J. North. Sheet 1. 2 Sheets.

Paper Folder.

No. 35738. Patented Jun. 24. 1862.

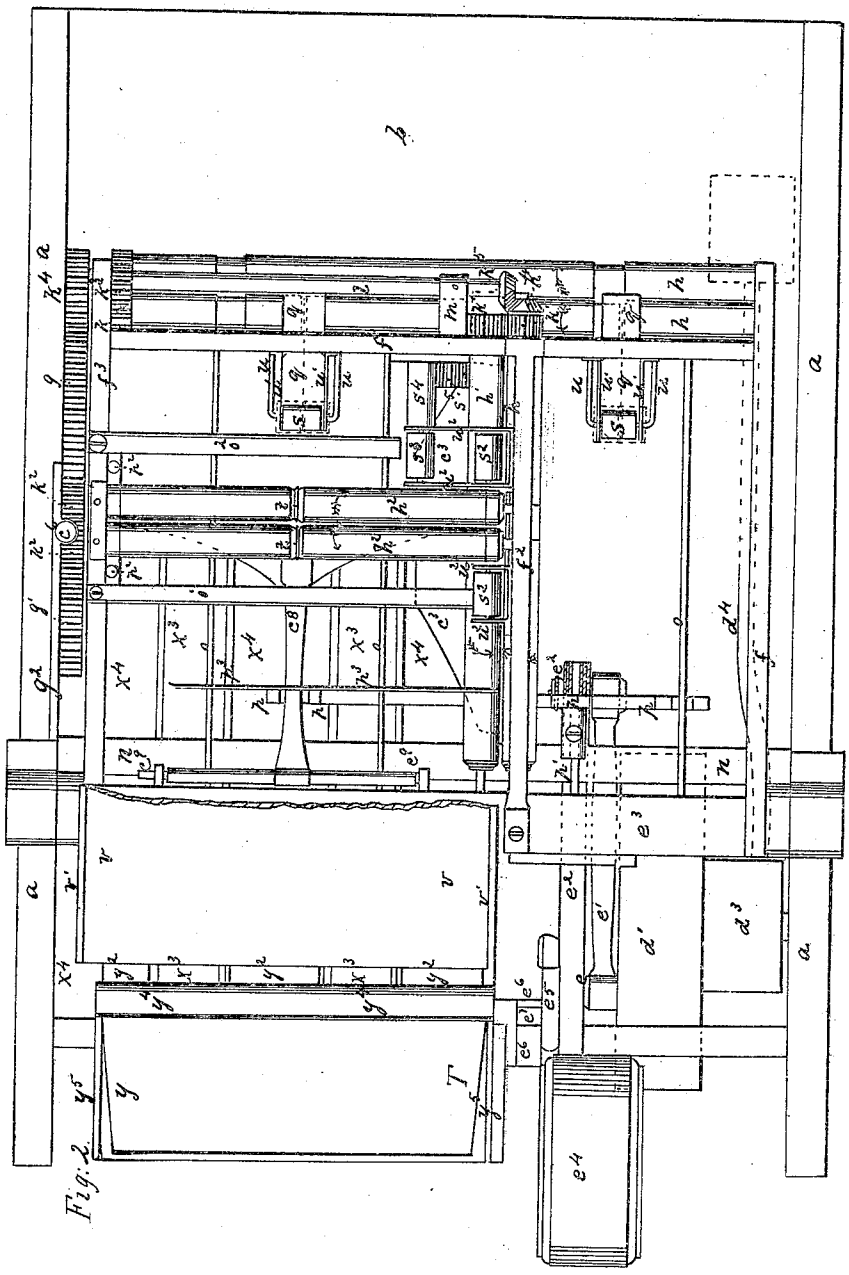


Fig. 2.

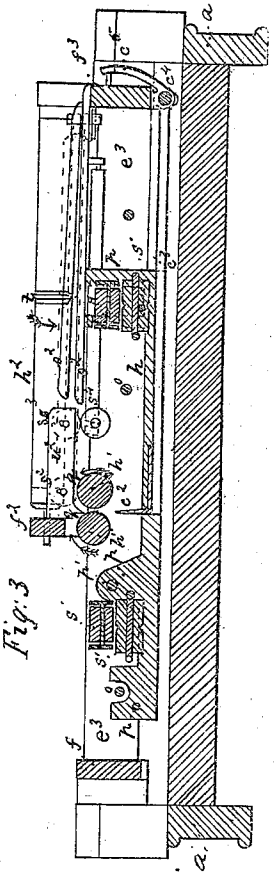


Fig. 3

Witnesses.

N. S. Geary

Saml. W. Blunt

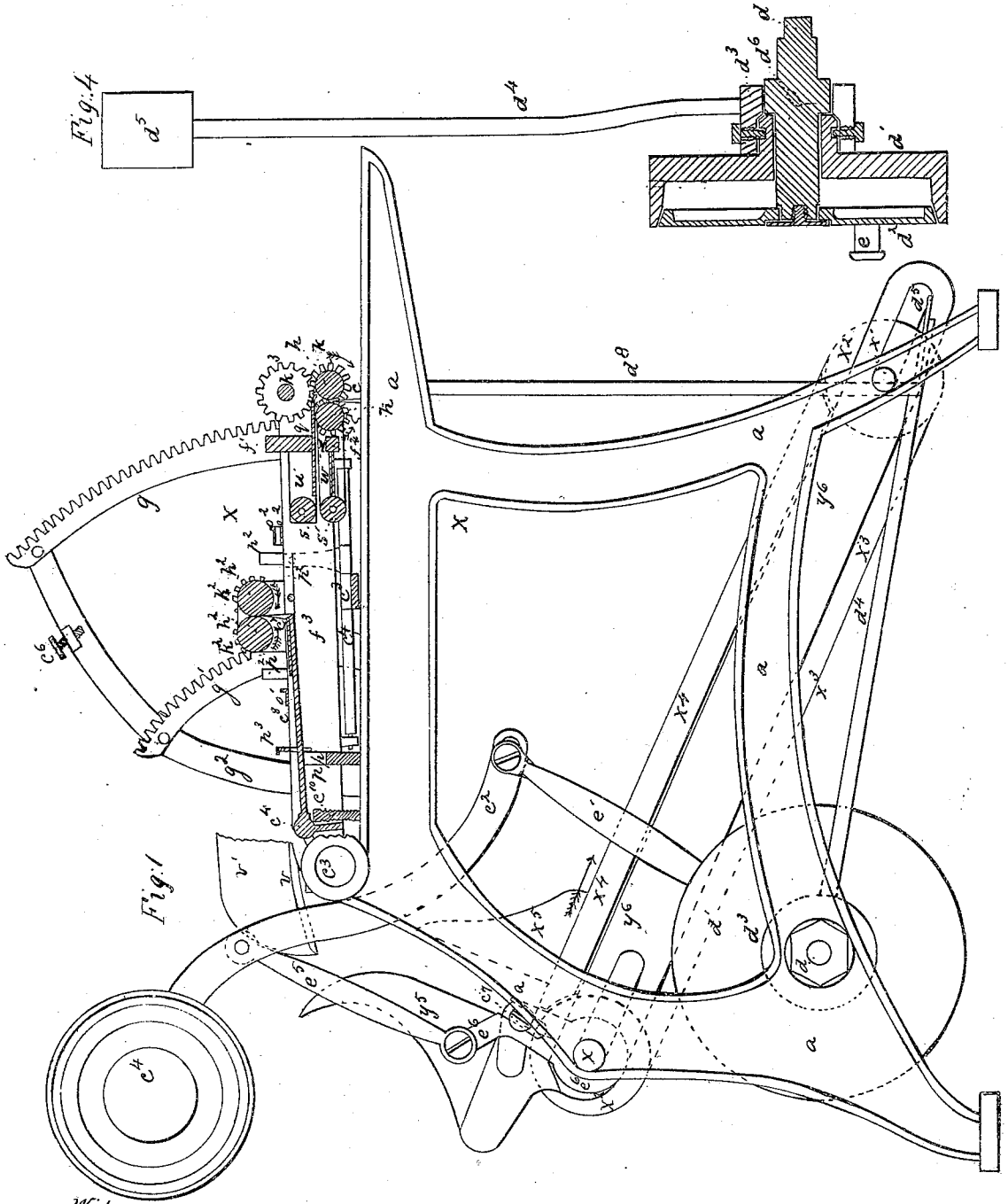
Inventor

John North

J. North. Sheet 2. 2 Sheets.

Paper Folder.

No. 35738. Patented Jun. 24. 1862.



Witnesses.
N S Geary
Saml H Blunt

Inventor.
John North

UNITED STATES PATENT OFFICE.

JOHN NORTH, OF MIDDLETOWN, CONNECTICUT, ASSIGNOR TO W. H., JOHN A., DANIEL S., AND SAML. F. APPLETON, OF NEW YORK, N. Y.

PAPER-FOLDING MACHINE.

Specification forming part of Letters Patent No. **35,738**, dated June 24, 1862.

To all whom it may concern:

Be it known that I, JOHN NORTH, of Middletown, in the county of Middlesex and State of Connecticut, have invented certain new and useful Improvements in Machinery for Folding Paper; and I do hereby declare that the following specification, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings, Figure 1 is a side elevation of my machine, with certain parts represented as broken away and other parts shown in section. Fig. 2 is a top view of the machine, or a plan with part of the delivery-board broken away, so as to show the parts beneath. Fig. 3 is a vertical cross section, on the line *x x* of Fig. 1, of parts of the machine; and Fig. 4 is a horizontal section through the stop-motion and driving-pulley.

All parts of the machine which might properly be represented on the various figures are not shown, in order to avoid obscurity; but each part is shown in one or more of the figures with sufficient precision to inform a constructor of the machine when aided by the description.

Prior to the date of my invention various machines have been devised having for their object the folding of paper after it has been printed, one large class of them having the following general characteristics, namely: blades to force sheets of paper between nipping-rollers, revolving nipping-rollers to draw the paper from the knives and fold it, tapes to carry it as folded to other knives, and then other rollers, tapes, knives, &c., in succession, properly arranged to give the various folds to the paper, which is properly guided and stopped so that it may be properly acted upon by the various knives and rollers.

My improved machine has these characteristics in so far as they are common to the class, except the endless tapes or bands for carrying the paper after it is folded or while it is being folded. These, which are a continual source of annoyance, I have dispensed with.

My machine has all its parts mounted on a strong metallic framing, (shown at *a a a*,) on which is supported a table, *b*, extending from side to side of the frame and rearward toward the delivery end as far as may be necessary to support the sheets that are to be folded. This table has extending across it and projecting above its surface a blade, *c*, which has extending above its upper edge proper registering-points, so as to insure a proper presentation of the sheet to be folded.

At the rear end of the machine, and at the lower part thereof, is supported a stud or pin, *d*, on which is fitted so as to turn freely a belt-pulley, d', and a disk, d^2. The pulley is bored out conically and the periphery of the disk is turned off to fit the concavity. (See Fig. 4.) The disk is held in place by a screw with a flat head and the pulley is free to slide endwise along the stud. A boss projects from the pulley and has a groove turned in it. Into this groove enter the points of screws, which pass through a sleeve, d^3. This sleeve is free to slide on the stud, and also to turn on it through a small arc of a circle, and has firmly attached to it a rod, d^4, terminating in a pedal, d^5. This pedal and rod are held upward by any proper spring—such as a band of india-rubber, d^8—which surrounds the rod and is secured to the under side of the table. Other screws (not shown in the drawings) pass through the sleeve, and their points enter spiral slots like portions of screw-threads (one of which is indicated at d^6) cut into the periphery of the stud or pin *d*. When the pedal is depressed, these screws, acting on the slots, throw the pulley away from the disk, so that the former may revolve without moving the latter. When the spring lifts the pedal, the pulley will slide in the opposite direction, and if it be driven by a band will cause the disk to revolve with it. The whole contrivance forms a friction-clutch, by means of which the machine may be put in motion or stopped.

From the disk extends a crank-pin, *e*, which actuates a connecting-rod, e', whose other end takes hold of a pin secured to an arm, e^2. This arm is secured upon a rock-shaft, e^3, which extends completely across the machine from side to side and gives motion to all the moving parts of the machine, which I call the "main" rock-shaft. The arm e^2 extends upward and rearward and terminates in a balance-bob, e^4, and from the extended part of this

arm depends a link, e^5, pivoted upon a pin made fast to the arm. The office of this link will be described hereinafter.

Upon the rock-shaft are secured two stout arms, $f\ f^3$, extending toward the front of the machine, and these arms carry all the rollers, guides, stops, deflectors, cogs, and knives, except the stationary knife before described as secured to the table. These arms are connected each to the other near their front ends by a cross-bar, f', and a horizontal bar, f^2, is secured to f' and to the rock-shaft, the whole constituting a vibrating frame. This vibrating frame is balanced or counterpoised by the balance-bob, and in consequence of being counterpoised it moves more regularly and with less jar to the machine than it would do if the weight were entirely upon one side of the rock-shaft.

Upon the right side of the frame, looking rearward, are mounted two toothed sectors, g g'. These sectors are stationary and are struck from the same center as that on which the rock-shaft oscillates. These sectors are supported and strengthened by a standard, g^2, also attached to the frame, and with their teeth engage the teeth of the cog-gearing which actuates the various rollers, the cog-wheels being forced to revolve first in one direction and then in the other, owing to the fact that they are mounted upon the arms $f\ f^3$, which oscillate up and down as the rock-shaft is oscillated by the connecting-rod which is attached to the revolving driving-disk.

Two rollers, $h\ h$, are supported in the forward ends of the arms. They extend across the machine from one arm to the other, are free to turn in either direction, and have secured upon their ends which are nearest to the sectors cog-wheels $k\ k$. These cog-wheels are in gear with one another, and also with a cog-wheel, k^3, mounted on a shaft, l, which extends crosswise of the arms and parallel to the rollers $h\ h$, being supported at one end by one of the arms and at the other by a hanger, m, projecting from the cross-bar f'. On the end of this shaft which projects beyond the arm is hung another cog-wheel, k^4, which engages with the sector g. The rollers $h\ h$ are near enough together to seize a double sheet of paper when presented to their grip by the blade c, and I call them the "first" pair of folding-rollers.

Another pair of rollers, $h'\ h'$, parallel to each other and sufficiently far apart to seize a sheet twice doubled, extend longitudinally from the cross-bar f' to the rock-shaft e^3. On their ends which project in front of f' are two gear-wheels, $k'\ k'$, whose teeth are engaged, and on one of these rollers is mounted a bevel gear-wheel, k^4, which engages with another bevel gear-wheel, k^5, hung upon the end of the shaft l. In consequence of this arrangement and connection of gearing this pair of rollers—called the "second" pair of folding-rollers—will revolve first in one direction and then in another as the arms move up and down.

Another pair of rollers, $h^2\ h^2$, extend from the arm nearest the sectors to the longitudinal bar f^2. These rollers are so arranged as to seize eight thicknesses of paper between them, and have on their ends which project over the arm cog-wheels $k^2\ k^2$, which are in gear with each other and with the sector-rack g'. When the arms are down upon the table, the rollers $h\ h$ are lowest, those $h'\ h'$ are above them, and the rollers $h^2\ h^2$ are highest of all, and when the arms are rising all the rollers revolve in the direction of the arrows marked upon them in the drawings.

A blade, c^2, is mounted upon a shank, c^3, which, by means of a rock-shaft, c^4, is pivoted beneath the arm nearest the sectors. Projecting upward from this shank is a tail, c^5, (best seen in Fig. 3,) which can strike against a pin projecting sidewise and outward from the arm f^3. This pin limits the blade in its downward motion. Another pin or stop, c^6, which should be adjustable, is mounted on a bracket extending inward from the brace g^2, and in such a position that the top of the tail c^5 shall strike it just before the arms reach their highest point. When the tail strikes this pin, the blade c^2 will be lifted and force paper lying above it into the grip of the rollers $h'\ h'$. Another blade, c^7, is mounted on a shank, c^8, pivoted upon the main rock-shaft at c^9, and has depending from it at ail. (Clearly seen in Fig. 1.) This tail limits the downward motion of the blade by striking against the main rock-shaft or a stop or pin projecting from it. An adjustable stop, c^{10}, projects upward from a stationary cross-bar, n, which unites the two sides of the main frame $a\ a$, and when the arms have descended nearly to their lowest point the shank c^8 strikes against this stop, which causes the blade c^7 to rise and force any paper lying above it into the grip of the rollers $h^2\ h^2$.

Wires or rods $o\ o\ o$ extend from the main rock-shaft to a cross-bar, f^4, which extends from arm to arm and lies underneath the cross-bar f'. Upon these wires the sheet of paper slides as it is rolled upward by the rollers $h\ h$.

Two rods, $o'\ o^2$, project from the arm f^3 toward the other arm. One of these rods, o^2, is represented as split, and the sheet of paper, as it is drawn upward by the rollers $h'\ h'$, slides over the rod o' and between the rods $o^2\ o^2$ toward the arm f^3.

An adjustable stop, p, is mounted upon a pin, p', projecting from the main rock-shaft. By means of a screw and slide (plainly shown in Fig. 2) this stop, whose forward surface is parallel to the axis of the rollers $h\ h$, can be adjusted forward and backward. The office of this stop is to arrest the sheet of paper as it is passed over the wires $o\ o$ after receiving its first fold. Another adjustable stop, $p^2\ p^2$, is supported upon a pin (clearly shown in Fig. 1) which projects from arm f^3 toward the cen-

ter of the machine. This stop can be moved toward and away from the rollers h' h', and its office is to arrest paper delivered through these rollers after having received its second fold. When the paper is traveling from these last named rollers along the rods o' o^2 toward the arm f^3, it might slide toward the rear of the machine, (owing to the inclination of the arms.) I have therefore arranged in the machine a guide, p^3, along which that edge of the paper nearest the rock-shaft may slide. This guide is, for the sake of convenience, attached to the stop p, as when thus mounted the same adjustment will serve for both. This guide, on which a folded edge slides in connection with propelling-rollers, hereinafter to be described, acting on the other edge of the sheet, performs an important office in keeping the sheet in a line of travel perpendicular to the axis of the folding-rollers, the propelling-rollers tending to twist the paper toward the guide, and the latter resisting this force, so that the paper moves into precisely the proper position to be acted upon by the next or third pair of rollers.

As the paper is carried upward by the rollers h h and h' h', it is necessary that it should be deflected off in a plane different from that in which it ascends, so that it may slide in the one case over the wires and in the other over he rods. In order to effect this object I use directors or deflectors q q. These deflectors in the case of the rollers h h are constructed of flat pieces of metal bent into the proper curve. In the case of the rollers h' h' they are constructed by working the edges of sheet metal into the proper curve. One set of these deflectors is attached to the cross-bar f', the other set to f^2. In either method of construction they present surfaces of metal to the edge of the fold of paper as it rises between the rollers, and by the curve of their acting surfaces and their arrangement with reference to the rollers, which are to be substantially such as shown in the drawings, they cause the edge of the fold, and consequently the folded sheet, to turn over in the required direction, so that it may pass along in a plane which is in proper position to permit the action of the next succeeding blade upon the paper. I have shown four of these deflectors as applied to the rollers h' h' and two wide ones as used in connection with the rollers h h. Their number is unimportant so long as it is sufficient to produce the required effect.

In addition to wires or rods on which the paper may slide and by which it is to be supported, some contrivance is necessary to carry the paper along over the wires. For this purpose I have used pressure-rollers, which nip the paper, one of each pair being caused to revolve at the same surface speed as the folding-rollers or a little faster. I sometimes intend to use one of the folding-rollers as one of a pair of pressure-rollers and at others to locate pairs of rollers at various convenient distances from the folding-rollers, as the exigencies of each particular case may require. These rollers should have their axes parallel to those of the folding-rollers, and the upper periphery of the lower roller of each pair should be in the plane in which the paper is to slide when supported on the wires or rods, or nearly so.

In the drawings two pair of propelling-rollers, s s s' s', are shown as applied in combination with the first pair of folding-rollers h h. The lower rollers of each pair are supported on rods u u, projecting from the cross-bar f^4, while the upper rollers are supported on brackets u' u', extending from the upper cross-bar, f'. Each lower roller has a small groove cut in it, and is to be caused to revolve by an endless string of catgut or twine passing round the roller and lying in this groove, and also passing around the folding-roller nearest to the propelling-roller and lying in a depression turned out in that roller. The journals of each upper roller rest in slots cut in the brackets, so that the roller may rise and fall, compressing by its own weight various thicknesses of paper between itself and the lower or driven roller.

Two small pressure-rollers, s^2 s^2, are supported by their axles resting in slots in brackets u^2 u^2, projecting from the bar f^2. These rollers, when no paper is being passed through the machine, rest upon one of the second pair of folding-rollers, and will nip the paper which is passing or has passed through that pair of rollers and has been deflected by the deflectors, and by so nipping the paper upon the folding roller that roller will also serve as a propelling-roller and will control the sheet, keeping it moving in lines perpendicular to the fold after it has passed from between the grip of the folding-rollers themselves.

Upon a spindle projecting from the bar f' is mounted a roller, s^5, and another roller, s^3, whose journals are free to slide up and down, lies over it parallel to and in contact with it when no paper is passing between them. The lower roller, s^4, is caused to revolve by the aid of a small friction-roller, s^5, lying between it and the nearest folding-roller. This friction-roller should be narrow, so that the edge of the paper shall not rest upon it, or, if wide enough to extend under the paper, it should be hung so low that the paper cannot touch its upper surface, which revolves in a direction contrary to that of the progression of the paper.

In an actual working-machine I have found the upper rollers, s^2 s^2, acting in connection with one of the folding-rollers, and a single pair of rollers, s^3 s^4, sufficient to cause paper to progress properly from the second pair of folding-rollers to the stop p^2 p^2; but, as I have before stated, the precise number and location of these rollers is immaterial so long as sufficient in number and properly located to perform the work required. The third pair of folding-rollers, for reasons hereinafter to be explained, need neither deflectors nor propell-

ing-rollers to be used in connection with them; but for certain kinds of work they may be provided with a pair of circular shears, *t t*, attached to them, which will slit the paper as it receives its last fold, cutting off what is technically known as an "inset."

A surface of wood or metal, *v v*, which I have termed a "delivering-board," is attached to the main rock-shaft and vibrates with it. This surface, as shown in the drawings, extends behind the rock-shaft, and should extend forward toward the rollers h^2 h^2. It is represented in the drawings as broken away, so as to exhibit those parts of the machine which lie beneath it. This board, in order to hold the paper perfectly secure, may have its upright sides v' v'. The office of this board is to receive the paper after it has received its last fold and discharge it off the machine, or into the compressing-box, if that be used, and also to keep the piles of folded paper from tumbling rearward.

Two cross bars, *x x'*, extend across the machine from side to side, and each supports rollers x^2 x^2, which rollers need not extend entirely across the machine, and should reach from the right side of the machine looking rearward toward the left side about as far as the delivery-board extends. These rollers are free to turn on the cross-rods *x x'*, and have passing around them endless bands x^3 x^3, the upper parts of which rest upon a slanting table or platform, x^4, (of about the same width as the rollers,) which is secured to the legs on the right side of the machine. Upon these tapes or bands are fastened two or more standards, x^5 x^5, whose rearward ends are united by surfaces of wood or metal which project upward at right angles to the slanting table and extend crosswise of the machine perpendicular to its sides. I intend usually to make two sets of standards, one for each tape, and have one surface governed by each tape, so that piles of paper of different length may rest against each surface, and so that the rearward surfaces of each pile may be in the same plane, or nearly so.

The object of the table, bands or tapes, rollers, and surfaces attached to the standards is to form a receptacle for folded paper, which lies edgewise on the table and is supported by the surfaces, which are held in place solely by the friction of the bands around the rollers. These surfaces, therefore, descend in the direction of the arrow on the table as more and more paper is forced in by the compression, hereinafter to be described.

When a proper load of paper is laid upon the table, it is to be removed by hand and the brackets with the surfaces that carry are to be slid up the table by hand in readiness to receive and support a fresh charge of folded paper. A flat piece of metal, *y*, projects from the rear end of the table, being secured fast to the upper part of the table and slotted out, so as to leave prongs, as shown at y^2 y^2, so that the tapes x^3 x^3 may pass up through the slots. This plate of metal passes through a slot in a curved surface, y^4, the lower part of which is perpendicular, or nearly so, to the surface of the inclined table, and the upper part of which is bent over backward. This curved surface is supported by two brackets, y^5 y^5, which are attached to or make part of two rods, y^6 y^6, lying under the table, one on each side thereof. These rods are slotted out, as clearly shown in Fig. 1, so as to embrace the rods x' x'. The pieces y^6 y^6 serve as guides and supports for the surface y^4, and this surface is free to slide backward and forward in planes parallel with the surface of the table, or thereabouts, being forced to move at each vibration of the main shaft through the agency of the link e^5, which rocks the arm e^6, pivoted upon the cross-arm *x*. In this arm e^6 is a slot into which extends a pin, e^7, which is secured to one of the brackets y^5. The office of the curved surface, which I call a "compressor," is to leave the pile of folded sheets so that a fresh sheet may be dropped between it and the top of the pile and then to advance toward the top of the pile, shoving the last-dropped sheet into contact with the others, and it may be shaped, actuated, and guided in various ways provided it accomplishes the object.

The operation of the whole machine is as follows: When the disk is caused to revolve, paper is laid upon the table *b*, while the arms carrying the rollers are at the top of their upward motion (or somewhere about that time) and this sheet of paper is properly located by the register-pins. As the arms descend, the rollers *h h* depress the paper over the stationary blade, so that the paper receives a bend and is forced into the nip or grip of the rollers. As the arms rise, the rollers revolve in the direction of the arrows on them and draw the paper as it is folded by them up between them. The folded edge of the paper as it rises strikes the deflectors and is turned over, the wires being forced to travel along them partly by the folding-rollers themselves and partly by the propelling pressure-rollers, and being incidentally aided by the continually-increasing backward slope of the wires. Before the arms reach their highest point the sheet once folded lies flat on the wires, being arrested at the proper point by the stop *p p*. As the arms continue to rise, the tail of the shank c^5 strikes against the pin c^6, and the moving blade attached to the shank rises, creasing the paper a second time and forcing it into the grasp of the second pair of feeding-rollers. As the arms descend, this second pair of rollers revolve in a direction opposite to that indicated by their arrows, causing the paper to be folded and rise, when its crease will meet the deflectors and by their action be turned over, when the paper will travel toward the right side of the machine over the rod o' and between the rods o^2 o^2, with the edge folded by the first pair of rollers sliding along the guide-

plate, being propelled by the various rollers acting on it and prevented from sliding rearward by the guide-plate p^{11} p^{5}. The paper twice folded continues thus to travel along until it reaches and is arrested by the stop p^{2} p^{4}, and is in place against the stop just before the arms reach their lowest position. Just before the arms reach this position the shank c^{8} strikes the pin c^{10}, and the blade governed by that shank rises, driving the twice-folded sheets into the nip of the upper pair of rollers. As the arms rise again, these rollers revolve in the direction of the arrows on them and cause the sheet to travel upward, completing the third fold. As the sheet passes through these rollers, it is slit, if the knives be employed, and as the arms and rollers rise the sheet bends over backward, owing to the force of gravity and the changing position of the rollers, and when it is released from the rollers it drops on the delivery-board, which is then inclined rearward. From this board it drops on the sheet-metal plate *y*, and as the main arms descend again the folded sheet is forced by the compresser against the surfaces supported by the tapes or against sheets of paper supported by those surfaces. These surfaces, as before described, travel downward, as required, being forced along step by step by the compressor acting through the intervention of folded sheets of paper. In order to prevent the piles of paper from tumbling over rearward, the projecting end of the delivery-board strikes down with its under surface against the rear ends of the piles as the compressor leaves them, and rises again out of the way of the compressor as the latter forces downward the sheet that it has just received from the delivering-board.

In case a sheet should tear or be creased, or any derangement take place in the action of the machine, it may be stopped instantly by the operator who feeds it pressing one foot on the pedal d^{5}.

It is to be noted that one sheet is to be fed in at each descent of the arms. As these arms rise, there will then be two sheets in the machine, one being acted upon by the first and the other by the third pair of rollers, and as the arms descend there will be but one sheet in the machine being acted upon by the second pair of rollers. The two moving blades drop out of the way of advancing sheets as soon as they have made the proper crease in the paper, and when their shanks or tails are by the motion of the machine freed from the contact of the stops against which they strike.

By reference to the drawings it will be perceived that the various folding-rollers in the machine are fluted over their whole surface, except at those parts of the first pair of rollers which are directly over the registering-pins, and I deem the fluting of rollers which are used for folding paper that is presented to them by a blade or knife a very important improvement in folding-machines, as such a construction enables the rollers to be set so far apart that they shall not damage the paper when they embrace or nip it with the edge of the blade between the folds, and at the same time causes the rollers, although thus far apart, to seize and carry the paper with certainty after the blade is removed, and there is consequently a less thickness of matter to fill the space between the rollers. The flutings are parallel to the axes of the rollers, and the flutes therefore act like a series of small cog-teeth on the paper, preventing one side of the sheet being folded from advancing faster or moving slower than the other side. This action is practically important, and conduces materially to the precision of the work done by the machine.

In this specification I have described various sorts of wires or rods on which the paper may slide and by which it is supported, and various arrangements and methods of driving propelling-rollers, chiefly to show that the precise kind of support for the paper is unimportant so long as it is a support on which the paper may slide, and that the position and method of actuating the propelling-rollers are immaterial so long as they are so arranged and actuated as to produce the the effect described, and with respect to the various gearings, connecting-rods, &c., in the machine, I also desire it to be understood that their precise construction and arrangement are entirely unimportant so long as they are constructed and arranged as to give the proper motion to the parts or surfaces which act directly upon the paper to be folded; and I wish it also understood that many of my improvements are applicable to paper folding machines in which the folding-rollers are mounted on journals that rest in stationary boxes and are not supported upon a vibrating carriage composed of arms and cross-bars, as herein described, and also that many of my improvements may be used when in connection with other acting parts of paper-folding mechanism different from those before described.

I claim as of my own invention in machinery for folding paper—

1. The combination of pressure-rollers for holding the paper upon and in working contact with propelling-rollers, with such propelling-rollers and folding-rollers, the latter folding and presenting paper, which is then moved by the former, the combination being substantially such as specified.

2. Propelling-rollers and pressure-rollers acting in combination as described, in combination with wires or rods to support sheets of paper, the combination being substantially such as specified.

3. In combination with a pair of folding-rollers, a pressure-roller applied, substantially as described, to compress paper against one of the folding-rollers, the combination acting substantially as set forth.

4. In combination with folding mechanism mounted upon a vibrating frame or vibrating

arms, a delivering-board constructed, arranged, and operating substantially in the manner described.

5. In combination, a compressor or compressing-surface, a delivering-board having a mode of operation substantially as described, a table or support for folded paper, and other surfaces parallel, or nearly so, to the compressing-surface, which latter gradually moves away from the compressor as folded sheets are introduced, the whole being constructed and acting substantially as specified, and in combination with a proper apparatus for folding paper.

6. In combination with a delivering-board, a compressor acting substantially as described.

7. In combination with proper blades or knives for creasing paper and introducing it between folding-rollers, folding-rollers fluted parallel to their axes, operating upon the paper and in connection with the blades, substantially as set forth.

8. Actuating the folding-rollers of a paper-folding machine by means of stationary toothed sectors substantially such as described when such rollers are mounted upon and carried by a counterpoised vibrating frame.

9. The general arrangement, substantially as herein described, in so far as the same consists of a stationary table on which the paper to be folded is laid, and a vibrating frame, and of sets or series of folding-rollers mounted in that frame under substantially such an arrangement of folding-rollers and blades as is described, whereby the paper is seized from the table and carried upward by the first pair of folding-rollers and delivered from the frame on the opposite side thereof by the last pair of folding-rollers.

10. In combination with apparatus for folding paper, a stop-motion or disconnecting apparatus constructed and operating substantially as described.

11. In combination with folding-rollers and propelling-rollers, a side guide for the edge of a sheet, arranged and acting substantially as specified.

In testimony whereof I have hereunto subscribed my name, in the city of New York, on this 18th day of November, A. D. 1859.

JOHN NORTH.

Witnesses:
H. S. GEARY,
SAM. W. BLUNT.