No. 666,325. Patented Jan. 22, 1901.

T. M. NORTH.

PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.) 8 Sheets—Sheet 1.

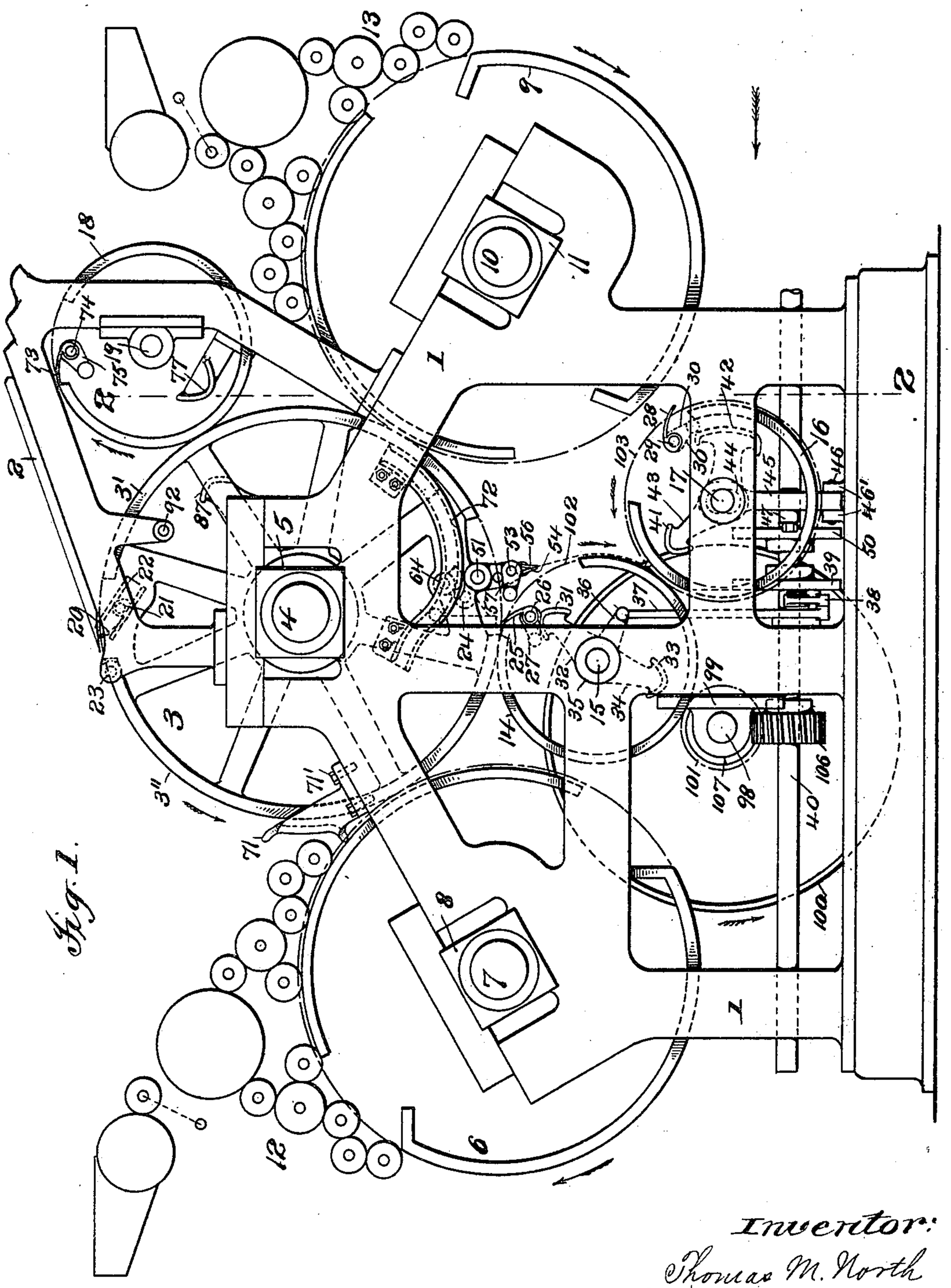

Fig. 1.

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No. 666,325. Patented Jan. 22, 1901.

T. M. NORTH.

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(Application filed May 17, 1899.)

(No Model.)

8 Sheets—Sheet 2.

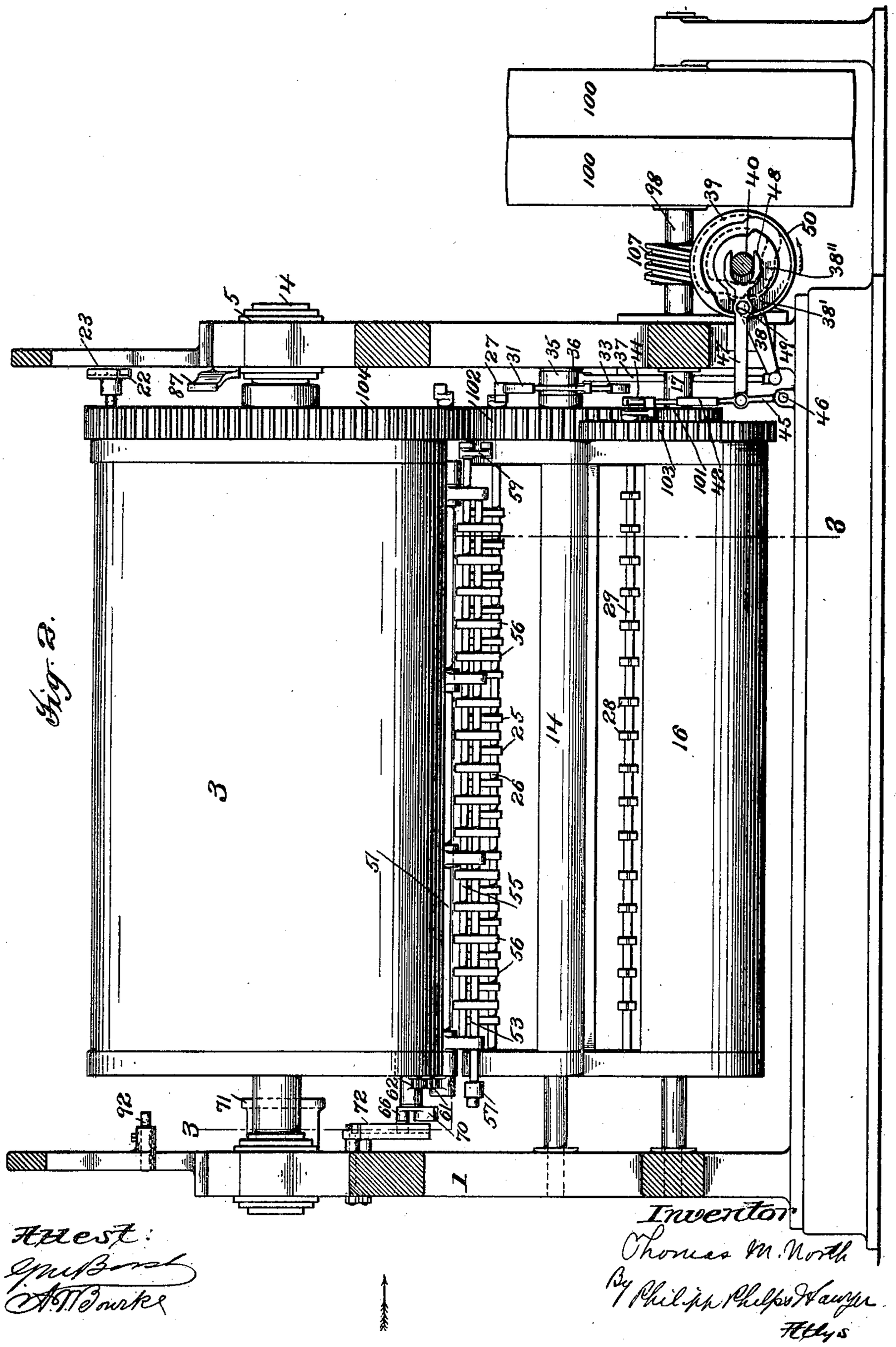

Fig. 2.

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PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.) 8 Sheets—Sheet 3.

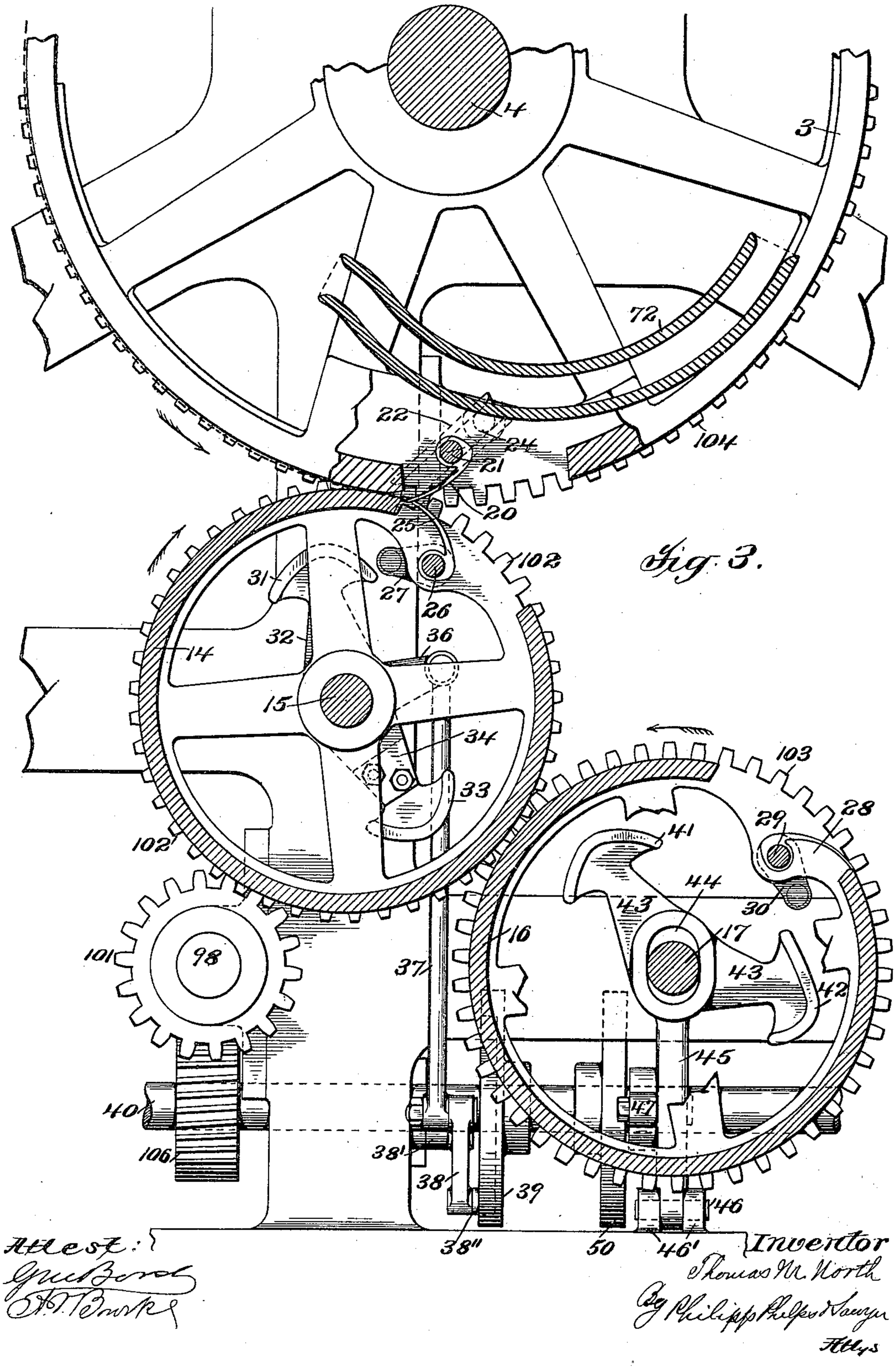

Fig. 3.

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No. 666,325. Patented Jan. 22, 1901.

T. M. NORTH.

PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.) 8 Sheets—Sheet 4

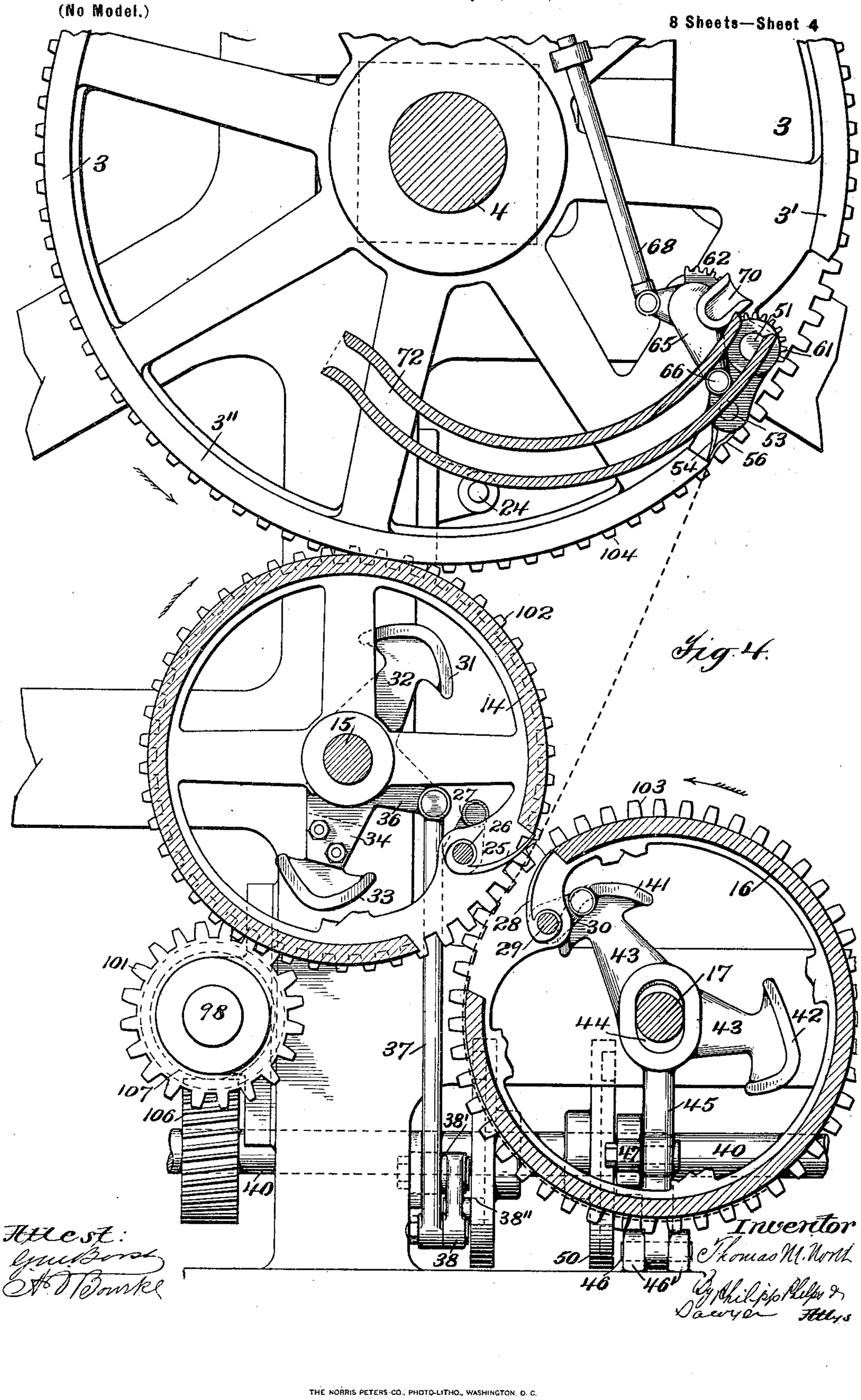

Fig. 4.

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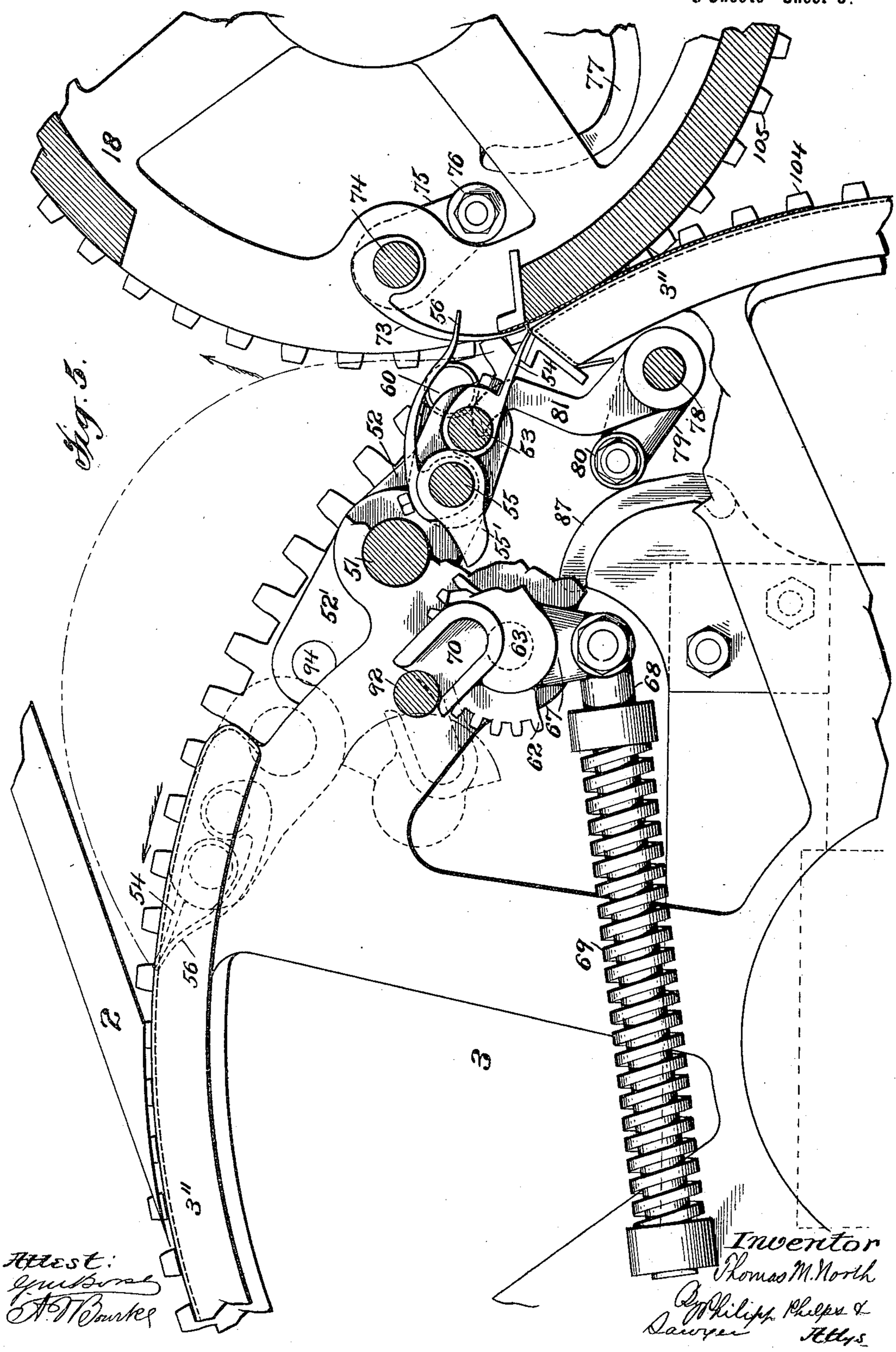
PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.) 8 Sheets—Sheet 5.



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Patented Jan. 22, 1901.

T. M. NORTH.

PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.)

8 Sheets—Sheet 6.

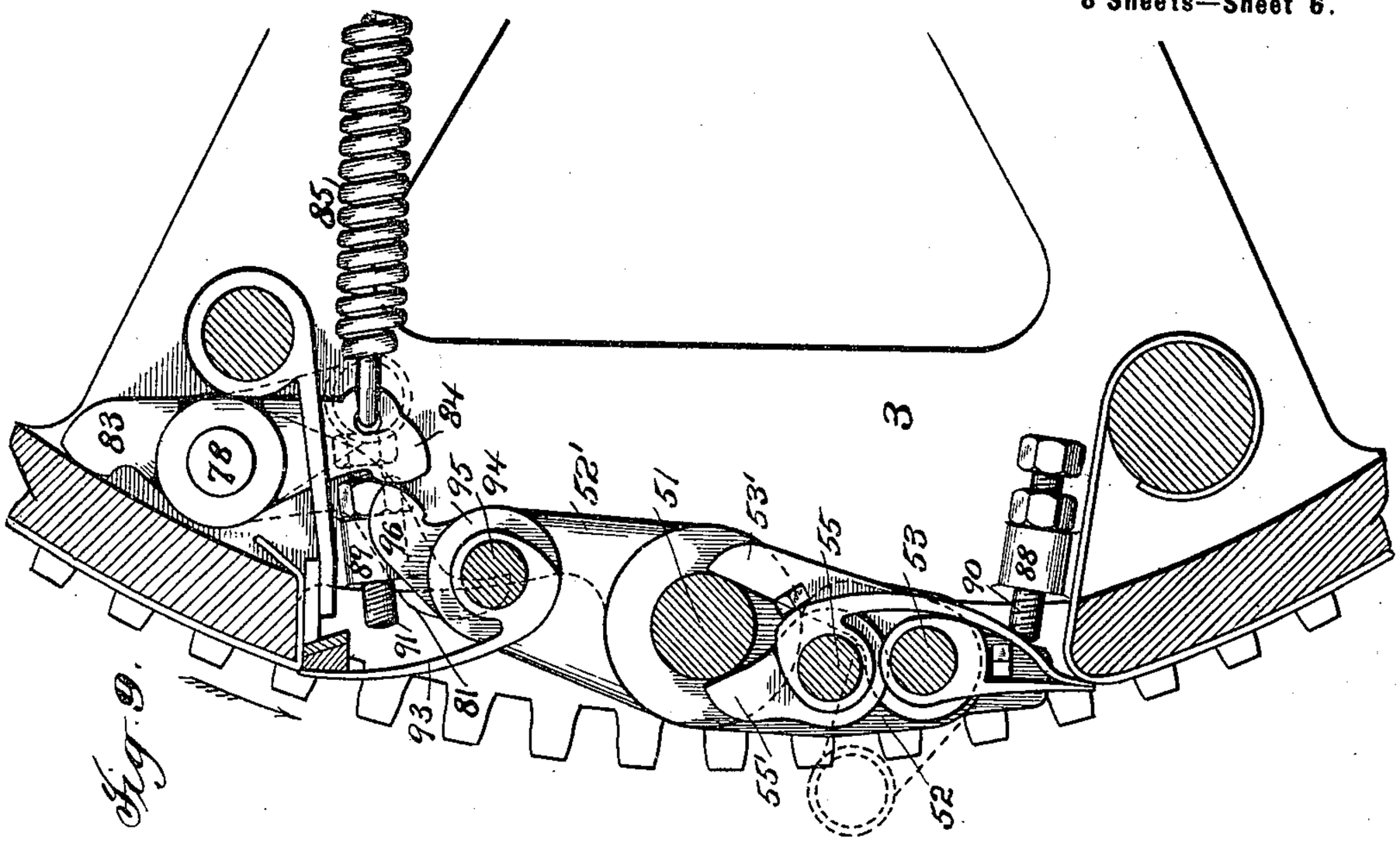

Fig. 9.

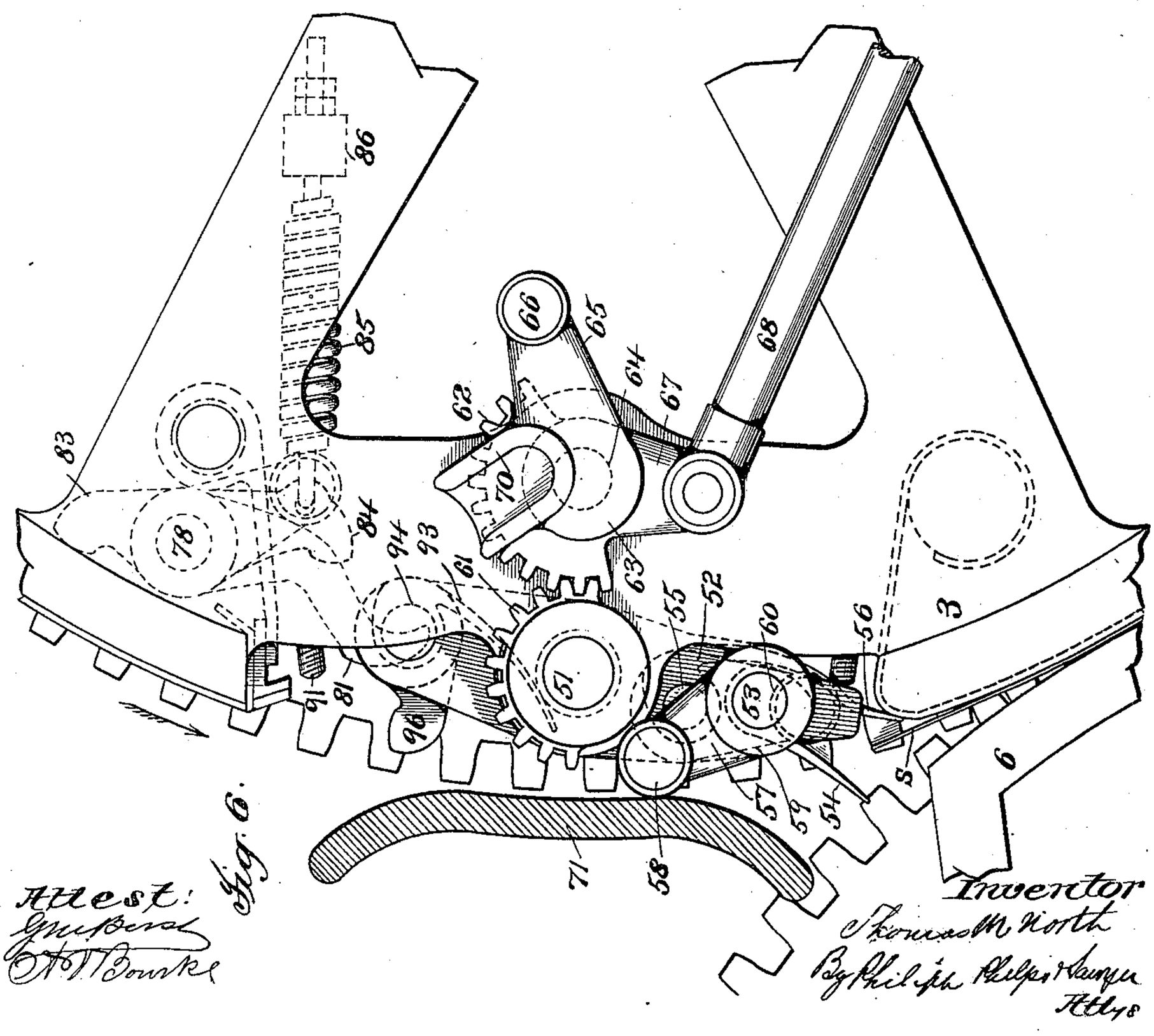

Fig. 6.

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T. M. NORTH.

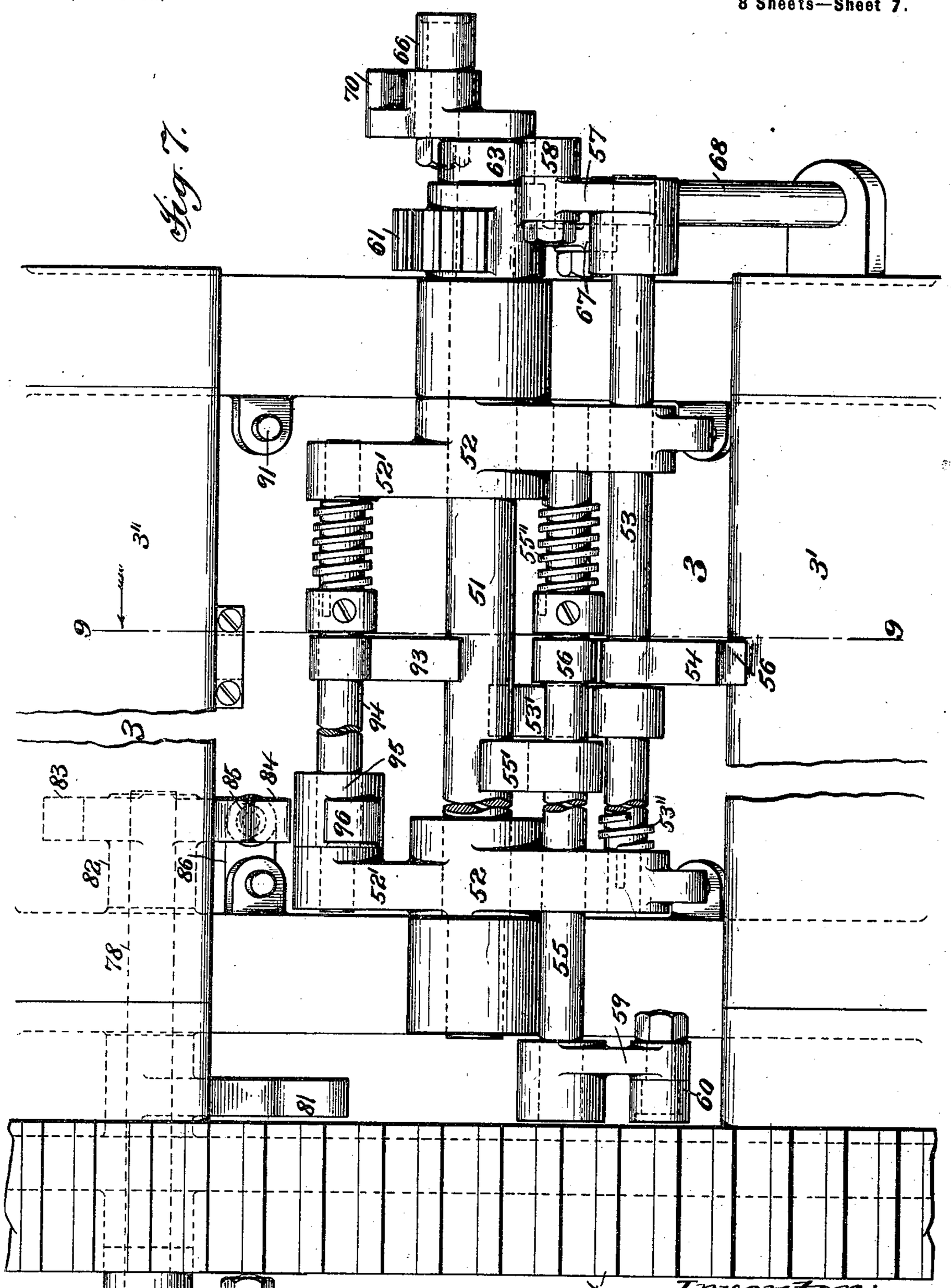
PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.)

8 Sheets—Sheet 7.

Fig. 7.



Witnesses:
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Atty's

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 666,325.

Patented Jan. 22, 1901.

T. M. NORTH.

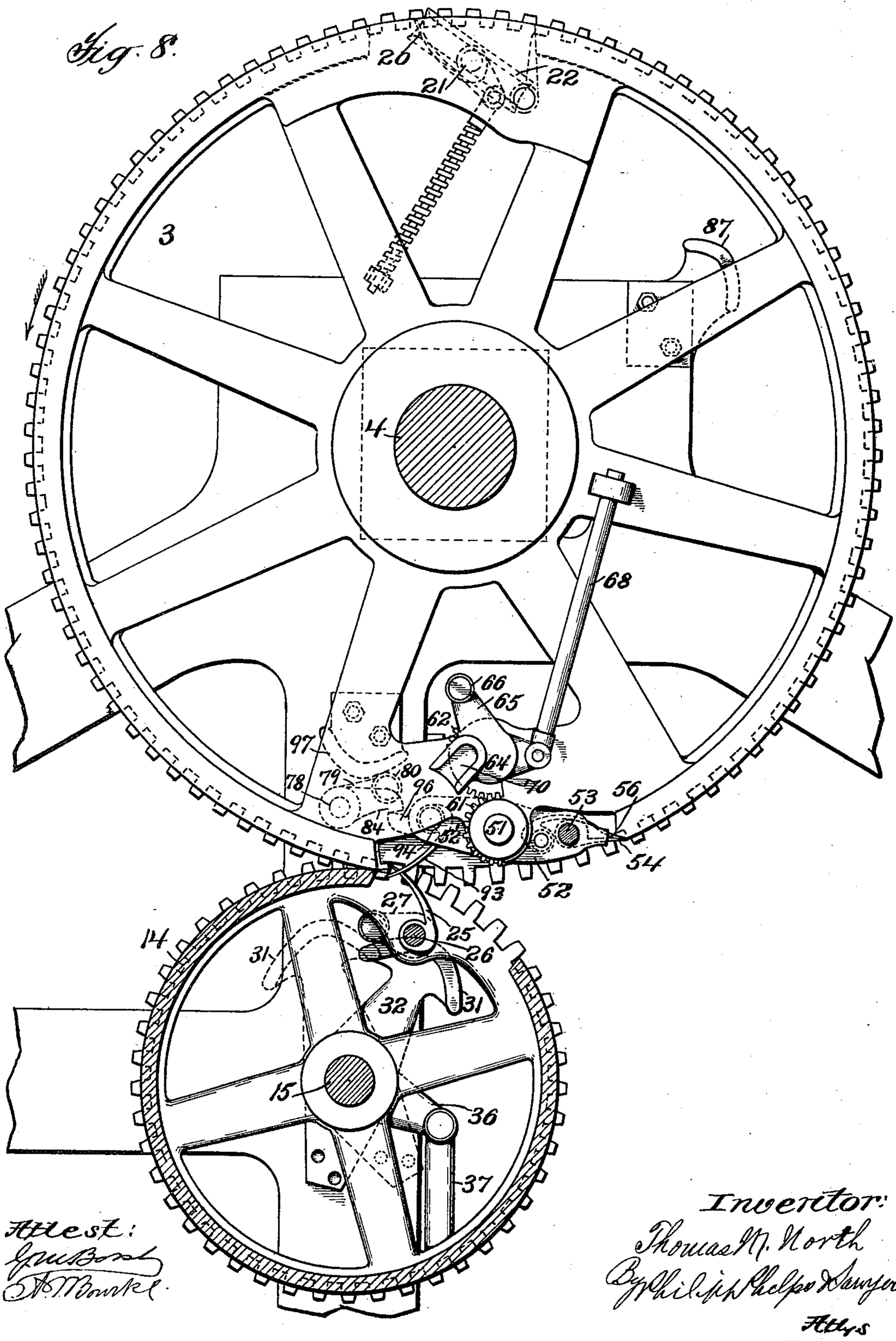
PRINTING MACHINE.

(Application filed May 17, 1899.)

(No Model.)

8 Sheets—Sheet 8.

Fig. 8.



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UNITED STATES PATENT OFFICE.

THOMAS M. NORTH, OF NEW YORK, N. Y., ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO ROBERT HOE AND CHARLES W. CARPENTER, OF SAME PLACE.

PRINTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 666,325, dated January 22, 1901.

Application filed May 17, 1899. Serial No. 717,122. (No model.)

To all whom it may concern:

Be it known that I, THOMAS M. NORTH, a subject of the Queen of Great Britain and Ireland, residing at New York city, county of Kings, and State of New York, have invented certain new and useful Improvements in Printing-Machines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to certain improvements in printing-machines.

It is the object of this invention to produce an improved sheet-printing machine in which a single impression-cylinder provided with two impression-surfaces shall coöperate with two form-carriers, which are preferably, though not necessarily, rotating cylinders, to give a sheet two impressions, said machine being also provided with means whereby the two impressions may be made either on the same or opposite sides of the sheet, the machine being thus adapted, with but slight changes, to print in two colors on one side of a sheet or to perfect a sheet—that is, to print in one color on each side of the sheet.

With this object in view the invention consists in certain constructions and in certain parts, improvements, and combinations, as will be hereinafter described, and the features forming the invention will then be specifically pointed out in the claims hereunto appended.

In the accompanying drawings, which form a part of this specification, and in which like characters of reference indicate the same parts, Figure 1 is a diagrammatic side elevation of a printing-machine constructed in accordance with the invention. Fig. 2 is a sectional end elevation looking in the direction of the arrow in Fig. 1, the plane of section being on the line 2 2 of Fig. 1. Fig. 3 is a detail sectional elevation, on a large scale, of a portion of the impression-cylinder and the two transfer-cylinders, the parts being shown in the position they occupy just as the grippers on the first transfer-cylinder have taken the sheet. Fig. 4 is a view similar to Fig. 3, the parts being shown in the position they occupy after the head of the sheet has been taken by and released from the second transfer-cylinder and the tail of the sheet has been taken and forwarded by the tail-grippers and after the tail-grippers have been turned over. Fig. 5 is a detail sectional elevation, on a large scale, showing the position of the parts after the edge of the sheet has been released by the turning-grippers and has been taken by the grippers on the delivery-cylinder. Fig. 6 is a detail, on a large scale, illustrating the turning-grippers and a portion of their operating devices, the grippers being shown in the position they occupy as they are about to seize the tail of the sheet. Fig. 7 is a plan view of the construction shown in Fig. 6, the cam which operates the turning-grippers being removed. Fig. 8 is an enlarged detail illustrating the impression-cylinder and the first transfer-cylinder, the press being arranged in this instance to print in two colors and the parts being shown in the position they occupy as the sheet is about to be transferred from the transfer-cylinder to the second impression-surface of the impression-cylinder. Fig. 9 is a detail sectional elevation illustrating the position of the turning-grippers when the machine is running as a two-color machine, the plane of section being on the line 9 9 of Fig. 7 and looking in the direction of the arrow in that figure.

Referring to the drawings which illustrate one embodiment of the invention, 1 indicates a frame which carries the usual feed-board 2, from which the sheets are fed to the machine. Suitably mounted in bearings in the frame is the impression-cylinder 3, provided with a first impression-surface 3′ and a second impression-surface 3″, said impression-cylinder being mounted on the shaft 4, which is carried in boxes 5, the boxes being mounted in and secured to the frame in any usual or desired manner. The machine is also provided with two form-carrying cylinders 6 and 9, the form-carrying cylinder 6 being mounted on a shaft 7, which is carried in boxes 8, located at one end of the frame, and the form-cylinder 9 being mounted on a shaft 10, which is carried in boxes 11 at the other end of the frame. Each of these cylinders 6 and 9 is provided with a form-carrying surface, on which a form of any usual description may be placed, and with an ink-distributing surface.

Suitable inking devices, as 12, coöperate with the cylinder 6, and suitable inking devices, as 13, coöperate with the cylinder 9. These inking devices may be of any usual type and may be operated in any usual manner.

The machine is further preferably provided with two transfer-cylinders. A first transfer-cylinder 14 is mounted on a shaft 15, which is suitably journaled in the frame, and a second transfer-cylinder 16 is mounted on a shaft 17, which is also suitably journaled in the frame.

The machine is also provided with any suitable delivery devices. In the present machine the delivery devices comprise the usual delivery-cylinder 18, mounted on a shaft 19, also suitably journaled in the frame.

As has been before indicated, this machine is intended with one adjustment of its parts to print in one color on each side of a sheet—that is, to perfect a sheet and with another adjustment to print in two colors on the same side of the sheet.

The machine will first be described as its parts are adjusted when it is intended to perfect a sheet.

The impression-cylinder 3 is provided with any usual form of sheet-taking grippers 20, these grippers being arranged at the edge of the impression-surface 3′, so that the sheet lies on this surface when taken by the grippers. The grippers 20 are mounted on a shaft 21, which extends across the machine and which is operated by means of a tumbler-block 22. The grippers 20 are closed after taking a sheet by a tumbler-pin 23, suitably mounted on the frame of the machine, and are opened to deliver the sheet to the grippers of the first transfer-cylinder by a tumbler-pin 24, also suitably mounted on the frame of the machine.

The first transfer-cylinder 14 is provided with a set of sheet-taking grippers 25, which are mounted on a shaft 26, extending across the cylinder from side to side, the shaft being rocked to open and close the grippers by an arm 27 extending therefrom.

The second transfer-cylinder 17 is provided with a set of sheet-taking grippers 28, which are mounted on a shaft 29, extending across the cylinder from side to side, the said shaft being rocked by an arm 30, suitably connected thereto.

The sheet having been taken from the feed-board 2 by the grippers 20 lies, as before stated, on the impression-surface 3′ and receives its first impression from the form on the cylinder 6. In order to give the sheet its second impression, it must in the machine shown be transferred from the first impression-surface 3′ of the cylinder 3 to the second impression-surface 3″, and it must at the same time be turned over, so as to bring its unprinted surface on the outside. In order to accomplish this, after the sheet has been taken by the grippers 20 and has received its first impression from the form carried on the cylinder 6 the grippers 20 are caused to release the sheet by the contact of the tumbler-block with the tumbler-pin 24, after which the head of the sheet is taken by the grippers 25 on the first transfer-cylinder 14.

Various mechanisms may be used for operating the grippers on the first transfer-cylinder. In the machine shown the grippers are closed by the usual springs (not shown) and are opened by a cam 31, mounted on an arm 32, the said arm being mounted loosely on the shaft 15 of the transfer-cylinder. The cam 31 contacts with a bowl on the arm 27, extending from the shaft 26, as is usual. After the head of the sheet has been taken by the grippers 25 it is carried forward, and the grippers are then rocked to release the head of the sheet, so that it may be taken by the grippers 28 on the second transfer-cylinder. This rocking of the grippers 25 to release the sheet, so that it may be taken by the grippers 28 on the second transfer-cylinder, may also be accomplished in various ways. In the machine shown it is effected by a cam 33, mounted on an arm 34, which is also loosely mounted on the shaft 15. While the arms 32 34 and cams before referred to may, if desired, be independent, in the preferred construction these arms will both be made integral with a hub 35, mounted on the shaft 15.

After the head of the sheet has been delivered to the grippers 28 on the second transfer-cylinder, as will be hereinafter described, it will be carried onward by them, the tail of the sheet having in the meantime been taken by a set of tail-grippers on the impression-cylinder and carried forward by them, as will also be hereinafter described. At this time therefore the head of the sheet being held by the grippers on the second transfer-cylinder and its tail being held and carried forward by the tail-grippers the sheet will be reversed and by a rocking movement of the tail-grippers, to be hereinafter described, will be laid upon the second impression-surface 3″, the grippers on the second transfer-cylinder having in the meantime released the sheet.

Before the operation of transferring the sheet to the second impression-surface 3″ is completed the first transfer-cylinder, which is geared to make two revolutions to one of the impression-cylinder, will have begun its second revolution. If its grippers 25 are allowed to open at the same point that they do when they transfer the sheet to the second transfer-cylinder, they would strike the sheet, and therefore be apt to smut or tear it. It is necessary, therefore, that the gripper-operating cam 33 be moved into a position where the grippers will be free to contact with it and rocked without striking the sheet. Various mechanisms may be employed for thus moving the gripper-operating cams. In the machine shown the hub 35 has extending therefrom an arm 36, which is connected by a rod 37 to a lever-arm 38, the said lever-arm

being rocked by a cam 39, carried on a way cam-shaft 40, suitably located in the frame of the machine. The arm 38 is pivoted at 38′ to a bracket on the side frame and has a bowl 38″ running in the groove of the cam before referred to. (See Figs. 3 and 4.)

The position of the parts when the cam 33 is in position to open the gripper-fingers is shown in Fig. 3, the parts being shown in this figure in the position they occupy after the grippers 20 have released the sheet and the grippers 25 have taken it. The parts remain in the position shown in Fig. 3 until the grippers 25 have taken the sheet and have delivered it to the grippers 28 on the second transfer-cylinder. As soon as the transfer of the sheet from the grippers 25 to the grippers 28 is effected, as will be described, or very soon thereafter, the cam 39, through the connections before described, rocks the hub 35 and the cams 31 33 into the position in which they are shown in Figs. 1 and 4. The cams remain in this position while the first transfer-cylinder completes its first revolution and makes its idle revolution. When, however, the grippers 25 again approach the point where they are to take a sheet, the cam 39, which is geared to make one revolution in the same time that the impression-cylinder makes one revolution, operates to swing the gripper-operating cams 31 33 into the position in which they are shown in Figs. 1 and 3, so that a sheet may again be taken by the grippers 25 on the first transfer-cylinder and transferred to the second transfer-cylinder.

The grippers 28 on the second transfer-cylinder 16 are opened to take the sheet by means of a cam 41 and opened to release the sheet by means of a cam 42, these cams contacting with a bowl carried on an arm 30 extending from the shaft 29. The cams 41 and 42 are preferably carried on a bent casting 43, which has a central aperture 44 surrounding the shaft 17, on which the second transfer-cylinder is mounted. The bent casting 43 is carried on and is preferably integral with a lever-arm 45, which is pivoted by a pin 46 to the frame of the machine, said pin passing through a pair of ears 46′.

The second transfer-cylinder 16 makes two revolutions while the impression-cylinder makes one—that is to say, the second transfer-cylinder makes a revolution, during which its grippers take and release the sheet and then makes an idle revolution. It is desirable, therefore, that the grippers 28 be not opened during the idle revolution so that there may be no danger of the grippers striking and smutting the sheet. In order to prevent the grippers 28 from being opened, the arm or casting 43, which carries the gripper-operating cams 41 and 42, is shifted lengthwise of the shaft 17, so that the cams 41 and 42 will be out of the path of the bowl, which is carried on the arm 30 of the gripper-shaft 29. This shifting of the arm 43 is effected by means of a cam-rod 47, (see Fig. 2,) which has a yoke end 48 engaging the way-shaft 40 and carries a pin 49, which runs in a groove in a cam 50, mounted on the said way-shaft. After the grippers 28 therefore have been operated to take and release the sheet by the cams 41 42 the cam 50 operates through the connections described to shift the arm 43 out of the path of the bowl on the arm 30. The position of the parts in which the cams 41 42 are to operate the grippers 28 is shown in Fig. 3. The position of the parts when the grippers are to remain inoperative is shown in Fig. 4.

Besides the grippers 20, which take the sheet from the feed-board, the impression-cylinder 3 is provided with two other sets of grippers, which coöperate with the second impression-surface, one of these sets being the tail-grippers hereinbefore referred to. One of these sets of grippers—viz., the tail-grippers—is operative when the machine is running as a perfecting-press and the other is operative when the machine is running as a color-machine. These sets of grippers and their operating mechanisms will now be described.

Suitably mounted in the impression-cylinder 3 (see Figs. 2 and 6) is a shaft 51, which carries a pair of cross-arms 52. Journaled in one end of the pair of cross-arms 52 is a shaft 53, which is provided with a set of gripper-fingers 54, which will be hereinafter denominated as the "taking" gripper-fingers. In the same end of the arms 52 there is mounted a shaft 55, which is provided with a set of gripper-fingers 56, which will be hereinafter denominated as the "releasing" gripper-fingers. These gripper-fingers 54 56, which together constitute the tail-grippers, may be of any usual construction and may be secured to their shafts in any usual manner. These grippers may also be operated in any desired manner. In the machine shown the shaft 53 is provided with an arm 57, which carries a bowl or stud 58, which contacts with a cam to be hereinafter described and by which the shaft is rocked to move the gripper-fingers 54. The shaft 55 is provided with an arm 59, carrying a stud or bowl 60, which also contacts with a suitable cam, by which said shaft is rocked to move the gripper-fingers 56. The shaft 53 is provided with a spring 53″, by which it is rocked in opposition to the movement provided by its bowl and arm, and the shaft 55 is similarly provided with a spring 55″.

The function of the gripper-fingers 54 56 is, as has been heretofore stated, to take the tail of the sheet as it lies on the impression-surface 3′ and transfer it to the impression-surface 3″, by which movement the sheet is reversed in position—that is to say, that end of the sheet which was the tail of the sheet when the first impression was made becomes the head of the sheet when the second impression is made and the sheet is turned over, so that its unprinted surface will be outward.

The movement of the gripper-fingers 54 and 56 just referred to is effected by rocking the shaft 51, on which the arms 52, which carry the

shafts 53′ 55, are mounted. The shaft 51 may be rocked by various mechanisms. In the machine shown this shaft is provided with a segmental gear 61, which meshes with a segment 62. The segment 62 is preferably cast in one piece with a hub 63, which is mounted on a stud 64, located in one of the cylinder-heads. The hub 63 is provided with an operating-arm 65, carrying a stud or bowl 66. The bowl 66 is operated upon by a suitable cam, to be described hereinafter, and causes the segment 62 to rotate the segment 61 of the shaft 51. The hub 63 is also provided with an arm 67, to which is connected a spring-rod 68. This spring-rod is surrounded by a spring 69. (See Fig. 5.) The operation of the spring-rod and spring is to hold the hub in one or the other of its two positions, the said rod passing by the center in a well-known manner as the hub is rotated. The hub 63 is further provided with a grooved tumbler-block 70, which operates the hub, as will be hereinafter described.

After the sheet has been taken from the feed-board by the grippers 20 and while it is being carried around to receive its first impression the gripper-fingers 54 56 are in the position indicated in dotted lines in Fig. 5 and in full lines in Fig. 9—that is to say, these gripper-fingers rest against the tail of the impression-surface 3″, the gripper-fingers 56 being next said impression-surface. As the impression-cylinder 3 revolves the sheet receives its impression and at the same time is smoothed and stretched. At that time in the revolution of the cylinder 3 when the sheet has been partly printed the bowl 58 on the arm 57 of the shaft 53 (see Fig. 6) strikes a cam 71, which is suitably connected to the frame of the machine, being in the present machine removably connected by bolts 71′. This cam through the bowl and arm rocks the shaft 53, and consequently moves the gripper-fingers 54 into the position shown in Fig. 6, in which position the tail of the sheet S lies between these fingers 54 and the fingers 56. As the bowl 58 runs off the cam 71 the gripper-fingers 54 will be closed in an ordinary manner by the spring 53″.

At the time when the tail of the sheet is seized by the gripper-fingers 54 56 the head of the sheet has been delivered to the grippers 25 on the first transfer-cylinder 14 in the manner heretofore described and is being carried around that cylinder. As the operation of the machine continues the head of the sheet is delivered from the grippers 25 to the grippers 28 on the second transfer-cylinder and is carried around the said cylinder, the tail of the sheet being held by the grippers 54 56. As soon as the grippers 54 56 pass the gap in the first transfer-cylinder the shaft 51, which carries the arms 52, begins to rotate, this rotation being effected by the engagement of the bowl 66 on the arm 65 with a grooved cam 72, mounted on the frame of the machine. This grooved cam 72 has an eccentricity sufficient to give the shaft 51 a rotation of sufficient speed, so that by the time the second impression-surface 3″ of the impression-cylinder 3 reaches the form-surface on the cylinder 9 the grippers 54 56 will have been moved from the impression-surface 3′ to the impression-surface 3″ and will have carried with them the tail of the sheet. By the time the grippers 54 56 have swung over to the surface 3″ the head of the sheet has been released by the grippers 28, and the sheet is now carried forward by the grippers 54 56, being drawn backward from between the transfer-cylinders 14 and 16. The sheet having received its second impression from the form-surface 9, acting in connection with the second impression-surface 3″, must now be delivered.

Any suitable form of delivery mechanism may be used. In the machine shown there is, as has been before said, a delivery-cylinder 18, (see Fig. 5,) which is mounted on the shaft 19 and which is provided with a set of grippers 73, which are carried on a shaft 74. The shaft 74 has an arm 75 extending therefrom, which carries a bowl 76. This bowl 76 contacts with a cam 77, suitably mounted on the frame of the machine, which operates to open the grippers to receive the sheet and is operated by a cam (not shown) to open the grippers to deliver the sheet to any suitable device, such as tapes or a fly.

It is to be noted that after the grippers 54 56 have swung from the first impression-surface to the second the gripper-fingers 54, which were the top grippers in the first instance, have now become the under grippers. As the gripper-fingers 54 56 approach the point where they are to deliver the sheet to the gripper-fingers 73 of the delivery-cylinder it is necessary, therefore, that the fingers 56, which are now the upper grippers, be rocked in order to release the sheet. This rocking of the grippers may be effected in various ways. In the machine shown there is provided a short shaft 78, (see Fig. 7,) which finds its bearings in the cylinder gear and head. This shaft 78 carries at its outer end an arm 79, which is provided with a bowl 80. The shaft also carries intermediate its ends a toe-piece 81, and at its inner end it carries a hub 82, from which extend arms 83 and 84. The arm 83 bears against the inner side of the impression-surface 3″ and acts as a stop. The arm 84 has connected to it a spring 85, the other end of which is secured to a block 86, fastened on one of the arms of the cylinder-head. At the time when the gripper-fingers 54 56 come into position to deliver the sheet (see Fig. 5) the bowl 80 on the arm 79 strikes a fixed cam 87, secured to the frame of the machine. This rocks the shaft 78 and causes the toe-piece 81 to strike the bowl 60 on the arm 59 of the shaft 55. When the toe-piece 81 strikes the bowl 60, the shaft 55 will be rocked and the gripper-fingers 56 moved outward, so as to release the sheet, which is then taken by the grippers 73 on the cylinder 19.

The gripper-shaft 55 is provided with a stop-lug 55′, which limits the movement of the shaft 55 and the gripper-fingers 56 under the the stress of the spring 55″. The shaft 53 is provided with a lug 53′, which limits the movement of the shaft 53 and the gripper-fingers 54 under the stress of the spring 53″. Located alongside of each impression-surface are threaded lugs 88 89, (see Fig. 9,) in which are mounted screws 90 91, said screws serving as stops with which any of the arms 52, which carry the shafts 53 55, contact. After the sheet has been delivered to the delivery-cylinder it is necessary to again rock the shaft 51, so as to throw the gripper-fingers 54 56 over against the other impression-surface, so that they may be in position to act upon the tail of a new sheet. In order to accomplish this movement of the shaft 51, the tumbler-block 70 engages with a fixed tumbler-pin 92, (see Figs. 1 and 5,) which is suitably mounted on the frame of the machine. The engagement of the tumbler-block 70 with the pin 92 rocks the hub 63 and through the gears 61 and 62 effects the rotation of the shaft, and thus throws the arm 52 and the shafts 53 55, together with the grippers carried by them, into the position indicated in dotted lines in Fig. 5.

By the operations so far described the machine has taken a sheet, printed it on both sides, and delivered it, and these operations will be repeated for successive sheets.

When the machine is to print two colors on the same side of a sheet, the swinging grippers 54 56 are not used, but remain continuously in the position shown in Fig. 9. During the two-color-printing operation, therefore, the cam 71, which operates the grippers 54 through the bowl 58 and its connections, is removed from the machine by taking out the bolts 71′. The cam 72, which operates the shaft 51 and swings the grippers 54 56 to reverse the sheet, is also not used and is therefore removed from the machine or may be moved outward out of the path of the bowl 66. (See Fig. 2.) In the same way the tumbler-pin 92 is slid back, so that it will be out of the path of the tumbler 70.

In the two-color operation after the sheet has received its first impression from the first impression-surface 3′ and the printing-surface on the cylinder 6 it is taken by the grippers 25 on the first transfer-cylinder, carried around by said cylinder, and redelivered to a set of grippers on the impression-cylinder 3, which coacts with the impression-surface 3″. The set of grippers on the impression-cylinder 3, which has just been referred to, is marked 93 and is carried on a shaft 94, (see Fig. 9,) which is mounted in the arms 52′, which are mounted on the shaft 51. These arms are preferably mounted on the same hub and cast integral with the arms 52. The shaft 94 is provided with a collar 95, which carries a toe-piece 96. The toe-piece 96 when the grippers 93 are in position to take and deliver the sheet is so located as to be struck by the arm 84 on the short shaft 78, before described. It is obvious, therefore, that if the shaft 78 be rocked at the proper times the grippers 93 will be opened and closed to take and deliver the sheet.

It has already been stated that the shaft 78 is provided with an arm 79, carrying a bowl 80. In the two-color operation a cam 97 (see dotted lines in Fig. 8) is mounted on the frame of the machine near the point where the grippers 26 are to redeliver the sheet to the impression-cylinder. As the cylinder in its rotation brings the second impression-surface 3″ into position to receive the sheet from the transfer-cylinder the cam 97 strikes the bowl 80, rocks the shaft 78, causes the toe-piece 84 to strike the toe-piece 96, and operates the grippers 93 to take the sheet from the grippers 25 on the transfer-cylinder. The sheet being thus taken is carried around and receives its second printing, after which the bowl 80 on the arm 79 strikes the cam 87, before described, and opens the grippers, so that the sheet may be taken by the grippers 73 on the delivery-cylinder. Inasmuch as the grippers 25 on the first transfer-cylinder are not to deliver the sheet to the second transfer-cylinder, the operating-cam 33 is removed, this being readily done by unscrewing the bolts by which it is connected to the arms 34. Since, furthermore, the grippers 25 are first to take the sheet from the impression-cylinder and then redeliver it thereto, it is necessary that the cam 31, which operates these grippers, act on the grippers earlier when it opens them to take the sheet than it does when it opens them to deliver the sheet. The two positions of the cam are shown in Fig. 8, the position of the cam 31 when it operates the grippers to deliver the sheet being shown in full lines and the position of the said cam when it operates to open the grippers to take the sheet being shown in dotted lines. The movement of the gripper-operating cam 31 is effected through the cam 39 by the connections before described.

The various parts of the machine may be driven in any suitable manner. In the machine shown a power-shaft 98 is shown as mounted in suitable bearings 99, secured to the machine-frame, the said shaft carrying belt-pulleys 100. The shaft 98 also carries a pinion 101, which meshes with a gear 102 on the first transfer-cylinder. The gear 102 meshes with a gear 103 on the second transfer-cylinder and with a gear 104 on the impression-cylinder. The gear 104 on the impression-cylinder meshes with gears (not shown) on the form-cylinders and also with a gear 105 on the delivery-cylinder. The way cam-shaft 40 is provided with a worm-wheel 106, which meshes with a worm 107 on the power-shaft 98.

The operation of the machine as a whole

will be readily understood from the description before given taken in connection with the following brief description.

Suppose the machine to be operating as a perfecting-machine. A sheet will be taken from the feed-board 2 by the grippers 20 and will be carried around and receive its first impression from the form on the form-cylinder 6, the sheet at that time lying on the first impression-surface 3′. As the head of the sheet reaches the first transfer-cylinder the grippers 20 will be operated by the tumbler-pin 24 to release the sheet, and the sheet will be taken by the grippers 25, these grippers being operated to take the sheet by the cam 31 striking the bowl on the arm 27, which is attached to the shaft 26. The sheet having been taken by the first transfer-cylinder is carried forward around said cylinder until it reaches the point where it is transferred to the second transfer-cylinder. When it reaches this point, the cam 33 operates the grippers 25 through the same connections to release the sheet, and its head is seized by the grippers 28, these grippers being operated by the bowl on the arm 30 of the shaft 29 striking the cam 41, this cam having been slid into the path of these grippers by the operation of the cam 50, operating on the bowl 49 of the rod 47. In the meantime the bowl 58 on the arm 57 has come into contact with the cam 71 and the shaft 53 has been rocked to move the gripper-fingers 54 into a position above the tail of the sheet. As the bowl 58 runs off the cam 71 the shaft 53 is rocked by the spring 53″ and the grippers 54 close down on the tail of the sheet. As the impression-cylinder continues to revolve the bowl 66 on the arm 65 enters the cam 72, and as soon as the gripper-fingers 54 56 have passed the first transfer-cylinder the cam 72 acts to swing the hub 63 and cause the segments 62 61 to rock the shaft 51, thus swinging the tail of the sheet from the impression-surface 3′ to the impression-surface 3″. In the meantime the head of the sheet has been carried around by the second transfer-cylinder until the bowl on the arm 30 of the shaft 29 strikes the cam 42, thus rocking the grippers 28, so that they open and release the sheet. The sheet is now free to be drawn backward between the cylinders 14 and 16, which will happen as soon as the gripper-fingers 54 56 have been swung from the impression-surface 3′ to the impression-surface 3″. This position of the parts is shown in Fig. 4, the position of the sheet at this time being indicated in this figure by the dotted lines. As the cylinder continues to rotate the sheet having been turned over and turned end for end receives its second impression from the form on the cylinder 9. When the grippers 54 56, which are holding the now leading end of the sheet, reach the position where the sheet is to be delivered to the grippers 73 on the delivery-cylinder, the bowl 80 runs on the cam 87 and rocks the short shaft 78. This causes the toe-piece 81 to operate on the bowl 60, rock the shaft 55, and raise the gripper-fingers 56, so that the sheet can be taken by the grippers 73. As soon as the sheet has been taken from the grippers 54 56 the tumbler-block 70 engages the pin 92 and causes the segment 62 through the segment 61 to rock the shaft 51 in the opposite direction, thus throwing the grippers 54 56 from the impression-surface 3″ to the impression-surface 3′, as indicated in dotted lines in Fig. 5. In the meantime a second sheet has been taken from the feed-board by the grippers 20, and the operations which have just been described will be repeated.

Suppose now that the machine is to be operated as a two-color machine. The cam 71 will be removed, the cam 72 will be either removed or moved backward out of the path of the bowl 66, the cam 33 will be removed from the arm 34, and the tumbler-pin 91 will be slid back out of the path of the tumbler-block 70. The cam 97 will be secured to the side frame in its proper position. The gripper-operating mechanism on the second transfer-cylinder 16 is also rendered inoperative, which may be done in various ways—as, for instance, by removing the pin 49 and throwing the lever-arm 45 outward, so as to bring the arm 43 and the cams 41 42 out of the path of the bowl on the arm 30. The changes referred to having been made in the machine, the sheet will be taken by the grippers 20, as before, from the feed-board and carried around, receiving its first impression from the form on the cylinder 6, after which it is delivered to the grippers 25 on the first transfer-cylinder, the said grippers being operated by the cam 31, as before described. The sheet is carried around by the cylinder and is transferred with its printed side out to the grippers 93, which coöperate with the second impression-surface 3″. After having been taken by these grippers it is carried forward and receives its second impression from the form on the cylinder 9. After the sheet is printed and it reaches the point where it is to be delivered to the grippers 73 on the delivery-cylinder the short shaft 78 is rocked by the contact of the bowl 80 with the cam 87, thus causing the arm 84 to strike the projection 96 on the gripper-shaft 94 and open the grippers, after which the sheet is taken by the grippers 73 on the delivery-cylinder.

Various changes and modifications may be made in the mechanisms by which this invention is carried into effect. The invention is not, therefore, to be limited to the specific construction which has been shown and described, but is to be regarded as generic in its nature and as embracing all changes and modifications which fall within its spirit and scope.

What I claim is—

1. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of two form-carriers, means

carried by the cylinder for transferring the sheet from one impression-surface to the other, means independent of the cylinder for transferring the sheet from one impression-surface to the other, and devices whereby either set of means may be made operative, substantially as described.

2. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces and a set of grippers for taking the leading edge of the sheet, of means coöperating therewith whereby a sheet may be given two impressions, means for removing the sheet from the first impression-surface by its leading edge after the first impression and transferring it to the second impression-surface with the same side out so that it may receive a second impression on the same side, a second set of grippers for seizing the tail of the sheet; and devices cooperating therewith for removing the sheet from the first impression-surface turning it over and end for end and transferring it to the second impression-surface with its unprinted side out, so that it may receive a second impression on the opposite side, and devices whereby either set of transferring means may be caused to transfer the sheet, substantially as described.

3. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of means coöperating therewith whereby a sheet may be given two impressions, means carried by the cylinder for removing the sheet from the first impression-surface by its leading edge after the first impression and transferring it to the second impression-surface with the same side out so that it may receive a second impression on the same side, means independent of the cylinder for removing the sheet from the first impression-surface and transferring it to the second impression-surface with its unprinted side out so that it may receive a second impression on the opposite side, and devices whereby either set of transferring means may be caused to transfer the sheet, substantially as described.

4. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of two rotating form-carriers coöperating therewith whereby a sheet is given two impressions, means for removing the sheet from the first impression-surface by its leading edge after the first impression and transferring it to the second impression-surface with the same side out so that it may receive a second impression on the same side, means including devices carried by the cylinder for turning the sheet over and end for end and transferring it to the second impression-surface with its unprinted side out so that it may receive a second impression on the opposite side, and devices whereby either set of transferring means may be caused to transfer the sheet, substantially as described.

5. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of means coöperating therewith whereby the sheet is given two impressions, a set of transferring-grippers operating to transfer the sheet by its rear edge from one impression-surface to the other, a set of transferring-grippers operating to transfer the sheet by its leading edge from one impression-surface to the other, and means whereby either set of transferring-grippers may be caused to transfer the sheet, substantially as described.

6. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of means coöperating therewith whereby the sheet is given two impressions, a set of transferring-grippers carried by the cylinder and operating to transfer the sheet by its rear edge from one impression-surface to the other, a set of transferring-grippers mounted independently of the cylinder operating to transfer the sheet by its leading edge from one impression-surface to the other, and means whereby either set of transferring-grippers may be caused to transfer the sheet, substantially as described.

7. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of two form-carriers coöperating therewith, a set of grippers carried by the cylinder operating to transfer the sheet by its rear edge from one impression-surface to the other, a gripper-carrier having a set of grippers operating to take the sheet by its leading edge, means whereby said grippers may be operated either to again present the leading edge of the sheet to the cylinder or to release it without so presenting it, a second set of grippers carried by the cylinder for receiving the leading edge of the sheet, and means whereby either set of grippers carried by the cylinder may be rendered operative or inoperative, substantially as described.

8. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of means coöperating therewith whereby a sheet may be given two impressions, a set of grippers operating to transfer the sheet from one impression-surface to the other by its rear edge, a rotating gripper-carrier having grippers for receiving the leading edge of the sheet, and means whereby the gripper-carrier may be caused to either deliver the sheet to the cylinder or release it without so delivering it, substantially as described.

9. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of means coöperating therewith whereby a sheet may be given two impressions, a set of grippers carried by the cylinder operating to transfer a sheet from one impression-surface to the other by its rear edge, a rotat-

ing gripper-carrier having grippers for receiving the leading edge of the sheet, a second rotating gripper-carrier, means whereby the first rotating gripper-carrier may be caused to deliver the sheet either to the cylinder or to the second rotating gripper-carrier, means for rendering the grippers on the second gripper-carrier either operative or inoperative, a second set of grippers on the impression-cylinder for receiving the leading edge of the sheet from the grippers on the first gripper-carrier, and means whereby either set of grippers on the cylinder may be rendered operative, substantially as described.

10. In a printing-machine, the combination with an impression-cylinder, of means coöperating therewith to give a sheet two impressions, and means carried by the cylinder whereby the sheet is turned over and end for end between the impressions, substantially as described.

11. In a printing-machine, the combination with an impression-cylinder, of means coöperating therewith to give a sheet two impressions, means carried by the cylinder for seizing the sheet by its rear edge and turning it over and end for end between impressions, and means for controlling the leading edge of the sheet while the sheet is being turned, substantially as described.

12. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of two rotating form-carriers coöperating with the impression-surfaces, and means carried by the cylinder whereby the sheet is turned over and end for end between the impressions, substantially as described.

13. In a printing-machine, the combination with an impression-cylinder, of two rotating form-carriers coöperating with the impression-cylinder, means whereby the sheet is seized by its rear edge and turned over and end for end between the impressions, and means whereby the leading edge of the sheet is controlled while the sheet is being turned, substantially as described.

14. In a printing-machine, the combination with an impression-cylinder, of means for printing the sheet, means for removing the sheet from the cylinder by its leading edge, devices for causing said means to release the sheet, and means for taking the sheet by its rear edge and returning it to the cylinder with its unprinted side up, substantially as described.

15. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces spaced apart, of a set of grippers, means for opening and closing the same means whereby said grippers while holding the sheet are moved from the edge of one impression-surface to the edge of the other impression-surface, substantially as described.

16. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces spaced apart, of two sets of grippers pivoted in the space between the impression-surfaces, means whereby the grippers are swung on their pivot from one impression-surface to the other, and means coöperating with each set of grippers to manipulate the sheet, substantially as described.

17. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces suitably spaced apart, of two sets of grippers pivoted in the space between the impression-surfaces one for operating on the head of the sheet and one for operating on its tail, means for printing the sheet, means for operating the tail-grippers to seize the sheet, means for taking the leading edge of the sheet from the sheet-taking devices of the cylinder after it has been printed, and means for swinging the grippers from their position at the rear edge of the first impression-surface to the front edge of the second impression-surface, sustantially as described.

18. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces spaced apart, of a set of tail-grippers pivoted in the space between the impression-surfaces and resting against the rear edge of the first impression-surface, means for printing the sheet, means for operating the grippers to seize the rear edge of the sheet, means for swinging the tail-grippers from their position at the rear edge of the first impression-surface to the front edge of the second impression-surface, means for taking the front edge of the sheet from the cylinder and for forwarding it until the tail-grippers have completed their movement, means for giving the sheet a second impression, means for opening the tail-grippers to deliver the sheet, and means for returning said grippers to their position against the rear edge of the first impression-surface, substantially as described.

19. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of means for giving the sheet two impressions, a set of tail-grippers pivoted between the impression-surfaces and resting against the rear edge of the first impression-surface, means for operating the tail-grippers to cause them to close on the sheet, a gripper-carrier having a set of grippers to take the leading edge of the sheet from the sheet-taking devices on the impression-cylinder, a second gripper-carrier having grippers for receiving the sheet from the first carrier, means operating to swing the tail-grippers from their position against the rear edge of the first impression-surface to the front edge of the second impression-surface, means for causing them to release the sheet, and means for returning them to their position against

the rear edge of the first impression-surface, substantially as described.

20. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of a gripper-carrying frame pivoted between the surfaces, a set of grippers mounted in the frame and consisting of two sets of movable gripper-fingers, means for rocking the frame so as to shift the grippers from one impression-surface to the other, means for moving one set of gripper-fingers to seize the sheet, and means for operating the other set of gripper-fingers to release the sheet, substantially as described.

21. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of a frame pivoted between the impression-surfaces, two sets of grippers mounted in the frame, and removable means for swinging the frame on its pivot to shift one set of grippers from one impression-surface to the other, substantially as described.

22. In a printing-machine, the combination with an impression-cylinder having two impression-surfaces, of a shaft mounted between the surfaces, a gripper-carrying frame mounted on the shaft, two sets of grippers mounted in the frame, a rocking arm mounted in the impression-cylinder, means whereby the movement of the arm is caused to rock the shaft carrying the gripper-carrying frame, and a removable cam-track for operating the arm, substantially as described.

23. In a printing-machine, the combination with a cylinder having two impression-surfaces, of a set of grippers consisting of two sets of pivoted gripper-fingers mounted in the cylinder, means for rocking one set of gripper-fingers so as to cause them to close upon a sheet while the sheet is lying upon one impression-surface, means for swinging the gripper-fingers while holding the sheet to the other impression-surface, means for controlling the other edge of the sheet during the swinging movement of said gripper-fingers, and means for thereafter rocking the other set of gripper-fingers to release the sheet, substantially as described.

24. In a printing-machine, the combination with an impression-cylinder having suitable sheet-taking devices and two impression-surfaces, of a gripper-carrying frame pivoted between the impression-surfaces, a set of grippers mounted in the frame and resting against the rear edge of one impression-surface, a shaft on which the frame is mounted, a hub pivoted in the impression-cylinder, an arm for rocking the hub, means whereby the movement of the hub rocks the shaft upon which the gripper-carrying frame is mounted, a cam in the path of the arm on the hub, said cam and arm operating to rock the hub in one direction, a tumbler-block also connected to the hub, and a pin on the frame with which the said tumbler-block engages, said pin and tumbler-block operating to rock the hub in the opposite direction, substantially as described.

25. In a printing-machine, the combination with a cylinder, of a pivoted support, a set of grippers consisting of two sets of gripper-fingers pivoted on the support, means for operating one set of the gripper-fingers to take a sheet, means for turning the support on its pivot to reverse the position of the gripper-fingers and sheet, and means for operating the other set of gripper-fingers to release the sheet, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

THOMAS M. NORTH.

Witnesses:
F. W. H. CRANE,
L. ROEHM.