June 10, 1952 L. DE FLOREZ 2,600,215

WEB PERFECTING, FOLDING, AND CUTTING MACHINE WITH ENDLESS BAND PRINTING MEMBERS

Filed Jan. 4, 1947 2 SHEETS—SHEET 1

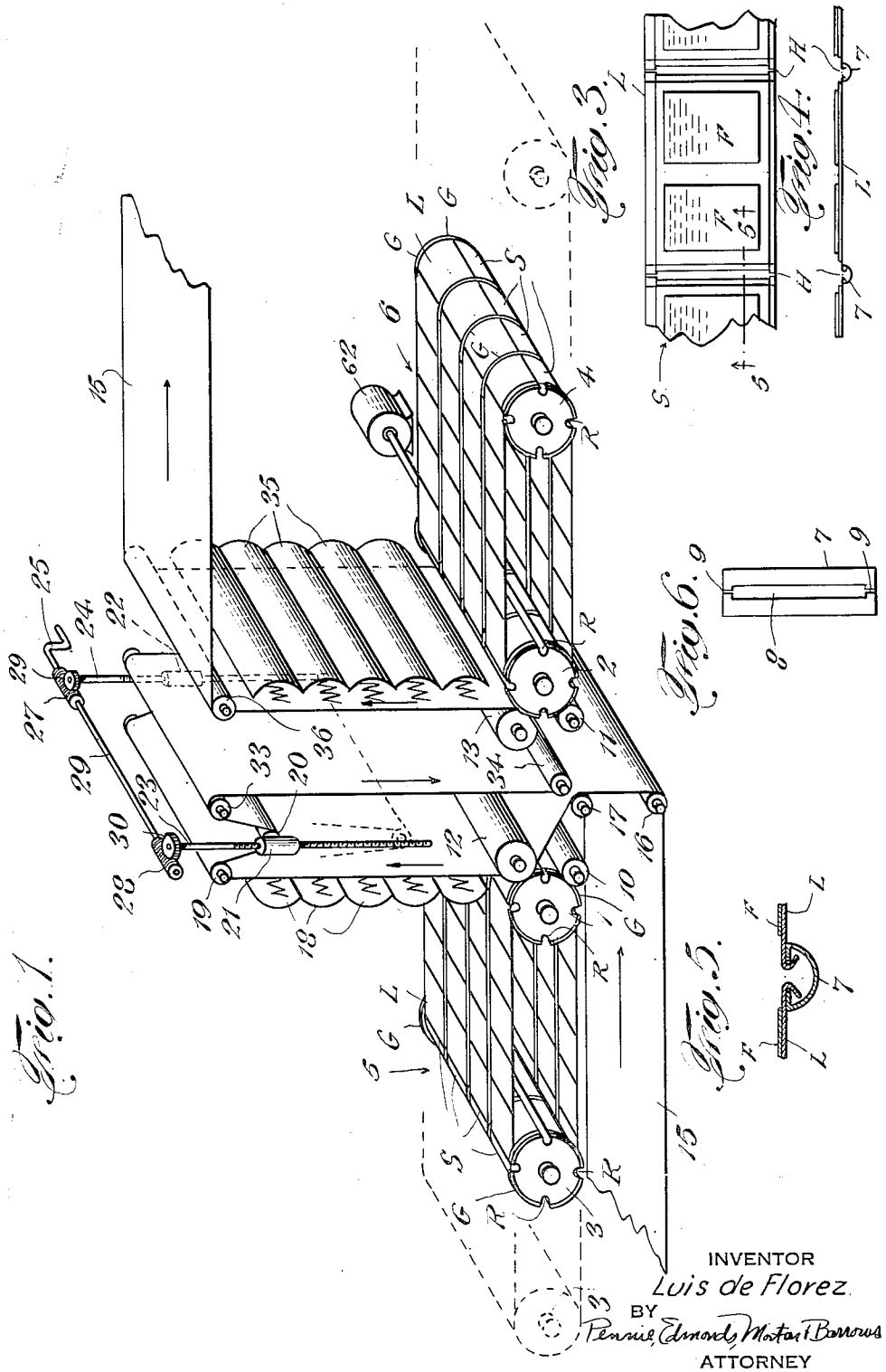


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 6.

Fig. 5.

INVENTOR
Luis de Florez
BY
Pennie, Edmonds, Morton & Barrows
ATTORNEY

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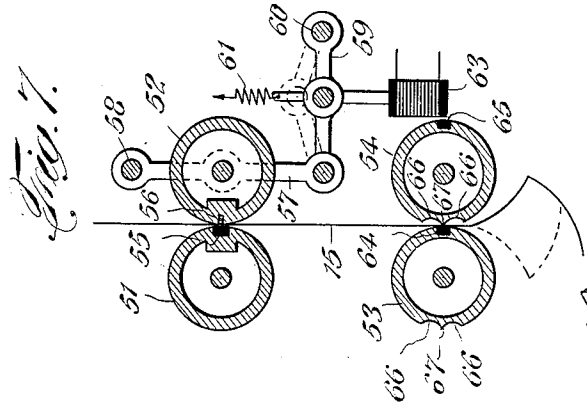


Fig. 1.

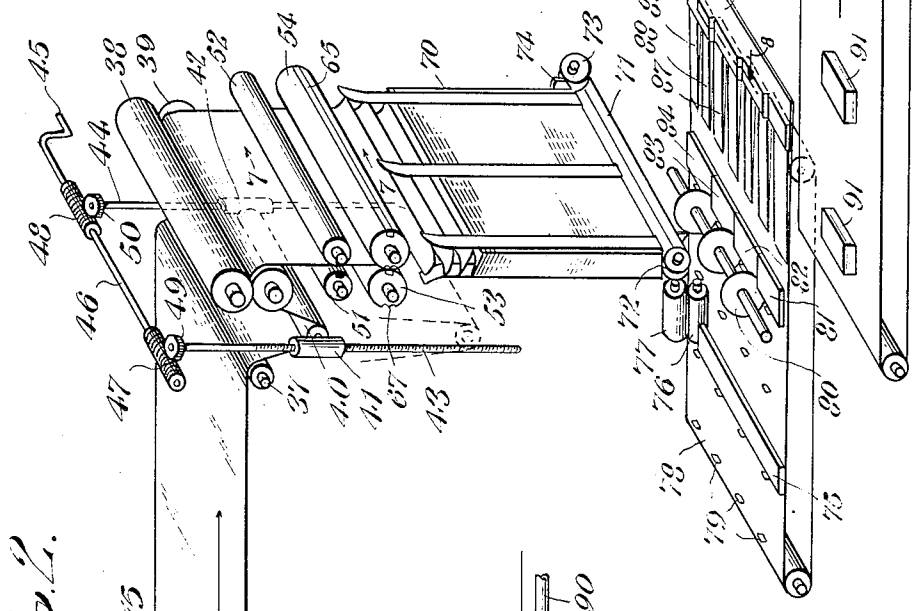


Fig. 2.

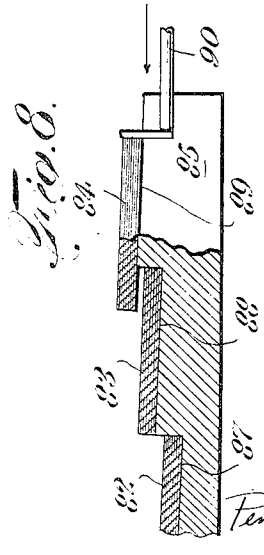


Fig. 3.

INVENTOR
Luis de Florez
BY
Pennie, Edmonds, Morton & Barrows
ATTORNEY

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UNITED STATES PATENT OFFICE

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WEB PERFECTING, FOLDING, AND CUTTING MACHINE WITH ENDLESS BAND PRINTING MEMBERS

Luis de Florez, New York, N. Y., assignor, by mesne assignments, to The de Florez Company, Inc., a corporation of Delaware

Application January 4, 1947, Serial No. 720,183

3 Claims. (Cl. 270—21)

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This invention relates to books and has for its objects the provision of an improved method of, and apparatus for, the manufacture of books. In accordance with one aspect of my invention, I print a moving web of paper on both sides in cyclic sections, each section comprising all the pages for a complete book, unless unduly large, by means of type set on endless belts. Another feature of the invention involves the zig-zag or accordion folding of the cyclic section into page sections and the cutting of the sections in a precisely arranged automatic operation.

In one of its more complete aspects, my invention provides a very simple and efficient means of printing any desired number of pages on a moving web in repeated cyclic sections, the cutting of the cyclic sections from the web, the accordion-like folding of the cyclic sections into page length folded units, and the arrangement of the folded units into page blocks ready for binding. I may print single rows of pages or multiple rows of pages in each cyclic section depending upon the size of the book. The folded units are compressed directly into blocks ready for binding when a single row of pages comprise the width of the web, or compressed and cut into several sub-page blocks when several rows of pages are printed on the web, said sub-page blocks being assembled in proper order into a single page block ready for binding.

One feature of the invention comprises the printing of one side of the web followed by rapid drying of the ink, printing on the opposite side of the web in a precisely controlled position on the web with respect to the first printing so that the printing on both pages of each leaf is suitably superimposed, and the adjustment of the moving printed web with respect to the folding and cut-off operations to effect the accurate folding between pages and cutting at the end of each cyclic section.

In the printing of the web in cyclic sections, whether in single or multiple rows of pages, in the accordion folding of the cyclic sections into folded units, and in the production of the blocks ready for binding, my invention provides the book industry with a simple operation of great flexibility which eliminates many of the difficulties and limitations in present printing and binding operations. In the succeeding operation of binding, and particularly in the arrangement of the folded leaves, the invention gives advantages in the direct utilization of the printed material, eliminating the present objectionable storage and assembly of portions of books incident to

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binding. I am able to convey the page blocks continuously as produced to the binding operation and thus I eliminate accumulations and storage which now plague the industry, and many of the expenses resulting therefrom.

One of the important steps or sub-divisions of a complete operation of my invention is the binding of the page blocks by adhesively connecting the folds together and to a cover. In accordance with this aspect of my invention, I arrange all the folds of the page block to embrace a common binding edge, and apply the adhesive to the folds of the binding edge to secure them together, and then adhesively connect the cover to the book.

It is one of the objects of this invention to provide a printing apparatus which, at each impression, provides all of the printed matter required for one ordinary book, say of not over 350 to 400 pages, and which, together with synchronously operated folding and cutting mechanisms, has as its end product a book copy ready for the binding operation.

The invention provides apparatus for effecting repeated printing cycles on a moving web, each cycle comprising a multiplicity of pages and automatically operated mechanical means for folding the resulting cyclic web section into accordion-like folds of page size or multiples thereof.

The apparatus of my invention comprises two pairs of cylinders, one cylinder of each pair being power driven, and an endless belt for printing mounted on each pair of cylinders, each belt comprising one or more type-belts, each type-belt being provided with means for printing one row of pages of the cyclic web section. The type-belts on one pair of cylinders are provided with page size type-forms for printing the web on one side and the type-belts on the other pair of cylinders are provided with page size type-forms for printing the web on the opposite side. The type-belts are of flexible construction preferably comprising interconnected readily separable links of any desired length, and the page type-forms attached thereto are preferably of rubber or of other flexible material. The links flex and conform to the cylinders which carry them. Each link may be the size of one or several pages and has mounted thereon one or several page type-forms of the actual printing characters. These links may be connected together by hinged joints, especially those which may be connected or disconnected with facility in changing from one printing operation to another. I have found it advantageous to use a coupling means which per-

forms the several functions of resiliently taking up slack, engaging the type-belts to the cylinders, and conforming the links to the cylinders. My invention provides for the printing of a web on the periphery of the type-forms as they travel over the circumference of the cylinder and in furtherance of this objective I arrange impression rollers in contact with the moving web to press the web into printing contact with the previously inked type-forms.

My invention provides an apparatus synchronized with the printing apparatus for cutting off the cyclic web sections, forming the sections into accordion-like folds, compressing them, and forming page blocks ready for binding.

These and other novel features of the invention will be better understood after considering the following discussion taken in conjunction with the accompanying drawings, in which:

Figs. 1 and 2 together comprise a more or less diagrammatic illustration of a complete apparatus embodying my invention;

Figs. 3 and 4 are enlarged fragmentary plan and side views, respectively, of an endless type-belt of Fig. 1;

Fig. 5 is an enlarged sectional view at 5—5 of Fig. 3;

Fig. 6 is a plan view of one of the linking members;

Fig. 7 is an enlarged fragmentary view at 7—7 of Fig. 2, and

Fig. 8 is an enlarged fragmentary view at 8—8 of Fig. 2.

The apparatus illustrated in the drawings comprises printing cylinders 1 and 2 corresponding somewhat to the cylinders of conventional rotary presses. These cylinders are securely mounted in fixed bearings for accurately aligned rotation and are power driven in synchronism. The idling cylinders 3 and 4 correspond in diameter and length to the printing cylinders and are mounted in adjustable bearing means (not shown) which permit moving the idling cylinders toward and away from the printing cylinders 1 and 2 for the purpose of space adjustment. The adjustment of the position of cylinders 3 and 4 is to accommodate endless belts 5 and 6 of varying lengths. These endless belts may be made of any suitable flexible material, such as steel or other metal, either as unitary members or in one or more sections S which I refer to as "type-belts." Fig. 1 shows endless belts, each comprising four identical type-belts. The number of type-belts is determined by the number of rows of pages printed on the web for one book. In the form of type-belts illustrated, the belt links L are formed in such size as to accommodate the type-forms F for two pages and are connected together with hinged joints H. The hinges serve as sprocket lugs and engage recesses R in the cylinders 1, 2, 3 and 4. These hinge lugs prevent creep of the belts and resulting misregister of the type with the paper web. It is advantageous to use links of such construction that in cooperation with the linking members 7 they form a slightly elastic connection to compensate for slight variations in the length of the type-belt. As best shown in Figs. 3 and 4, the links L carry type-forms F of flexible material. In one suitable form of type-belt, the type-forms are of vulcanized rubber cemented to the links. The type is preferably formed by molding the material of the type-forms F in any suitable manner. The links have hooks at the ends which are inserted in the opening 8 and are prevented from endwise displacement. Members 7 are preferably formed of spring steel and the slits 9 at the end permit adequate flexing to insure the elimination of slack.

Each of the type-belts is but little wider than the page to be printed. The edges of the type-belts travel around the cylinders 1 to 4 between annular ribs or guides G. Each type-belt, regardless of the number used, is secured in its proper location by the hinged lugs H which engage the recesses R in the cylinders and by the ribs G which prevent displacement in the axial direction of the cylinders. The belts traveling around cylinders 1 and 3 print one face of the paper web, while the belts traveling around cylinders 2 and 4 print the opposite side of the web.

The inking rollers 10 and 11 are mounted in positions with respect to rollers 1 and 2 so as to apply ink to the type-forms F in the usual way. The impression cylinders 12 and 13 of steel or other suitable smooth material are so located that they press the web of paper 15 into contact with the type-forms F on the type-belts. The web of paper 15 from a roll of paper (not shown) is drawn over the direction idler rollers 16 and 17 in the direction of the arrows and is guided between the type-forms F and the impression cylinder 12. To dry the ink in the short time available, the web is passed upward and in front of the radiant or other suitable type heaters 18 to the direction idler roller 19.

In order to maintain the web of paper in proper position so that the type-forms F on belt 6 will print in the precise position with respect to the printing on the opposite side a suitable means is provided to effect a lengthwise adjustment in the traveling web. The web is, accordingly, passed downward and around a floating compensating roller 20 which is mounted in threaded bearings 21 and 22 which travel up or down on the screws 23 and 24. These screws are rotated in either direction by a crank 25 on the shaft 26. The worms 27 and 28 on shaft 26 rotate gears 29 and 30, and thereby cause upward and downward travel of the adjustment roller 20 to effect a gradual advancement or retardation in the position of the web.

The web is then passed over the direction idler rollers 33 and 34 and between impression roller 13 and the type-forms F on belt 6. This operation prints the opposite face of the web in such manner that the printed matter on one page of a given leaf is superimposed over the printed matter on the opposite page of the leaf in the desired degree of register.

After the printing between roller 13 and the type-forms on belt 6, the web of paper is passed upward in front of the battery of radiant heaters 35 to dry the ink and then over the direction idler rollers 36 and 37 to the draw rollers 38 and 39 which pull the web through the apparatus just described. The rollers 38 and 39 are driven in synchronism with rollers 1 and 2. In order to maintain proper folding and cutoff in the next operation, the web is passed over the floating compensating roller 40. This roller is mounted in threaded bearings 41 and 42 which travel up and down on the screws 43 and 44. By means of the crank 45 the shaft 46 and worm gears 47 and 48 are rotated in either direction and the connected gears 49 and 50, accordingly, rotate the screws 41 and 42 to adjust the roller 40 so that the web will be folded at the proper place and cut off at the end of each cyclic section.

After passing between the draw rollers 38 and

39, the web passes between the flying shear rollers 51 and 52 and then between the folding rollers 53 and 54. The rollers 51 to 54 are driven in synchronism with draw rollers 38 and 39. The roller 51 has a longitudinal hard rubber bar 55 inserted in a peripheral slot which registers with a cutting blade 56 on roller 52. Roller 51 is mounted on a fixed shaft but roller 52 is mounted at each end on an arm 57 pivoted at 58. The link 59 is pivoted at 60 and when pulled upward by spring 61 to the position shown in broken lines, the cylinder 52 is swung away from contact with roller 51 and the blade 56 does not cut. The rotary switch 62 (Fig. 1) is driven by cylinder 2 and is provided with a system of internal gears which are so synchronized with the number of type-forms used that when the end of each cyclic web section passes between the block 55 and blade 56, the switch 62 energizes the solenoid 63 and the link 59 is pulled downward to the position shown in Fig. 7 in full lines. The knife is, therefore, carried into cutting contact with the block 55 and the cyclic web section is cut off at a position between the end of one section and the beginning of the next. The circumference of rollers 51 and 52 is equal to two folds, or in other words, to two-page widths so that the cut is never on the binding edge but on that edge which is trimmed off in binding the book.

The rollers 53 and 54 are the same diameter as rollers 51 and 52 but are provided with folding means for making two folds on each revolution. Each roller is provided with a longitudinally disposed peripheral insert 64 and 65 formed of resilient rubber. Each roller has a pair of adjacent longitudinally disposed peripheral grooves 66 with a knife edge 67 embracing the circumference of the cylinders. As the web of paper passes between these cylinders, the knife edges 67 press the paper into the rubber inserts 64 and 65 alternately first in one direction and then in the other to give the paper a zig-zag or accordion-like fold.

In printing the ordinary book, having up to, say, 350 to 400 pages, one complete travel of the type-belts prints the pages of the entire book and each time the blade 56 is moved into cutting position the section of web comprising the pages of an entire book is cut off. If the book is small, containing, say, thirty pages, only one type-belt for printing each side of the web is required. Where the book is larger, however, two or more type-belts, as required, are used on each set of cylinders. It will thus be apparent, therefore, that the web comprises either a complete book in one row of pages or a complete book in several rows of pages which must be assembled. Where several rows of pages are printed in each cyclic web section, the invention provides means for slicing the folded and preferably compressed folded units into sub-page blocks and the assembling of the sub-page blocks in the proper page order into page blocks comprising all the pages of a book ready for binding.

As the folded web leaves rollers 53 and 54, it falls into and accumulates in the hopper 70. The accordion-like folds become compressed closer and closer together under their own weight until they are compacted into a fairly dense structure at the bottom. The endless chain 71 which travels around the chain sprockets 72 and 73 is driven in synchronism with rollers 53 and 54. The chain travels under the hopper 70 and the cleat 74 on the chain engages the lowermost compressed and folded unit 75 and

pushes it out of the hopper. When the folded unit enters the bite of rollers 76 and 77, it is carried to the position shown and deposited on the chain belt 78. The spaced cleats 79 on the belt engage the folded units and carry them under the rotary saws 80 and the unit is cut into sub-page blocks 81, 82, 83 and 84. The chain belt 78 carries the blocks over a platform 85 having a series of inclined and step-like shelves 86, 87, 88 and 89, one for each sub-page block (Fig. 8). The belts 71 and 78 are driven in synchronism with cylinders 1 and 2 and also rollers 53 and 54 so that the folded units are pushed out of the hopper 70 and carried under the saws 80 and onto platform 85 at the rate formed. Plunger 90 is also operated in the same synchronism so that each time the sliced sub-page blocks reach the proper position on platform 85 they are pushed over each other and deposited as a complete page block 91 on conveyor 92. The page block 91 is passed to a binding operation which comprises, in its more complete aspects, setting the book pages between jaws or clamps of conventional types (not shown) which hold them together, adjusting the binding edge embraced by the folds of the pages, either as a flat surface or rounded, applying adhesive over the binding edge, applying crash over the adhesive and attaching the cover to the crash. In one preferred practice, folded end sheets are applied to the sides of the page blocks before they are held by the jaws. The end sheets usually comprise two leaves and have folds which are in alignment with the folds of the pages. The end sheets are attached to the crash and to the cover in binding the book.

The invention is not limited to the printing and binding of books having no more than 400 pages. The operations just described may be used in producing page blocks which comprise only part of a book, say, one-half. These fractional portions may be accumulated and combined with the other fractional portions formed in a similar operation. To avoid storage, identical machines may be operated side-by-side, one printing one portion of the book and the other the other portion of the book. The resulting page blocks may be assembled or combined in any suitable way incident to binding.

I claim:

1. The improvement in book printing machines which comprises two pairs of cylinders, at least one cylinder of each pair being power driven, at least one endless flexible type-belt on each pair of cylinders, type means for printing several pages of a book mounted on the type-belts, means for feeding a web of paper adapted to receive page impressions of a plurality of pages across its width into printing contact on one side with the type means of one type-belt and then the other side of the web into printing contact with the type means on the other type-belt whereby the web is printed on both sides, means for folding the printed web transversely in accordion-like folds, means for cutting off a folded unit of the web comprising a predetermined number of printed pages, means for compressing the folded section, and cutters for slicing the compressed section into page blocks for assembly into a book.

2. A continuous web perfecting press adapted for printing repeatedly on both sides of a passing web any selected one of a plurality of imprint pairs having various dimensions longitudinally of the web, comprising in combination, two groups of spaced rotatable means, at least one endless

type belt mounted on each group of rotatable means and adapted to carry printing plate means for respectively printing the imprints of a selected pair on opposite sides of a web, impression means disposed to coact with said type belts adjacent one of said rotatable means, means for directing a continuously moving web first in contact with the printing plate means of one type-belt, mounted on one group of spaced rotatable means and then into printing contact with the printing plate means of the other type-belt mounted on the other group of spaced rotatable means and adjusting means for accommodating the apparatus to effect application of imprints of the aforesaid various dimensions, said adjusting means including means for changing the spatial relationship of the spaced rotatable means of each of the two groups, to accommodate type-belts of various lengths and means for adjusting the length of web between the impressions to correspond to the length of the carrier.

3. A continuous web perfecting press adapted for printing repeatedly on both sides of a passing web any selected one of a plurality of imprinted pairs having various dimensions longitudinally of the web, comprising, in combination, two pairs of rotatable cylinders at least one cylinder of each pair being power-driven, at least one endless type belt mounted on each pair of cylinders, type means of printing several pages of a book mounted on the type-belts, impression means disposed to co-act with said type-belts adjacent one of said rotatable cylinders, means for feeding a web of paper into printing contact

on one side with the type means of the one type-belt and then the other side of the web into printing contact with the type means on the other type-belt and adjusting means for accommodating the apparatus to effect application of impressions of the aforesaid various dimensions, said adjusting means including means for changing the spatial relationship of the rotatable cylinders of each of the two pairs, to accommodate type-belts of various lengths and means for adjusting the length of web between the impressions corresponding to the length of the carrier.

LUIS DE FLOREZ.

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