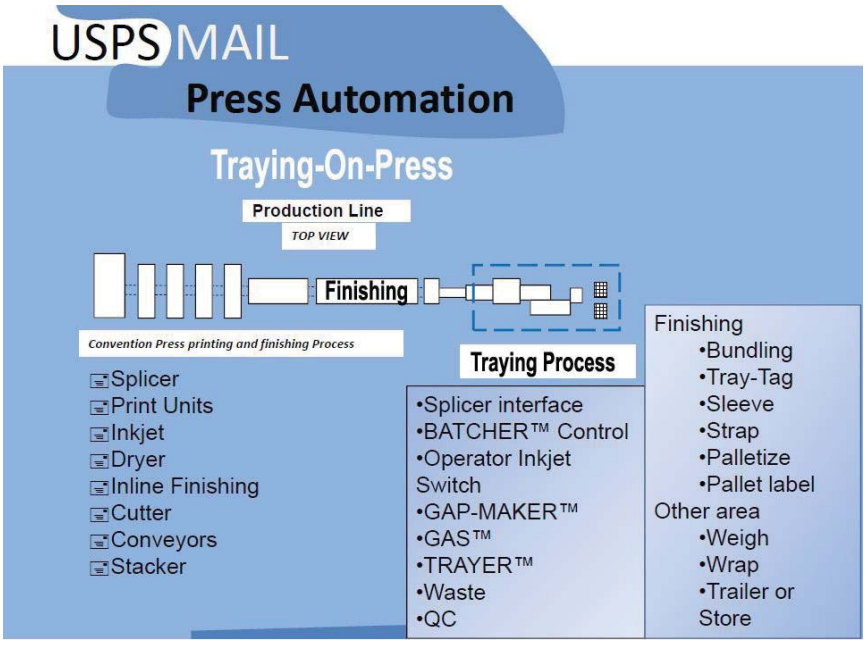


Figure 4: *Press Process for production of USPS mail*

Methods

With all the technical challenges a maven is needed on both the direct-mail side and the printing side to integrate all of the requirements and needs of the head pressman, the inkjet operator and the USPS postal affairs manager. Since all operations in the area around the press have traditionally been the responsibility of the pressmen, this finishing of mail on press requires the press crews to take on a new task of managing the direct-mail department that's now operating under the pressman's authority.

Adding additional people on press causes some initial conflicts since the focus for many years has been on reducing press crew sizes and manpower. Once mail trays and pallets of addressed prepared mail are produced on press, we have to increase the crew size to handle the material flow. We also need new procedures to deal with the inkjeting and the exceptions, so that 100% mail integrity is maintained.

Customers, direct-mail print buyer's needs

Mail must be sorted and packaged according to the "United-States-Postal-Systems (USPS) manual, called Direct-Mail-Manual (DMM). Any postal mistakes can cause an unexpected increase in postage or penalties. The advantage of the automated Traying-On-Press-System is elimination of humans touching the mail.

The benefits of traying-on-press to the printer are also the benefits of the printer's customers, the direct-mail buyer. Experienced print buyers have learned that certain requirements are more luck than intention. They have come to know printing and understand what is reasonable to expect from the process. However the market is maturing and technology is improving. The tools and techniques are now in place for leading competitive companies to retain their customers and grab a larger share of the market. This requires understanding what's valuable to your customers and providing it to them, in a profitable way.

There is a conflict between what the customers say they want, what they really want and what the printer can profitably give them! The emphasis should not be on "what a buyer asks for", but what a knowledgeable buyer would ask for, if they thought it reasonable. What do they hope for and dread if they don't get it in their direct-mail campaign? This assumes good quality and highly personalized messages are a given. Printers know how to get a great product out on time but what else is important with direct-mail production?

We interviewed the consultants who coach print/mail-buyers. We have discovered mail/print-buyers wish for three things but rarely achieve them.

Here are three significant goals for this next generation of direct-mail production methods.

1) 100% accuracy: Every name on the list goes in the mail stream. For 100% saturation class of mail; everyone in a geographical area gets their mail piece.

2) Reduced cycle-time: also known as turn-time or the turn-around, the time from when the content and format changes are frozen and the direct-mail pieces are in the hands of the addressees. In today's environment with the competition from the internet and online, the ability to get the product to the end user with the minimum preparation time is now imperative.

3) 100% mail piece integrity: No misuse of the piece or the information such as advanced leaking of content, using the coupons or information not as intended or altering the piece in a way not approved.

The inclusion and guaranteeing these three benefits to the media advertising buyer allows the printed and mailed message to compete with all forms of electronic commerce (e-commerce).

Workflow

An automation solution such as this is not a machine, it's an entire process we've come to call, the "Six-M's". Unless at least six areas of an organization are unctioning well, the entire automation process cannot function well. The Six-M's are: Machine, Material, Manpower, Maintenance, Methods and Management, Figure 5. Broken Machine, poor Materials, Manpower that doesn't care, inadequate Maintenance, ineffective Methods and Management that doesn't convey their goals; any one of these 6-M's can cripple the success of the automation process. The machine traditionally is blamed for everything, but it requires other's assistance, it's just a machine: can't turn itself on, can't fix itself and can't perform in a flawed environment.

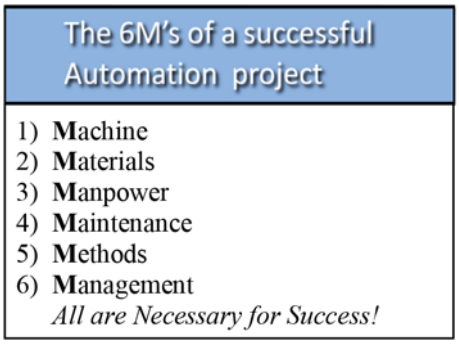


Figure 5: *System view of automation process*

Mechanical elements of the process

A web-press begins with a roll of paper that runs out every 45 minutes at press speeds. With automatic splicers we have non-stop operation, however the transferring of one roll to another changes the substrate and downstream affects the printing; so color, registration, folding and cutting accuracies are all affected by this change of paper. The initiation of the roll splice can be felt downstream by all the other processes. To ensure that during the splice time a few feet ahead and a few feet behind can automatically be accommodated or ignored. Other web items such as flame dryers, the flames may need to be extinguished during the moment the splice passes through so if there is a web break in the middle of the dryer, it does not cause a paper fire.

The Figure 4 shows the paper process flow and all the many elements that have to be dealt with in today's press operation. It's just a matter of implementation to make these systems accommodate the splice upsets. In many cases the best way to accommodate them is to divert the waste. Any attempt to adjust functions is futile since once a few of the roll's outer layers have been run, the internal condition of the paper returns to similar as the previous roll. This often is no more than a few hundred or so feet and these paper changing press conditions are often best avoided. Once the product is cut it drops onto conveyors all running at different speeds. We use a patented process to track product from any part of the entire web press to any other part, without actually looking at the product itself. This ensures 100% accuracy with no dependence on any printing quality such as registration marks Patent: 5,538,171. Once the product has been cut and laid onto the conveyor belt the first waste solution is a divert gate. But unlike traditional press divert gate designs, divert must happen on product boundaries, that is, it must divert all waste so the good product is saved on a specific addressed piece.

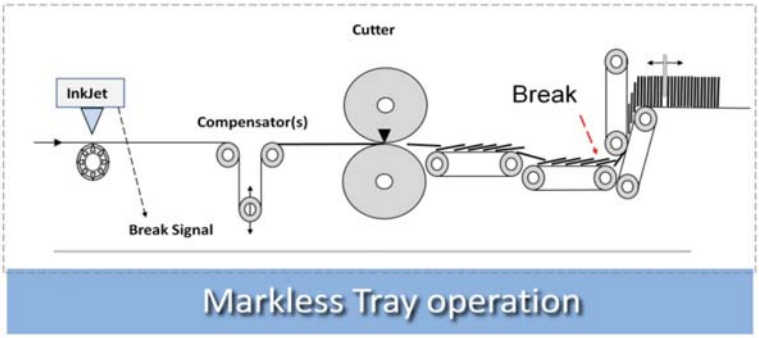


Figure 6: *Breaking on address boundaries without marks*

The next element is a gap-maker Figure 6. In order to separate the tray we need to create a gap in the flow of product. The address of the piece that is in the first and last of the tray must match the tray-tags exactly. The United States Postal Service discourages traying mistakes since they lead to significant delay in mail that may end up all the way across country, just because it ended up in the wrong tray.

The gap-maker for addressed products has new requirements over other traditional printing press gap-maker designs. First it's working at 200 pieces per second … that is five-hundred-thousand pieces per hour. That is a very fast mechanical on-demand impulse design. We hold the stream in the precise order delivered from the press. The gap-maker is computer-controlled so all the aspects of the mechanics and products are measured, monitored, and adapted to keep it running at absolute perfection. This also allows us to monitor what we call fail-soft. It is inevitable that all mechanical components wear. We identify problems before they affect the functionality of the process.

Direct-mail formed on press with inline finishing contains irregular products of different widths, glue-lines for attaching parts of elements of the paper, coatings and types of additives, addition of labels, die-cut and perforation; in other words it's lumpy and bumpy and forms a difficult stack. The stack is so difficult it is almost impossible for a person to grasp the stack and pick it up as the product is slippery, ill shaped and wants to explode all over the floor.

One of our secrets as to why this process is so successful is that we base it on a folder design that has been in wide use for more than 20 years and has matured to the point that the machinery and the operators understand how to deal with these complex mechanical issues and stack poorly formed products.

There are new requirements however to accommodate addressed pieces directly into mail trays, Figure 7. For instance this folder must restart automatically after a break in the product stream. Fortunately this problem was already solved when this type of stacker was used in digital printing, Patent: 5,366,212. Starting in the 1990's all of the necessary components to break product streams on individualized pieces were built into related digital stacker designs. We brought these digital designs solutions forward to the traditional press stacker designs to have the capabilities we required.

Our next folder requirement is to bundle and batch the products. The bundle varies in size and weight. This is accomplished with solutions from the digital stacker.

The next big breakthrough is our stack of mail pieces is put into a temporary container that completely encloses the product and carries it completely into the mail tray. Once the product stacks in the mail tray, the temporary enclosure expands and retracts without any stress on the stacking or handling of the products.

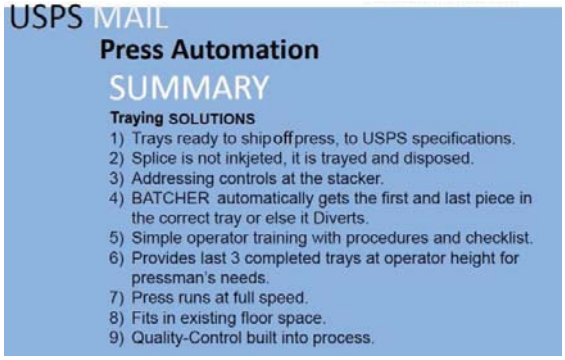


Figure 7: *Overall requirements for successful automation*

Mail trays

Postal-Trays in the United States are made from two types of material: coroplast or cardboard. They can be very difficult and in poor condition as they are moved long distances and used for many subsequent processes including storage in the back of a mail truck.

The goal that we set for USPS mail-trays quality requirements is similar to any material feeding goal, which is an operator believes that the integrity of the raw material meets a reasonably defined criteria, then we must feed it reliably. As an example: trays are typically pop riveted together and if the pop rivets are broken and the tray has no integrity then clearly it's not going to be able to hold the material.

Computer sensors and quality control (QC)

Quality control was built into the automation traying process by a little used technique of introducing periodic errors. These planned errors test the quality inspection process because if these errors are not caught when expected, the process is stopped and the QC detection problem is resolved. In other words, QC procedures and processes also need to be QC'd.

Manpower

An important breakthrough for realizing the viability of this insert on press mail production process was that there are operators needed just to bring the raw materials in and take the finished material out. So there is some labor that is required to remain in the process to stitch up all the loose ends Figure 8. One example is trayed mail must be sleeved and strapped. The strapper eventually runs out of material. If a spare strapper is available, that can be rolled into position quickly. A couple of people can handle all these processing issues. Therefore, it doesn't justify a return-on-investment to automate these last elements of the process.

The tray on press system allows addressed mail to come off the press and go out the door to waiting trucks rather than a traditional approach of 10 to 30 people, often in another building traying addressed pieces. We now have fully trayed product, untouched by the human hand.

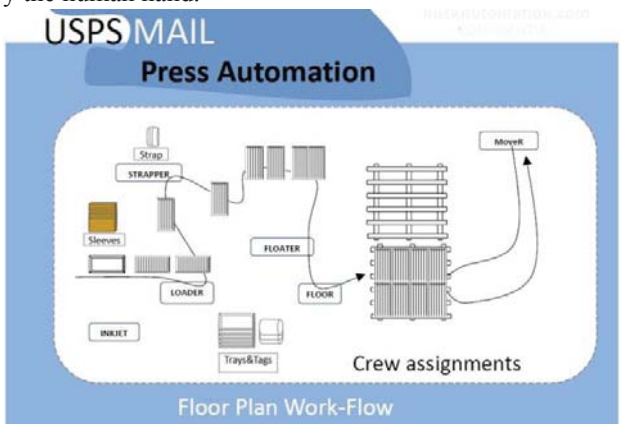


Figure 8: *Crew duties at end of press*

Mail inserters

Only part of all the mail a printer might produce can be completed on press, ready to go to waiting USPS trucks. The other output from a printing press is to go into envelope inserters. To accommodate the industry requirement, we've made the traying portion of the stacker modular with the ability to quickly be undocked and moved away. A new process was designed that allows for cassettes to be filled with press produced inserts. This patented process, Patent: 6,663,100 allows mail insert hoppers to be filled, not a handful at a time, but a thousand or more pieces at a time by a single insertion of a cassette into the envelope-inserter hopper.

The cassette, Figure 9 provides significant advantages to mail inserting as it eliminates many operational problems: 1) an inserted piece can go into a mail inserter hopper four different possible orientations; only one of which is correct, 2) inserts can end up in the wrong machine. Bar-coded cassettes ensure the correct product goes into the correct inserter for the correct job in the correct hopper in the correct orientation or else the automation process is halted.

Bar-coded cassettes also allow tracking pieces through the inserter for all types of management needs. One example is inventory. The precise inventory level is known at all times as the quantity in the cassette is known minus the usage and therefore the amount remaining in the cassette is known. Inventory management of mail production also allows tracking of quality problems since it's the equivalent of a manufacturing lot code, meaning that if there is a problem other products produced at the same time on that same process line can be isolated and removed for inspection to ensure that substandard materials are not in the process.

The cassettes also allow management to keep track of process flow such as: time-to-finish, productivity comparisons between personnel and machinery and comparison between estimates and actual cost when estimating a new job.

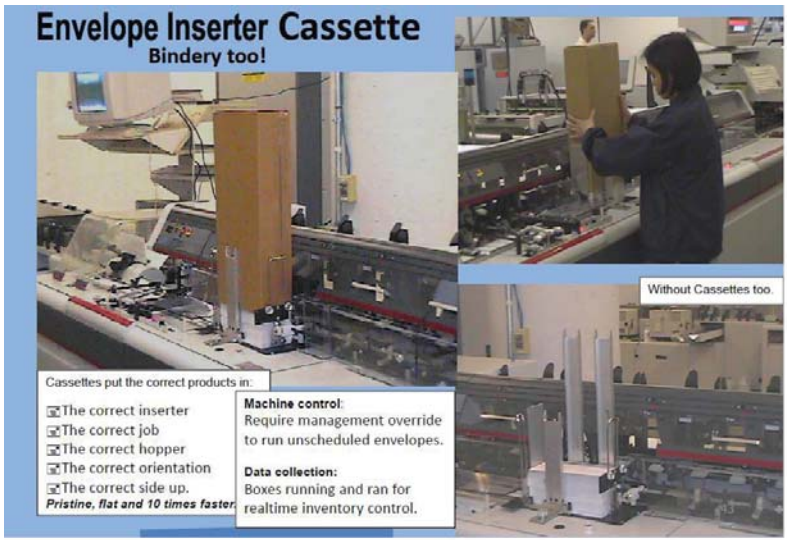


Figure 9: *Cassettes: loaded on press and mounted on inserters*

Conclusion

We have now brought the last major printing automation components inline, allowing a totally automated mail factory for the average web printer. This was achieved with a unique combination and arrangement of many proven elements.

The majority of all printing now goes in the mail, so therefore the majority of all printing production can now be automated.

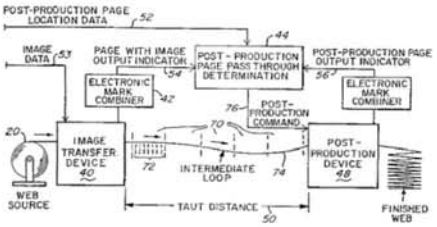
The combination of the new technology of computers, sensors and mechanical design components have all come together to allow total mail automation, untouched by humans, with a level of integrity and speed only dreamed of a few years ago.

An essential element to this success is an attitude that this can be accomplished with proven techniques and technology. Producing finished mail on press is not just a machine but a complete inline process. Owners and managers of printing companies realize that the time is now for technology to enable printing to not just survive, but to excel as a communication medium.

United States Patent
Crowley

Patent Number: **5.538.171**

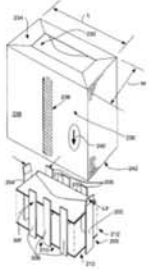
[54] **METHOD OF TRACKING WEB SEGMENTS FOR POST-PRODUCTION OPERATIONS**



United States Patent
Crowley

Patent No.: **US 6,663,100 B2**

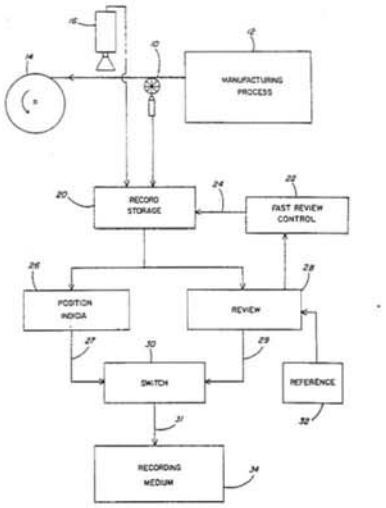
SYSTEM AND METHOD FOR SUPPLYING STACKED MATERIAL TO A UTILIZATION DEVICE



United States Patent
Crowley

Patent Number: **4,951,223**

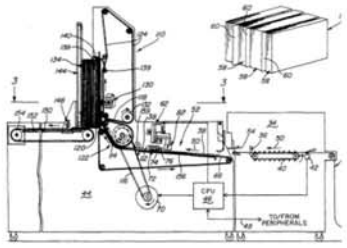
WEB MATERIAL INSPECTION SYSTEM



United States Patent
Crowley

Patent Number: **5,366,212**

WEB-FED SHEET STACKER AND SEPARATOR



United States Patent
Crowley

Patent Number: **6.113.344**

METHOD AND APPARATUS FOR SORTING STACKS