(No Model.)

6 Sheets—Sheet 1.

J. T. HAWKINS.

WEB PERFECTING PRINTING MACHINE.

No. 332,518. Patented Dec. 15, 1885.

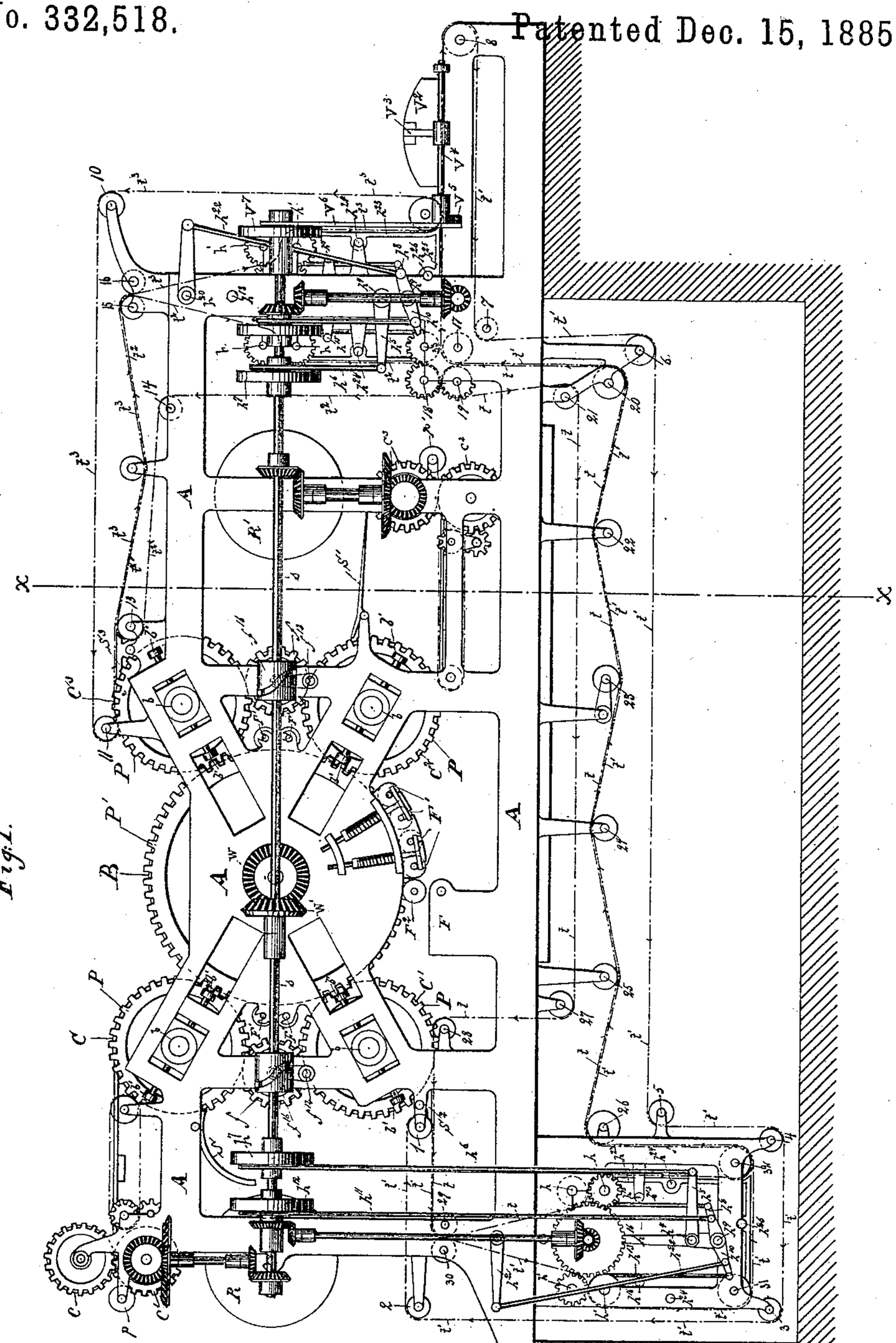

Fig. 1.

WITNESSES:

Frank. M. Ramney.

Francis P. Reilly

INVENTOR

John T. Hawkins

by Bordhead, King & Worthen

ATTORNEYS

(No Model.)

6 Sheets—Sheet 2.

J. T. HAWKINS.

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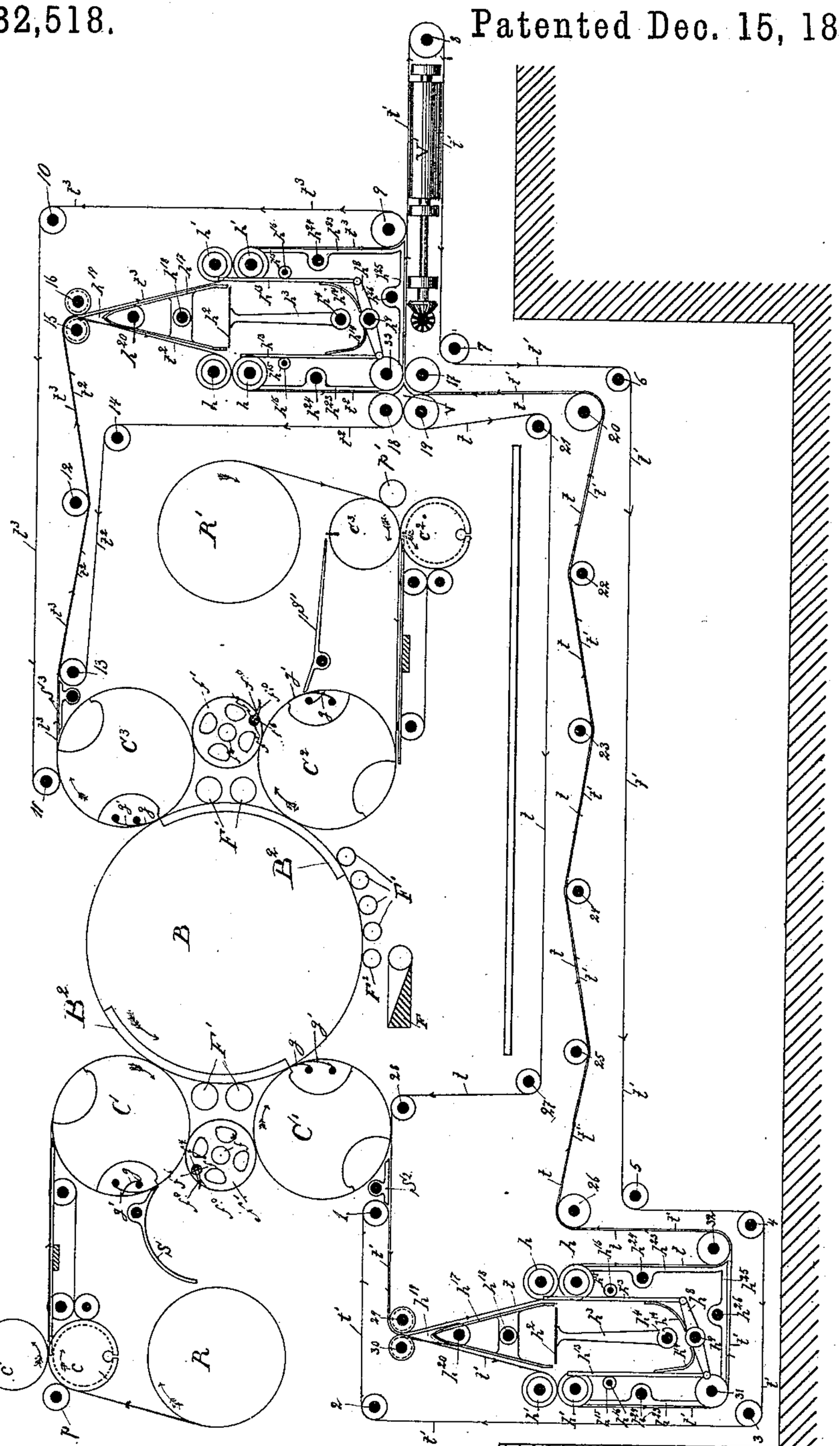
No. 332,518. Patented Dec. 15, 1885.

Fig. 2.



WITNESSES:

Frank. M. Ramey.
Francis P. Riley

INVENTOR

John T. Hawkins
by Brodhead, King & Workes
ATTORNEYS

(No Model.)

6 Sheets—Sheet 3.

J. T. HAWKINS.

WEB PERFECTING PRINTING MACHINE.

No. 332,518. Patented Dec. 15, 1885.

Fig. 3.

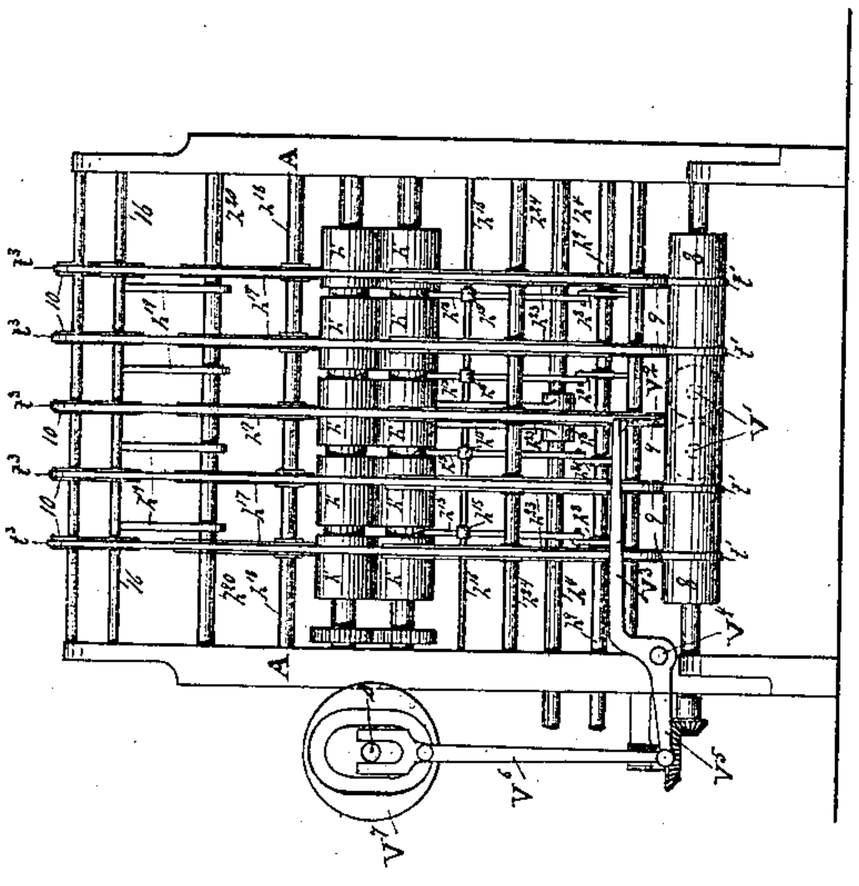
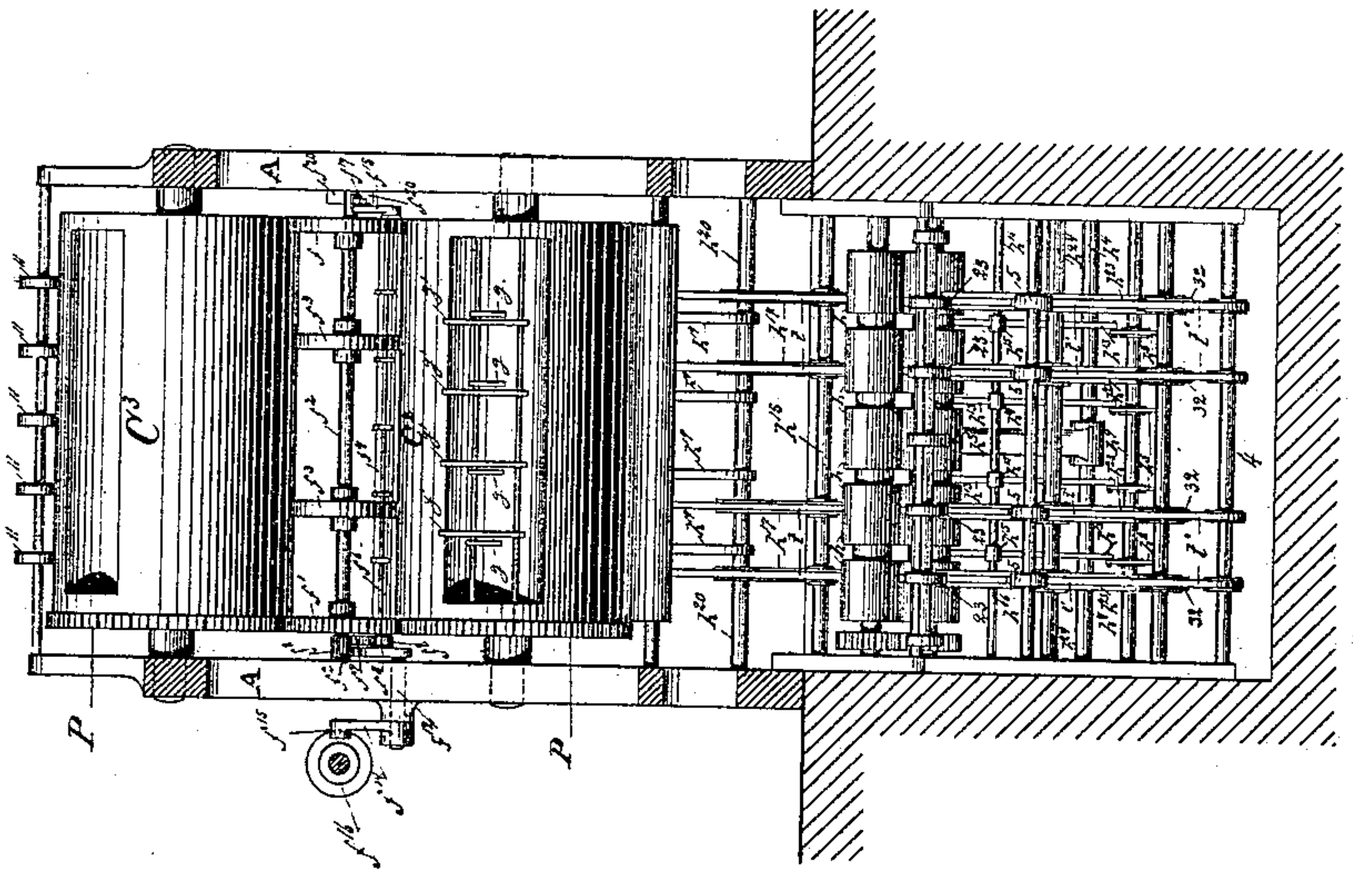


Fig. 4.
Profile xx.



WITNESSES:
Frank. M. Ramey.
Francis P. Reilly

INVENTOR
John T. Hawkins
by Brodhead, King & Voorhees
ATTORNEYS

(No Model.)

6 Sheets—Sheet 4.

J. T. HAWKINS.

WEB PERFECTING PRINTING MACHINE.

No. 332,518. Patented Dec. 15, 1885.

Fig. 5.

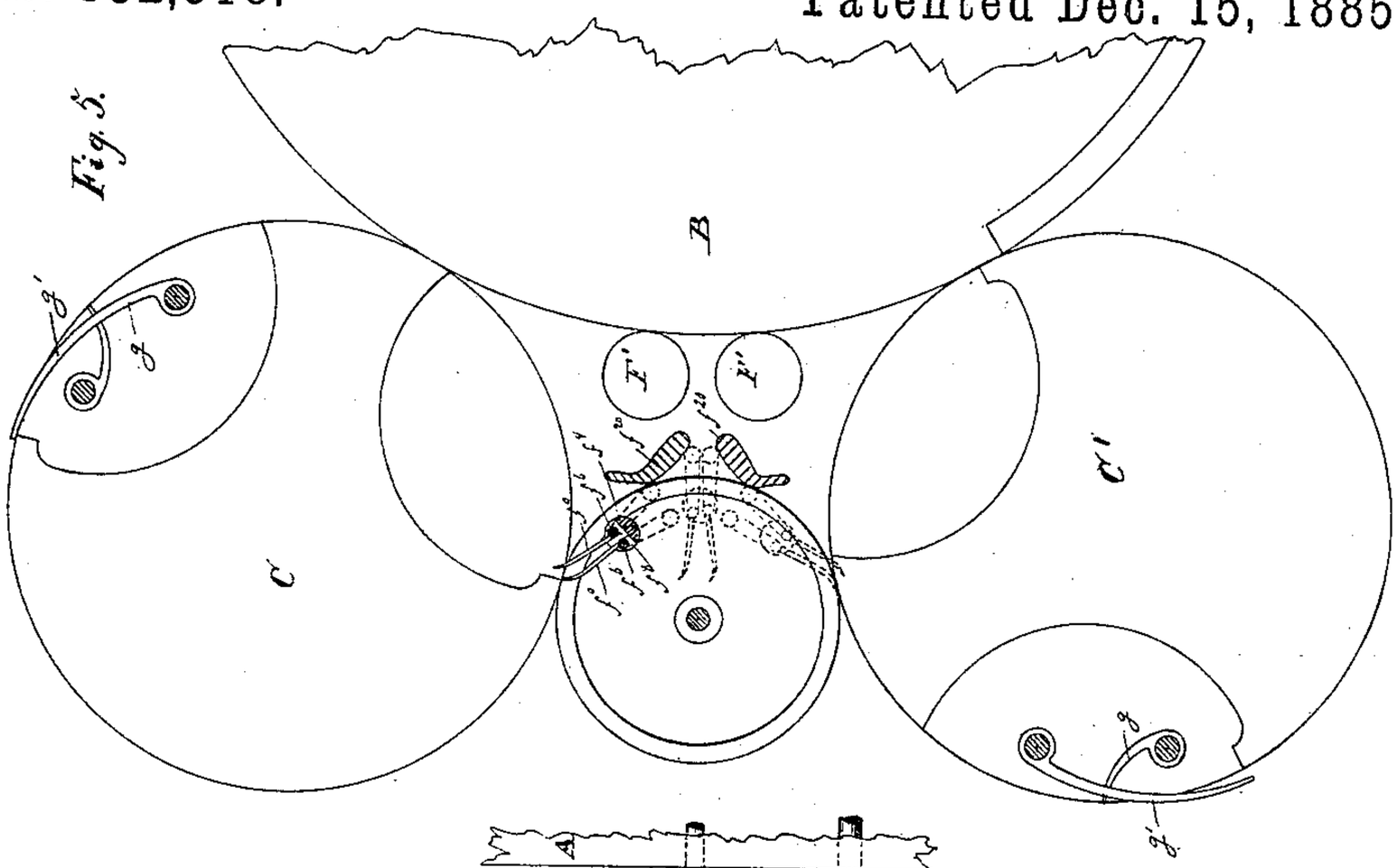


Fig. 9.

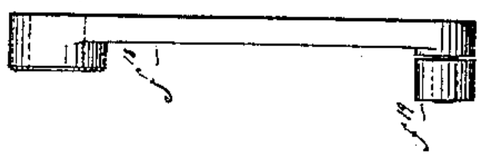


Fig. 6.

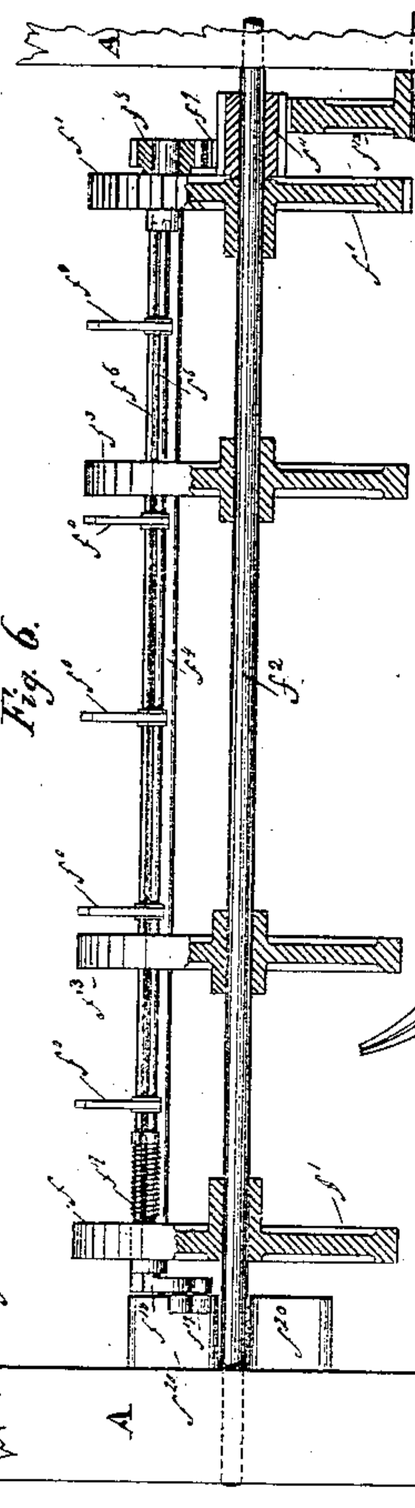


Fig. 7.

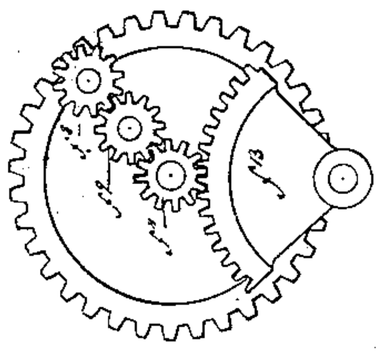


Fig. 8.

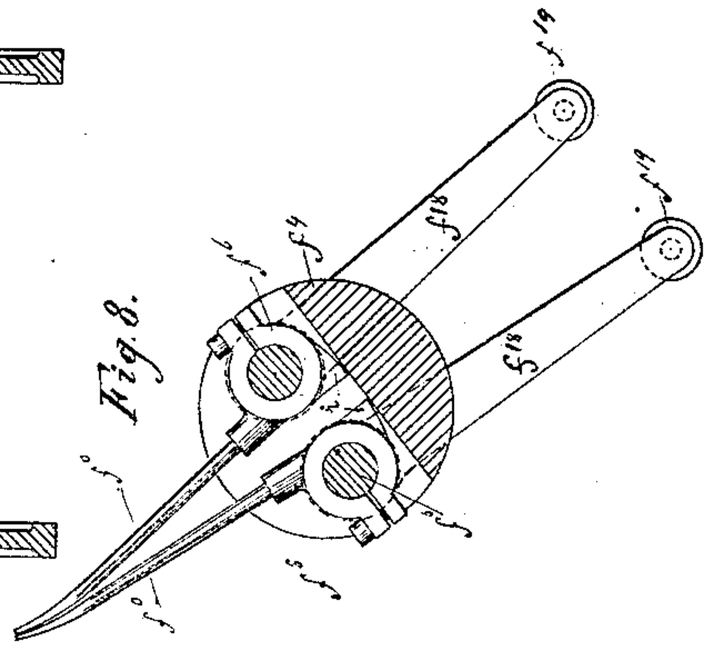
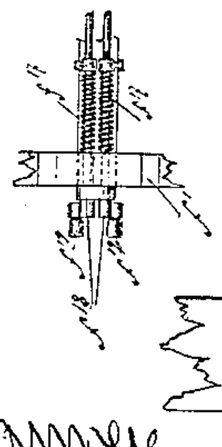


Fig. 10.



WITNESSES:

Frank M. Ramey.

Francis P. Reilly

INVENTOR

John T. Hawkins

by Brodhead, King & Worthen

ATTORNEYS

(No Model.) 6 Sheets—Sheet 5.

J. T. HAWKINS.

WEB PERFECTING PRINTING MACHINE.

No. 332,518. Patented Dec. 15, 1885.

Fig. 11.

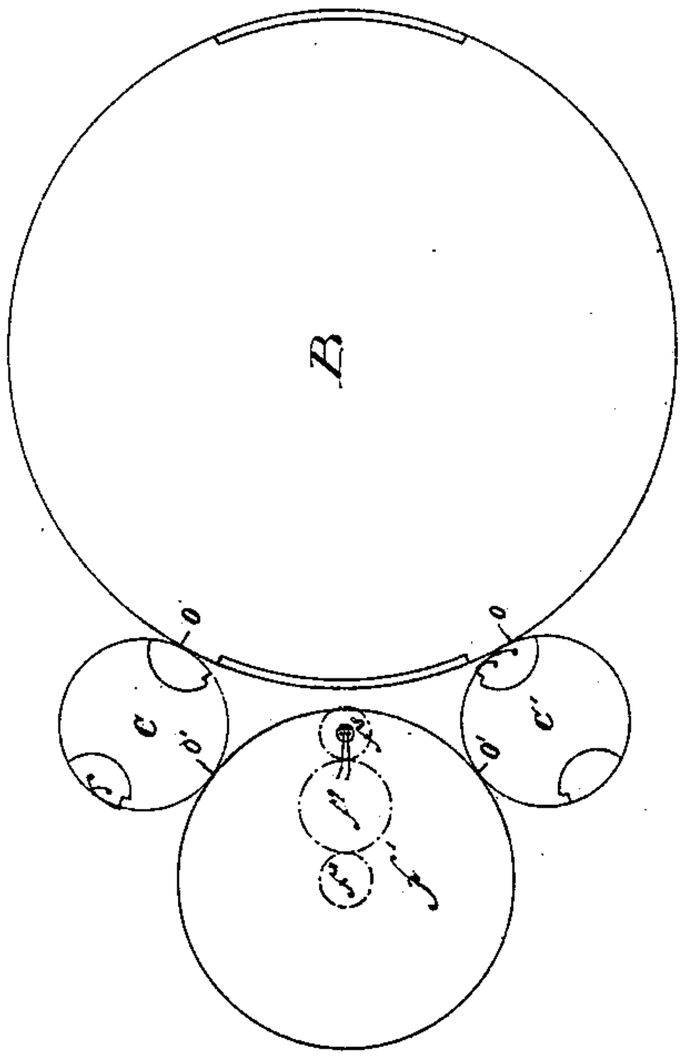
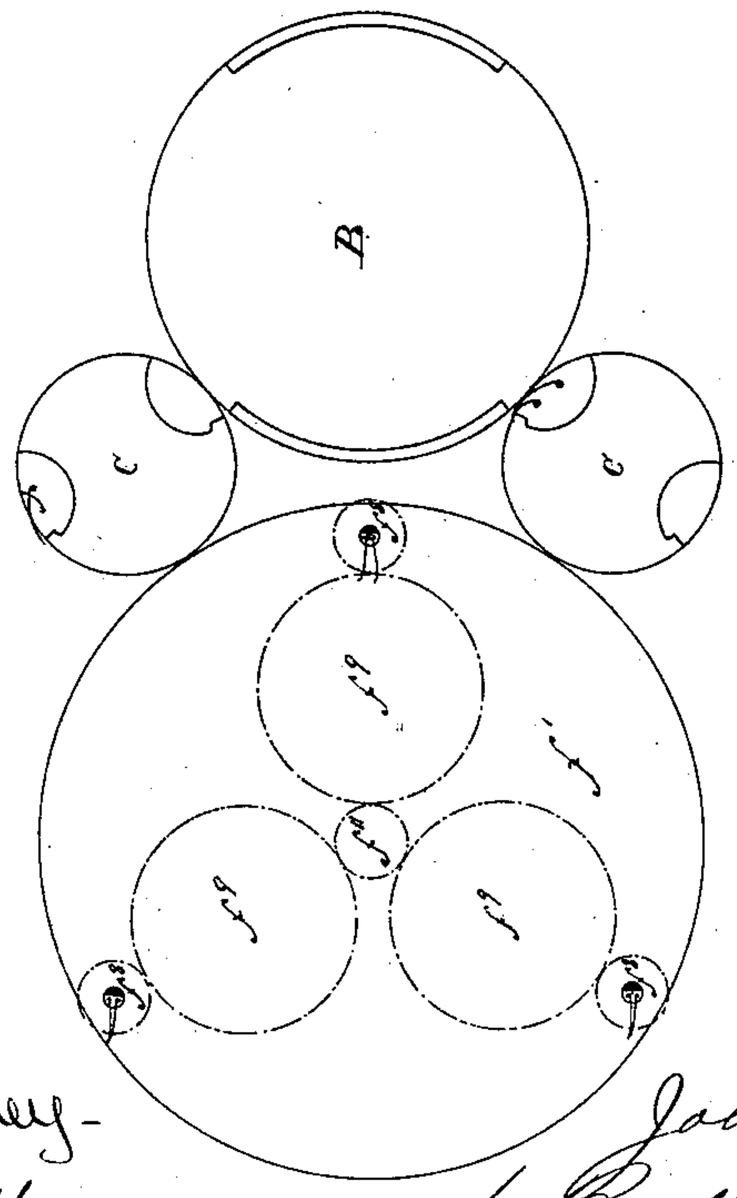


Fig. 12.



WITNESSES:

Frank M. Ramney

Francis P. Reilly

INVENTOR

John T. Hawkins

by Brodhead, King & Voorhees

ATTORNEYS

(No Model.)

6 Sheets—Sheet 6.

J. T. HAWKINS.

WEB PERFECTING PRINTING MACHINE.

No. 332,518. Patented Dec. 15, 1885.

Fig. 13.

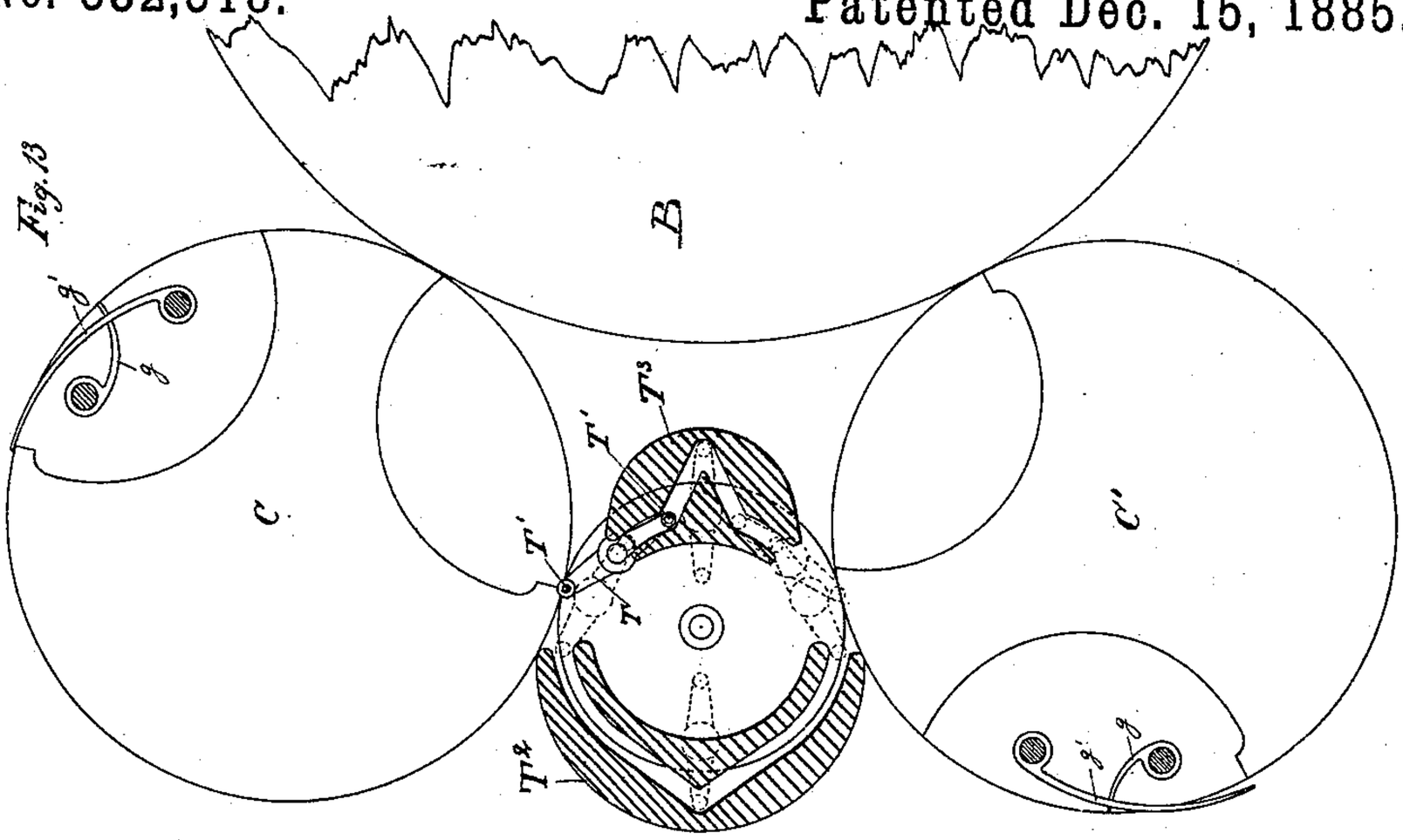
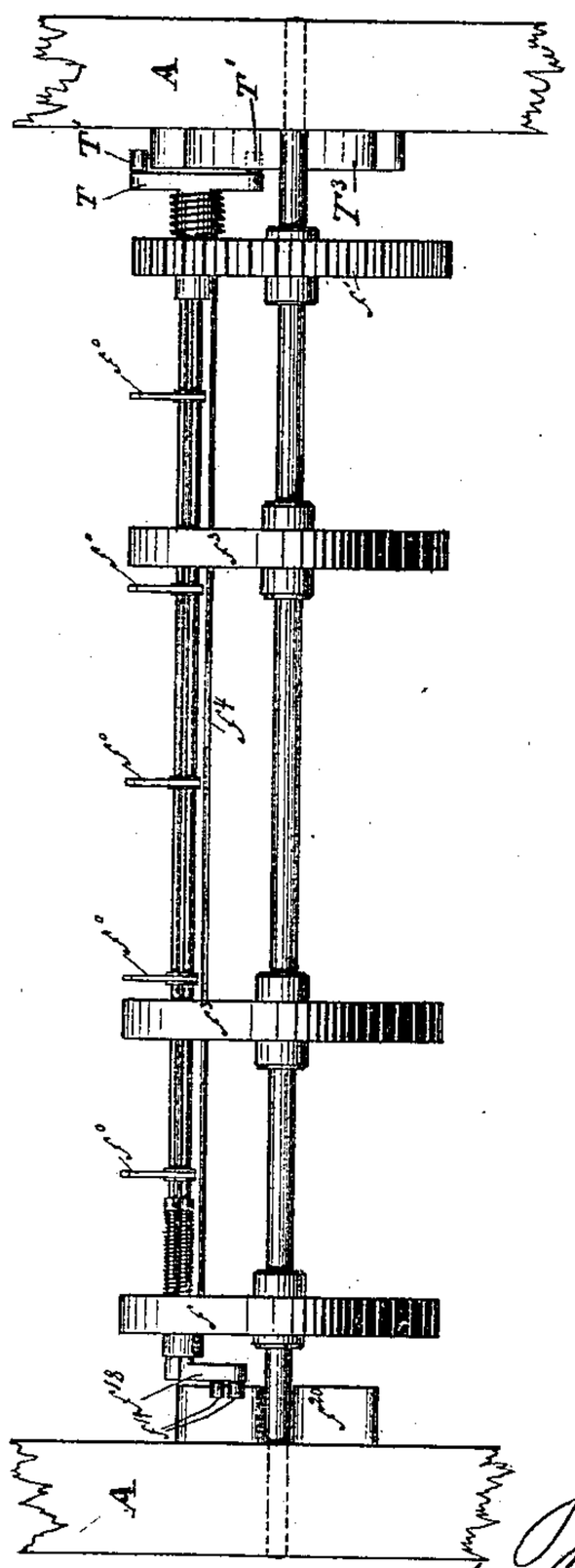


Fig. 14.



WITNESSES:

Frank W. Ramey.

Francis P. Reilly

INVENTOR.

John T. Hawkins

by Brodhead, King & Bonnell

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN T. HAWKINS, OF TAUNTON, MASSACHUSETTS.

WEB-PERFECTING PRINTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 332,518, dated December 15, 1885.

Application filed February 18, 1884. Serial No. 121,083. (No model.)

To all whom it may concern:

Be it known that I, JOHN T. HAWKINS, a citizen of the United States, residing at Taunton, in the county of Bristol and State of Massachusetts, have invented certain new and useful Improvements in Web-Perfecting Printing-Machines, which invention or improvement is fully set forth and illustrated in the following specification and accompanying drawings.

The object of the invention is to provide a machine to print on both sides of the sheets, cut from one or more continuous webs of paper, which machine shall deliver the perfected sheets either flat or properly folded, as may be desired, performing the whole in a rapid and correct manner. This object is effected by cutting the sheets from the web or webs before printing and providing a simple means of reversing the separate sheets after the first side is printed, so as to present their second sides to the form.

This invention may be regarded in some respects as an improvement on Patents Nos. 272,834 and 272,835, granted to me February 20, 1883, the moving of the impression-cylinders away from the type or plate cylinders to avoid alternate forms, as therein practiced, being herein dispensed with and the forms caused to print at every passage by an impression-cylinder, thus doubling the capacity of the machine constructed as shown in the patents above mentioned.

The invention consists, principally, in a novel form of sheet-reverser, which transfers the sheet from the first to the second impression-cylinder, while reversing it, without any sudden arrest of its motion, thus permitting of the single sheets being conveyed from one impression-cylinder to the other and reversed at high speeds.

In the accompanying drawings, Figure 1 is a side elevation, Fig. 2 a longitudinal vertical outline section, and Fig. 3 an end elevation, of the delivery end of the machine. Fig. 4 is a transverse vertical section through *x x*, Fig. 1, looking toward the type or form cylinder. In Figs. 3 and 4 sundry parts of the machine are omitted which would otherwise come in view, for the purpose of clearness in illustrating the essential parts. Fig. 5 is an enlarged outline longitudinal vertical section, partly through the left-hand pair of impression-cylinders and the sheet, and wholly through the reversing and conveying apparatus, Fig. 1; and Fig. 6 is an end view, partly in section, of part of Fig. 5. Fig. 7 is an end view at the right-hand end of Fig. 6, with the part of the main frame A shown in Fig. 6 removed. Fig. 8 is a transverse section, enlarged, of the gripper-carrier. Fig. 9 is a side elevation, enlarged, of one of the levers secured to the twin gripper-shafts. Fig. 10 is a view in plan of one end of the twin gripper-shafts, showing the position of the springs which operate to close the twin grippers upon each other. Figs. 11 and 12 are outline longitudinal vertical sections of a part of the machine, shown in two modifications, for purposes hereinafter explained. Fig. 13 is an outline longitudinal vertical section through a portion of the machine, illustrating a modification in the method of operating the reversing and conveying apparatus; and Fig. 14 is an end view of part of Fig. 13.

In said drawings, referring to Figs. 1 to 10, inclusive, the letters A indicate the main frames of the machine; B, the type or form cylinder, carrying the two forms B′ B², one for each side of the sheets to be printed, and C C′ C² C³ impression-cylinders. F indicates the ink-fountain; F′, form-inking rollers, and F² an ink-ductor roller.

The mechanism for operating the inking apparatus is omitted, as not essential to this invention.

The cylindrical surface of the type or form cylinder not occupied by the forms B′ B² serves for distributing-surface, and is on the same level as the form. The impression-cylinders C, C′, C², and C³ are half the diameter of the type or form cylinder B, about half their periphery being impression-surface and the other half made up of gaps for the grippers, reel-rods, and cylindrical surface between the gaps, which latter surface, not being covered by a blanket or tympan, escapes contact with the distributing-surface of the type or form cylinder. The type-cylinder B is geared to the impression-cylinders C C′ C² C³, so as to make their peripheral velocities equal, in the usual way.

R R′ indicate the rolls from which the webs of paper are fed to the machine.

The letters *c c′* and c^2 c^3 indicate two pairs of sheet-cutting cylinders for severing the sheets as they are fed to the grippers of the impression-cylinders C and C^2, respectively. This cutting apparatus is fully described in the patents granted to me, above mentioned.

The letters *p p′* indicate pressure-rollers to prevent the web falling back as the sheets are severed from them. The journal-boxes *b* carry the impression-cylinders C, C′, C^2, and C^3, sliding in rectangular openings in the frames A, and adjusted by the set-screws *b′*. The impression-cylinders each carry a spur-gear, P, meshing with a corresponding spur-gear, P′, on the axis of the type or form cylinder B. The impression-cylinders C C′ C^2 C^3 are each provided with the usual grippers, *g*, and with lifter-fingers *g′*, the method of operating neither of which is shown, as not essential to this invention; but it may be done in many well-known ways.

S and S′ indicate each a series of stripper-fingers for stripping the head of the sheet from the impression-cylinders C and C^2, respectively, after the printing of the first side, and S^2 and S^3 also indicate each a series of stripper-fingers for stripping the then head of the sheet (being the tail before) from the impression-cylinders C′ and C^3, respectively, after the printing of the second side.

The letters *f f′* indicate pairs of wheels secured to the shafts f^2, one, *f′*, in each pair forming a spur-gear engaging or meshing with gears P on the impression-cylinders C, C′, C^2, and C^3. Two or more plain wheels, f^3, of the same outside diameter as the wheels *f* or of the diameter at the pitch-line of the spur-wheels *f′*, are secured to the shafts f^2. Journaled in the pairs of wheels *f f′* and in the wheels f^3 are two oscillating gripper-carriers, f^4 and f^5. In each of the gripper-carriers f^4 and f^5 are journaled two gripper-shafts, f^6. On one end of the gripper-carriers f^4 and f^5, respectively, is secured a spur-pinion, f^8. Upon a stud in each spur-gear *f′* runs an intermediate pinion, f^9. On the shaft f^2 is journaled for each gripper-carrier f^4 and f^5 a wide-faced pinion, f^{11}, gearing on one-half its face with the intermediate pinion, f^9. On a short rock-shaft, f^{12}, journaled in the frames A, for each of the gripper-carriers f^4 and f^5, is secured to its inner end a sector-gear, f^{13}, gearing with the other half of the face of the pinion f^{11}, and on its outer end a lever-arm, f^{14}, carrying a roller, f^{15}. The rollers f^{15} engage cams f^{16}, said cams being secured to the longitudinal shaft *s*. On each pair of the twin gripper-shafts f^6 are secured pairs of twin grippers f^0, closing upon each other at the points by means of the springs f^{17}. The hubs on each of these grippers f^0 are made so as to form a stop, *i*, resting upon the gripper-carriers f^4 and f^5, to prevent one of each pair of grippers f^0 from following the other when either shall be opened, as shown at *i*, Fig. 8. On each twin gripper-shaft f^6, outside of the wheel *f* of each pair of wheels *f f′*, is secured a lever-arm, f^{18}, each carrying a roller, f^{19}. To the frame A is secured two stationary cams, f^{20}, opposite the wheel *f* of the pairs *f* and *f′*, and in position to engage the rollers f^{19}.

For each pair of impression-cylinders is a folding apparatus for making the first fold in the sheets, and as they are duplicates of each other in all that relates to the making of the said first fold, a description of that apparatus receiving the sheets from the cylinders C^2 and C^3 will suffice for both until the description is reached of the mode of transferring the sheets from all four impression-cylinders to a common point to perfect their folding.

The letters *h* and *h′* indicate each a pair of folding-rollers, and h^2 indicates a double oscillating folding-blade secured to an arm, h^3, oscillating upon a rock-shaft, h^4, to which an arm, h^5, is secured, which in turn is operated by a rod, h^6, carrying on its upper end a roller (not shown) engaging a grooved cam, h^7, upon the shaft *s*. The folding-blade h^2 is thus made to alternately enter the bite of the pairs of folding-rollers *h h′*.

The letter h^8 indicates a series of double equal-armed levers attached to a rock-shaft, h^9. To rock-shaft h^9 is secured at one end a double equal-armed lever, h^{10}. To one end of this arm h^{10} is articulated a rod, h^{11}, carrying on its upper end a roller (not shown) engaging a grooved cam, h^{12}, on the shaft *s*.

The letter h^{13} indicates a series of guide wires or rods, pivoted at their lower ends to the levers h^8, and h^{14} indicates a series of springs operating to keep the guide-rods h^{13} pressed outward against a series of rollers, h^{15}, carried on shafts h^{16}. The upper ends of the guide-rods h^{13} pass into grooves in the rollers *h* and *h′*, so that their surfaces are just above the peripheries of these rollers.

The letter h^{17} indicates a series of stationary guide-rods supported upon a stationary shaft, h^{18}, and extended downward till their lower ends just clear the folding-blade h^2. Their upper ends pass below the surface of a series of switches, h^{19}, secured to a rock-shaft, h^{20}. On the outer end of the rock-shaft h^{20} is secured an arm, h^{21}, which is connected by a rod, h^{22}, to one end of the double lever h^{10}, and therefore the switches h^{19} are operated through the lever h^{10} by the cam h^{12}.

The letter h^{23} indicates a series of guide-rods secured to stationary shafts h^{24}, the upper ends of which rods enter grooves in the lower roll of each pair of folding-rollers *h* and *h′*.

The letter h^{25} indicates a series of guide-rods secured to stationary shafts h^{26}.

The following numbered parts are each a series of tape-pulleys secured to their respective shafts—that is to say, from No. 1 to No. 33, inclusive.

The letter *t* indicates a series of tapes whose respective directions of motion are indicated by the arrow-heads.

The letter *t′* indicates another series of tapes

whose directions of motion are similarly indicated by arrow-heads.

To indicate now the paths of tapes t', commencing at pulleys 1, said tapes pass under 1; thence in contact with tapes t, over 29, (where they separate from the tapes t,) thence downward in contact with the left-hand guide-rods, h^{17}; thence under the upper of the folding-rollers h', over the lower folding-roller h'; thence downward in contact with guides h^{23}, under 31; thence horizontally in contact with guides h^{25} under 32, (from this point in contact with tapes t,) over 26, under 25, over 24, under 23, over 22, under 20; thence vertically and over 17, (at this point separating from tapes t;) thence horizontally in contact with guides h^{25} over and under 8, returning over 7, under 6, over 5, under 4, under 3, and over 2 to point of starting.

To indicate now the path of tapes t, commencing at the same point, said tapes are in contact there with tapes t' and pass over 29, (separating from tapes t';) thence downward in contact with the right-hand guides, h^{17}, under the upper folding-roller h, over the lower roller h; thence downward in contact with guides h^{23}, under 32, (from this point in contact with tapes t',) over 26, under 25, over 24, under 23, over 22, under 20, upward over 19, (at this point separating from tapes t',) downward under 21, under 27, upward over 28 to the point of starting.

The letters t^2 and t^3 also indicate two other series of tapes, whose directions of motion are also indicated by arrow-heads. Tracing the path of tapes t^3, commencing at 11, said tapes pass over the stripper-fingers S^3 and pulleys 13, (coming in contact with tapes t^2,) pass under 12, over 15, (at this point separating from tapes t^2,) downward in contact with the right-hand guides h^{17}, under the upper folding-roller h', over the lower roller h', downward in contact with guides h^{23}, under 9, vertically and over 10, over and returning under 11 to place of starting. Commencing with tapes t^2 at the top of 13, said tapes pass (in contact with tapes t^3) under 12, over 15, (where they separate from tapes t^3,) downward in contact with the left-hand guides h^{17}, under the upper folding-roller h, and over the under roller h, downward in contact with the guides h^{23}, under 18, upward over 14, and under and over 13 to place of starting. Motion is given to all these tapes by the folding-rollers h and h', as driven from the shaft s, by the several bevel and spur gears, plainly shown in Fig. 1, and not necessary to indicate by letter or number. The switches h^{19} pass between the tapes at their points. The pulleys 33 have no tapes running upon them, and only serve to guide the sheets brought downward by tapes t^2 under said pulley 33, and thence on top of tapes t' to the rollers for making the second fold. A series of stationary switches, V, deflect the sheets coming from the left-hand side of the right-hand folding apparatus and the sheets coming from both sides of the left-hand folding apparatus under pulleys 33 and over 17, respectively, into the common horizontal path to the rollers for making the second fold.

V′ indicates a pair of folding-rollers for making the second fold, and V^2 a folding-blade attached to an arm, V^3, which in turn is secured to a rock-shaft, V^4. To V^4 is secured a lever, V^5, connecting to a rod, V^6, carrying on its upper end a roller (not shown) engaging a grooved cam, V^7, having a groove of proper shape, as shown in Fig. 3, to give two motions to the folding-blade V^2, for each revolution of the shaft s or type-cylinder B. The shaft s is driven from the shaft of the type-cylinder B by the miter-wheels W and W′.

The method of imparting motion to the cutting-cylinders and other rotary members is so plainly shown in Fig. 1 as not to require further indication by letters or figures.

The operation of the parts, as above described in Figs. 1 to 10, inclusive, is as follows: Taking the left-hand pair of impression-cylinders, Figs. 1 and 2, the sheet is fed to the top of cylinder C. At said point it is taken by its grippers g, at the time it is severed from the web by the cutting-cylinders $c\,c'$, and brought into contact with the form for printing the first side. The grippers of cylinder C open at the points of the stripper-fingers S, and at the same time the sheet-lifter fingers g' lift, or rather depress, the head of the sheet upon the strippers S. The wheels f^3 hold the sheet in contact with cylinder C until the tail of the sheet reaches the point of contact between the cylinder C and the wheels f^3. At this point the pairs of twin grippers f^0 will be brought by the mechanism already described into position to seize the tail of the sheet while running in the same direction and at the same velocity as the sheet. By the action of the cam f^{16} the arm f^{14}, the sector f^{13}, wide-faced pinion f^{11}, intermediate gear, f^9, and pinion f^8, also by the concurrent action of the rollers f^{19} upon the stationary cams f^{20}, the twin grippers f^0, by the time they reach the point of contact between cylinder C′ and the wheels f^3, will be presented in proper position to deliver the previous tail of the sheet, now the head, to the grippers g of the cylinder C′, and by the operation of the same described parts, while moving in the same direction and at the same velocity as the surface of the cylinder C. The grippers g of cylinder C′ being open and operated to close at this point upon the sheet, the lower one of the cams f^{20}, Fig. 5, operating on one of the rollers f^{19}, opens one series or set of jaws of the twin grippers f^0. The sheet-reverser continuing on, said grippers finally leave the lower cam, f^{20}, being again presented in proper position for receiving the tail of the next succeeding sheet from the cylinder C, by the aforesaid action of the cam f^{16}, with one set of jaws pressed open by the action of the upper one of the cams f^{20} upon one of the rollers f^{19}. In this construction the wheels $f\,f'\,f^3$ and gripper-carriers f^4, with their grippers f^0, constituting the reversing and conveying appara-

tus, make two revolutions to one of an impression-cylinder, and therefore should have the twin grippers f^0 presented in position to receive a sheet from cylinder C and deliver a sheet to cylinder C′ only at each second revolution, and the groove in the cam f^{16} is so formed as to keep the twin grippers f^0 from coming in contact with the surface of cylinders C and C′ during the revolution, in which they do not convey and reverse a sheet. It will be obvious that if the wide-faced pinion f^{11} were fixed upon its axis the gripper-carrier f^4 and its grippers f^0 would not receive any angular motion at any point in the revolution of the wheels f, f', and f^3, so that all that is required to make the twin grippers f^0 present themselves in proper position to receive the sheet from cylinder C and to deliver it to cylinder C′ is to rotate the wide-faced pinion upon its shaft each way by means of the properly-shaped groove in the cam f^{16} a proper amount during the effective revolution of the sheet reversing and conveying apparatus, and during its non-effective revolution a lesser amount, so as to keep the points of the grippers f^0 within the respective circumferences of the wheel f^3 or f.

In Fig. 5 the full lines indicate the position of the twin grippers f^0 when receiving or grasping the tail of a sheet from the cylinder C, and the dotted lines when delivering it to the cylinder C′, and in position midway between these two points.

So far this description will apply to the cylinders C^2 and C^3 and its connected apparatus, except that the sheets are fed to and taken by the grippers of the cylinder C^2 at its bottom, and delivered perfected from the top of the cylinder C^3. As the impression-cylinders take a sheet at every revolution, and make an impression at the meeting of each form as it passes, the sheets printed by any one impression-cylinder will be printed on alternate sides—that is to say, if the outside of the paper is first printed by cylinder C its next sheet will receive its impression on the form for the inside, and when cylinder C prints the outside of a sheet cylinder C′ prints the inside of the same sheet, and conversely when cylinder C prints the inside cylinder C′ prints the outside of the same sheet. In this way each perfected sheet when delivered from cylinder C′ by the operation of opening its grippers g (and its sheet-lifter fingers g' depressing the sheet to pass under the stripper-fingers S^2) will issue at this point with an alternate side uppermost, and, if carried directly in this position to a single pair of folding-rollers, would be folded alternately right and wrong side out. To avoid this and make the first fold in every sheet in the same direction, as to its inside or outside, the sheets pass between the tapes t and t' to the switches h^{19}, which are so operated by the cam h^{12} as to pass the sheets alternately to the right and left of themselves. The double folding-blade h^2 is, as heretofore described, moved so as to alternately tuck the sheets into the bite of the rollers h and h', the blade h^2 meeting in each case the inside of the sheet. The vibrating or sliding guides f^{13} are for the purpose of keeping the descending sheets from coming in contact with the lower roller of each pair of rollers h and h'. Said rollers, running in a direction the reverse of the motion of the sheet, would be liable to obstruct its free passage downward unless the sheet were protected from contact with them. The guides h^{13} provide a smooth path for the head of the sheet down into the space between the arm h^3 and said vibrating guides h^{13}. Such motion is given to these guides by the cam h^{12} as to be isochronous with the motion of the folding-blade h^2, and so that when the blade is about to enter the rollers h the guides h^{13} cover the lower roller of the rollers h', down which a sheet will be passing, and vice versa.

Following the course of the four series of tapes, as above described, it will be seen that the sheets (the several distances of travel of the sheets being properly adjusted) will be presented to the second form-rollers alternately from each pair of impression-cylinders with the first fold made in them, and all with the same side up. From this point the sheets may be given as many additional folds, by the usual well-known means, as may be desired.

The rock-shaft Z carries a series of tape-wheels, 23, running on studs Z^2 in the arms Z^3, for the double purpose of tightening the tapes t and t' and varying the distance between the type-wheels 26 and 20, in order to nicely adjust the time of arrival of the sheets from the left-hand folder at the common point of receiving the second fold.

The construction here shown is for a folio sheet, making the first fold parallel with the column-rules; but it will be understood that it may be adapted to a quarto sheet, which requires the first fold to be made transversely to the column-rules by placing the fold-rollers h and h' and the double oscillating folder-blade at right angles to the position shown, and replacing the vibratory guides h^{13} with stationary guides, and running the tapes in proper directions to suit this arrangement. It will also be obvious that instead of delivering the sheets all at one end of the machine the arrangement of the folding apparatus and tapes t^2 and t^3 may be the same for both ends of the machine, as is shown for cylinders C^2 and C^3, with separate apparatus for completing the further folding at each end of the machine. It will also be clear that this machine may be constructed with but one pair of impression-cylinders and one complete folding apparatus as a cheaper construction for papers with a circulation smaller than such as would require the four-cylinder machine, as drawn and described. It will also be understood that this machine may be constructed without any folding apparatus, delivering the sheets flat, when so desired, in which any of the well-

known methods of so delivering the sheets may be applied.

I do not therefore herein claim the folding mechanism herein described and illustrated, reserving the same, however, for the subject of another application for Letters Patent, said application having been filed November 8, 1884, bearing the Serial No. 147,459.

Referring now to Figs. 11, 12, 13, and 14, the proportions of the sheet to be printed may involve such conditions that the proportions of type or form cylinders B, impression-cylinders C C′, and rotary sheet-reversing apparatus shown in Figs. 1 to 10, inclusive, may not be available. In such cases the impression-cylinders C C′ may be made one-quarter the diameter of the type or form cylinder B, printing a sheet at every second revolution of the impression-cylinders C C′, and the sheet-reverser one-half the diameter of the type or form cylinder B, making but one revolution for each sheet transferred, as shown in Fig. 11; or with the impression-cylinders C C′ one-half the diameter of the type or form cylinder B, and the sheet-reverser one and one-half time the diameter of the type or form cylinder B, or equal to three times the diameter of the impression-cylinder C, carrying three sets of grippers, f^0, and transferring and reversing three sheets for each revolution of itself, as shown in Fig. 12. In the latter case, of course, the intermediate gear, f^9, and the spur-pinion f^8 will be repeated as many times as there are sets of grippers f^0 and gripper-carriers f^4, while the wide-faced pinion f^{11} will serve to operate them all. In cases where none of these proportions would be available the sheet-reverser may be constructed so as to be given an irregular motion by cams from some revolving part of the machine in such manner that, while the grippers f^0 were passing the sheet-transferring points, they would move at about the same velocities as the surfaces of the contiguous impression-cylinders, and at other points of said cylinders' revolutions be made to move faster or slower, as might be necessary, to give an entire revolution of the sheet-reverser in the proper time, in which construction, of course, the sheet-reverser would not be geared to the impression-cylinders.

Wherever in any of the above-described methods of construction the sheet-reverser runs sufficiently slow, the method shown in Figs. 13 and 14 may be employed for oscillating the gripper-carrier f^4 in its bearings.

In Figs. 13 and 14 the letter T indicates a double-ended lever secured to the gripper-carriers f^4. On either end of lever T is carried a roller, T′. Secured to the frame A are two stationary grooved cams, T^2 T^3. (In Fig. 14 the cam T^2 is removed to show more clearly the position of cam T.) In Fig. 13 the lever T is shown in position when the grippers f^0 will be taking the tail of a sheet from the impression-cylinder C, and a little farther on, in dotted lines, the position when the roller T′ on one end of lever T is leaving the groove of cam T^3, simultaneously with the entrance of the other roller, T′, into the groove of cam T^2, and farther on in the several other positions in dotted lines for an entire revolution. As a simpler and cheaper method than that shown in Figs. 1 to 10, inclusive, for oscillating the gripper-carrier f^4, this construction may be used where the proportions of the various cylinders with the sheet-reverser and the number of revolutions of the latter in a given time will admit of its use.

In the various figures the arrows designate the directions in which the respective parts are supposed to be moving.

Having thus fully described my said improvements as of my invention, &c., I claim—

1. In a perfecting printing-press in which the sheets are cut from the roll or web before printing, then taken and held by the grippers of a first impression-cylinder, as C, until partially printed on one side, the head of the sheet then being stripped from said impression-cylinder and the printing completed, in combination with said cylinder and a second impression-cylinder, a rotary sheet-reverser consisting of such parts as f^2, f, f', f^0, f^4, and f^6, whereby the tail of the sheet is taken directly from said first impression-cylinder by the grippers of said sheet-reverser and the sheet delivered by said grippers directly to the grippers of said second impression-cylinder in such reversed position, tail first, while said impression-cylinders and sheet-reverser are traveling in the same direction and at the same velocity, substantially as and for the purposes set forth.

2. In a perfecting printing-press, a rotary sheet-reverser geared to a pair of impression-cylinders so as to give equal velocities of travel to the respective grippers of said cylinders and reverser, and consisting of an oscillating gripper-carrier, as f^4, journaled in revolving wheels, as f f', a series of twin grippers, as f^0, upon suitable shafts, as f^6, journaled in said oscillating gripper-carrier, and means, consisting of a cam, as f^{16}, a roller, as f^{15}, an arm, as f^{14}, a rock-shaft, as f^{12}, a sector, as f^{13}, and pinions, as f^{11} f^9 f^8, by which said gripper-carrier is oscillated to present its grippers to each of the pair of impression-cylinders in proper position to seize the tail of a sheet from the first impression-cylinder and deliver said tail of the sheet, with the sheet reversed, to the second impression-cylinder, the reception and delivery of the tail of the sheet by the grippers of said sheet-reverser being made while said grippers and sheet are both moving in the same direction and with the same velocity, substantially as and for the purposes set forth.

3. In a perfecting printing-press, a rotary sheet-reverser consisting of a series of rotary wheels, as f f', having journaled therein an oscillating gripper-carrier, as f^4, carrying a series of twin grippers, as f^0, a pinion, as f^8, on the end of said oscillating gripper-carrier, an intermediate pinion, as f^9, running loosely

on a stud in one of said wheels, a central pinion, as f^{11}, running loosely on the shaft of said wheels, the three pinions engaging in a train, and means, consisting of a cam, as f^{16}, a roller, as f^{15}, an arm, as f^{14}, a rock-shaft, as f^{12}, and a sector, as f^{13}, whereby said central pinion is oscillated so as to present the twin grippers in a proper position at such two points of the revolution of the first-mentioned wheels as may be required to take a sheet tail first from the grippers of a contiguous cylinder and deliver it to the grippers of another contiguous cylinder, substantially as and for the purposes set forth.

4. In a perfecting printing-press provided with a rotary sheet-reverser consisting of a series of wheels, as $f\,f'$, in which is journaled an oscillating gripper carrier, as f^4, means for oscillating said gripper-carrier in said wheels while the said wheels revolve, consisting of a pinion, as f^8, on the end of the gripper-carrier, an intermediate loose pinion, as f^9, carried on a stud in the said wheels, a loose central pinion, as f^{11}, running upon the shaft of said wheels, a toothed arc, as f^{13}, meshing with said central pinion and operated by a rock-shaft, as f^{12}, an arm, f^{14}, and a cam, as f^{16}, secured to any suitable rotary shaft of the machine, whereby a series of twin grippers, as f^0, of said gripper-carrier will be presented in proper position to the grippers of two contiguous cylinders, to take a sheet tail first from the grippers of one and deliver it to the grippers of the other said cylinder in a reversed position, substantially as and for the purposes set forth.

5. In a perfecting printing-press provided with a rotary sheet-reverser consisting of a series of wheels, as $f\,f'$, having journaled therein an oscillating gripper-carrier, as f^4, carrying a series of twin grippers, as f^0, in combination with said twin grippers, lever-arms, as f^{18}, upon the shafts of said twin grippers, rollers, as f^{19}, on the ends of said arms, and stationary cams, as f^{20}, engaging said rollers, whereby said twin grippers are opened and closed at the proper times to directly receive and convey the tail of the sheet between two contiguous cylinders, substantially as and for the purposes set forth.

6. A rotary sheet-reverser having journaled therein an oscillating gripper-carrier, as f^4, carrying a series of twin grippers, as f^0, provided with springs, as f^{17}, and projections or stops, as i, on their hubs engaging said gripper-carrier, whereby either one of each pair of said series of grippers is prevented from following its respective twin gripper when the other is opened, and said grippers are closed when either twin is released by its opening mechanism, substantially as and for the purposes set forth.

7. In a perfecting printing-press in which the sheets are cut from the web before printing, the combination of a type or plate cylinder, one or more pairs of cutting-cylinders, one or more pairs of impression-cylinders, and a rotary sheet-reverser (consisting of such parts as $f^2\,f\,f'\,f^0\,f^4\,f^6$) for each pair of impression-cylinders, all arranged and constructed substantially as described, whereby said sheet-reverser is caused to take the sheet tail first directly from one of a pair of impression-cylinders and deliver it tail first and reversed directly to the grippers of the other of said pair of impression-cylinders, while the grippers of each impression-cylinder and sheet-reverser are traveling at the same velocity in the same direction, substantially as and for the purposes set forth.

JOHN T. HAWKINS.

Witnesses:
WM. T. MAGRUDER,
ALBERT J. PARK.