

No. 612,931.

Patented Oct. 25, 1898.

H. PARKER & H. FAIRBANKS.
VACUUM WEB DRIER.

(No Model.)

(Application filed Feb. 10, 1897.)

3 Sheets—Sheet 1.

Fig. 1.

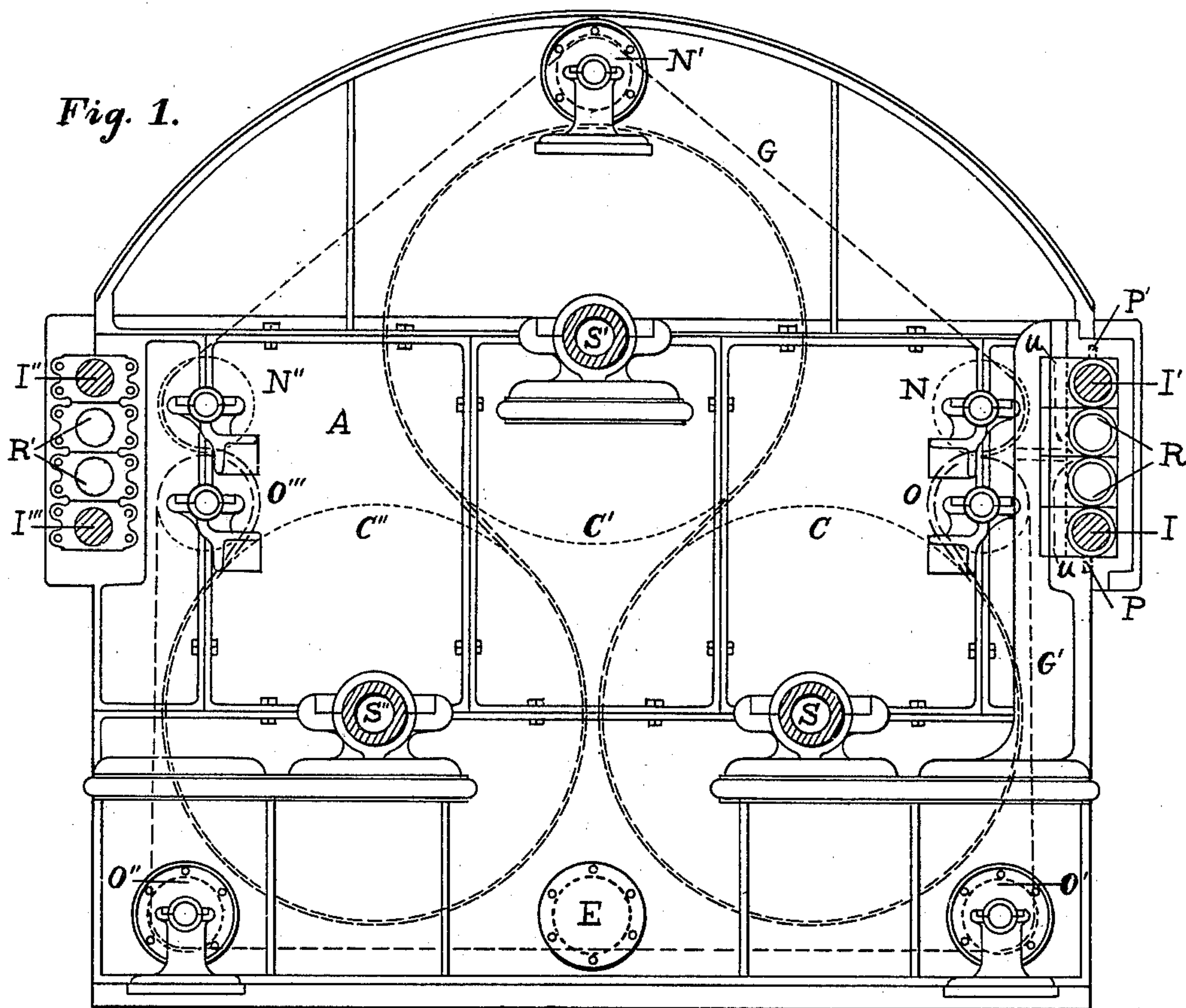
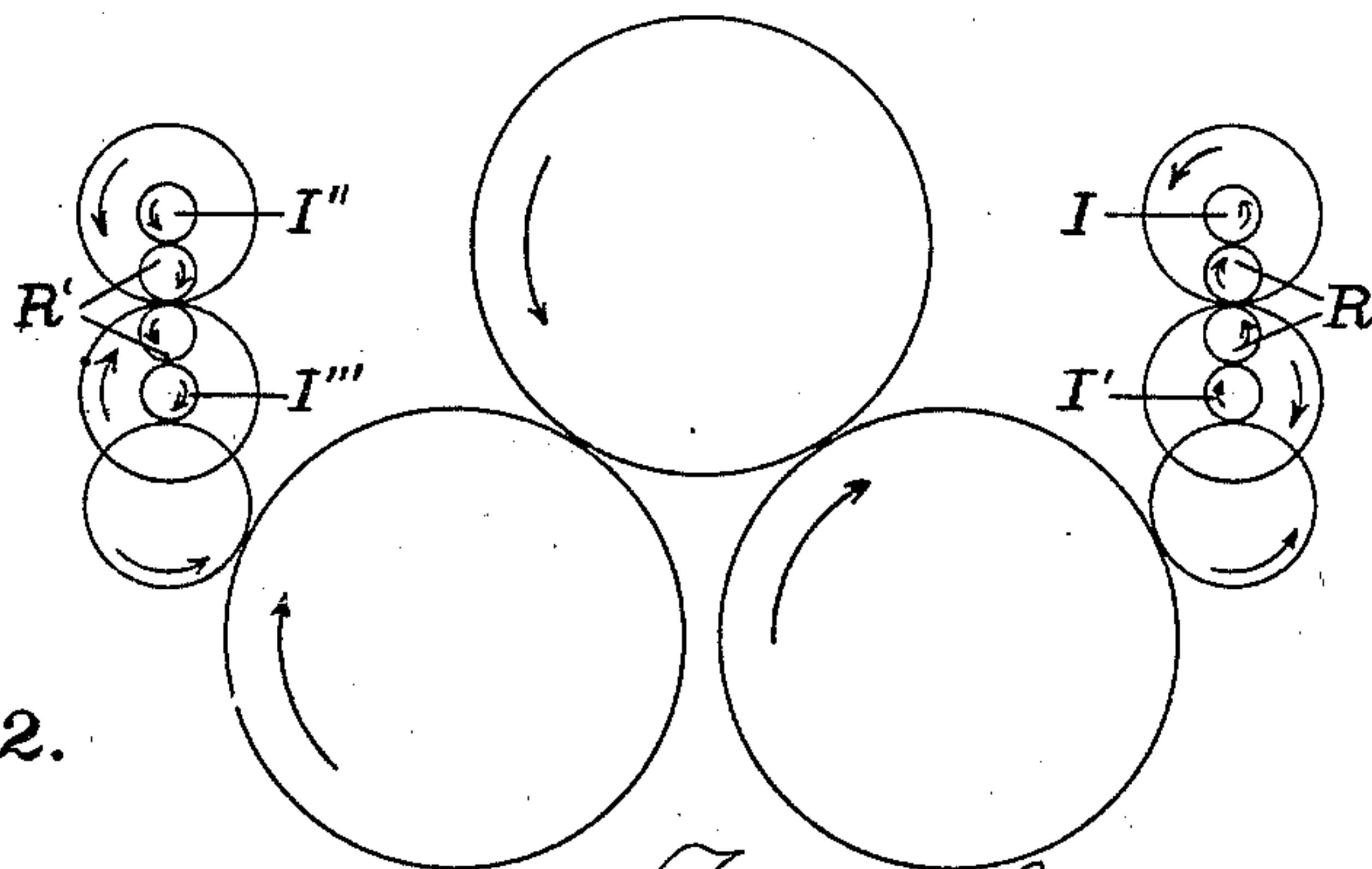


Fig. 2.



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3 Sheets—Sheet 2.

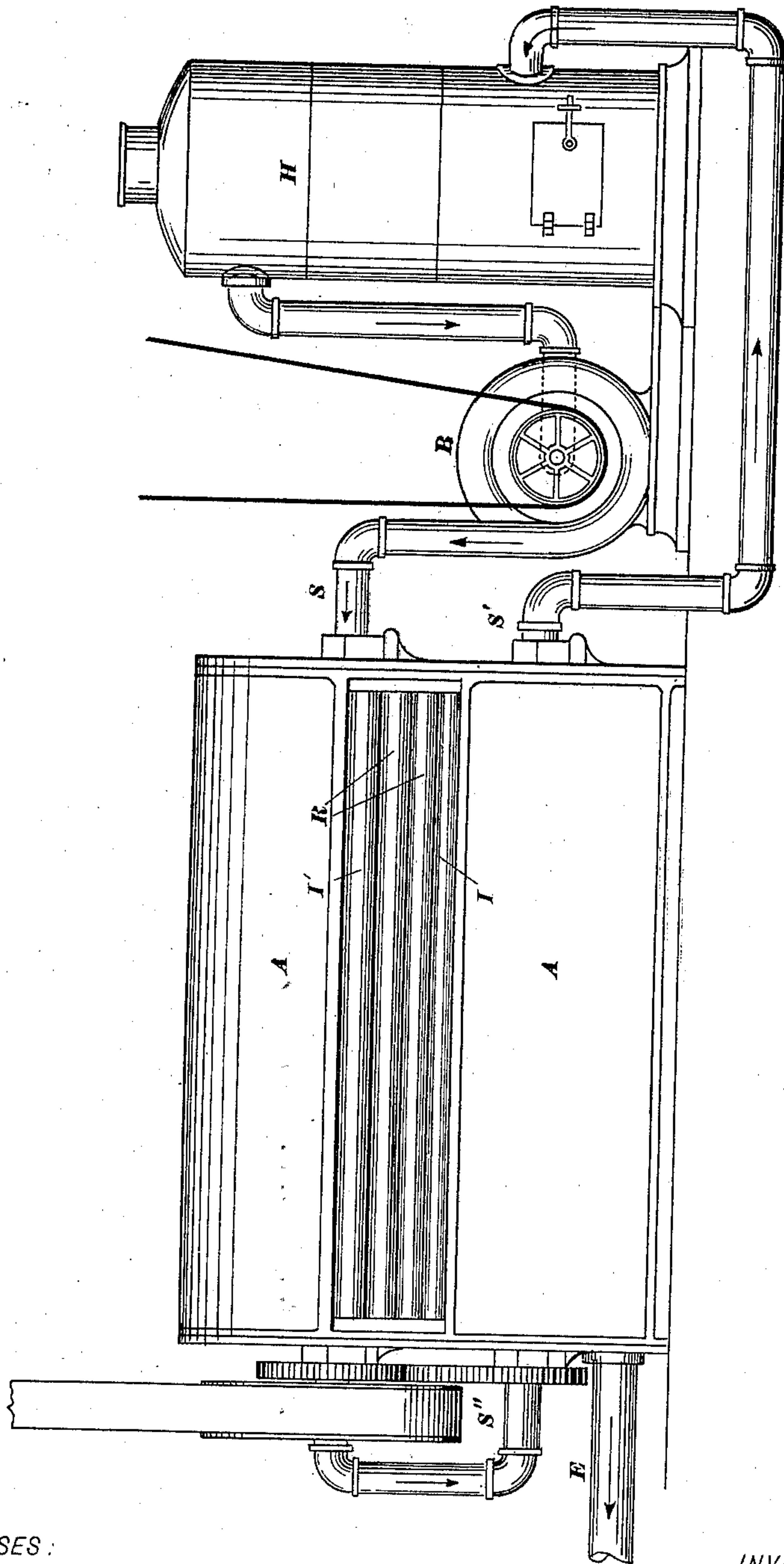


FIG. 3.

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3 Sheets—Sheet 3.

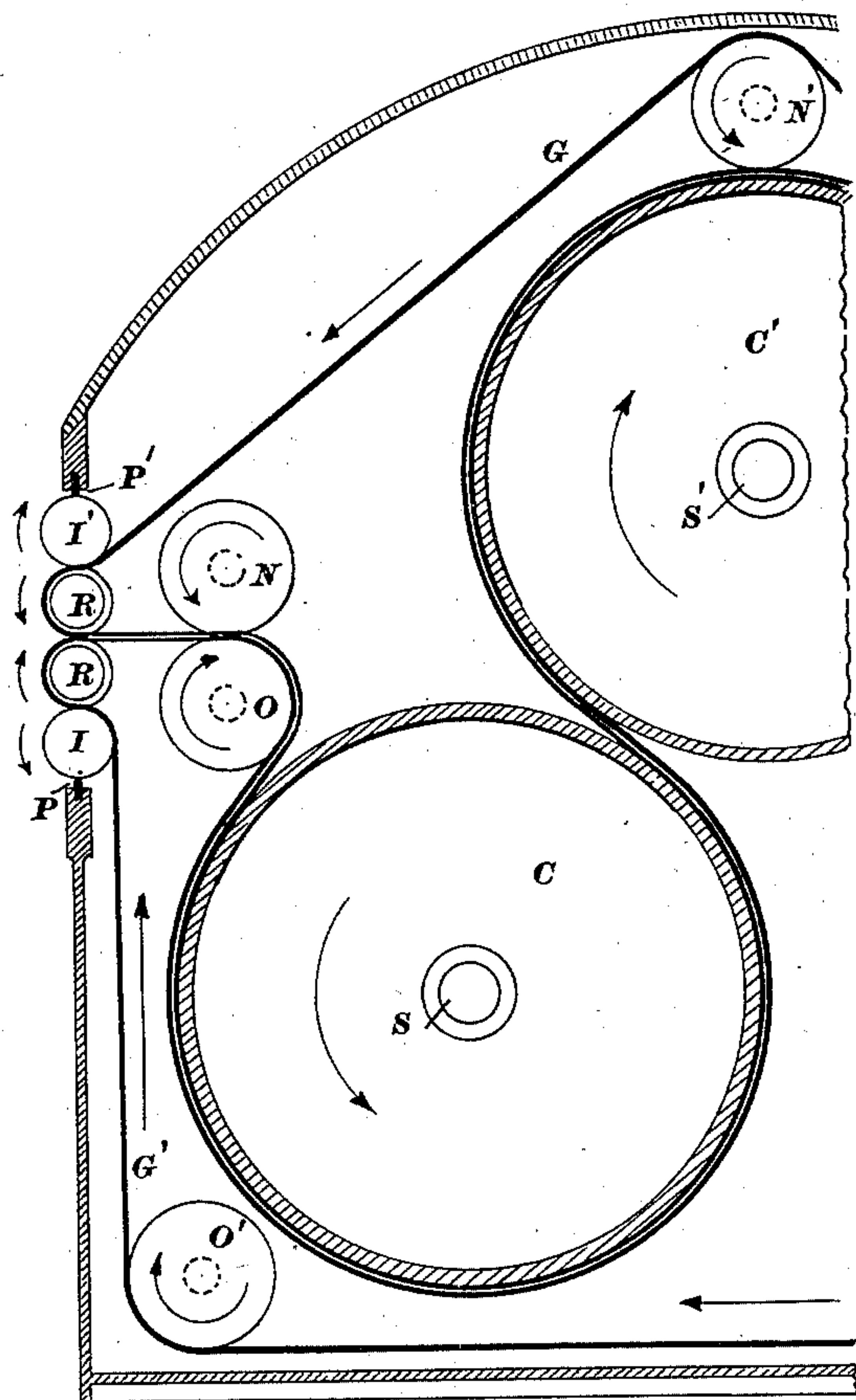
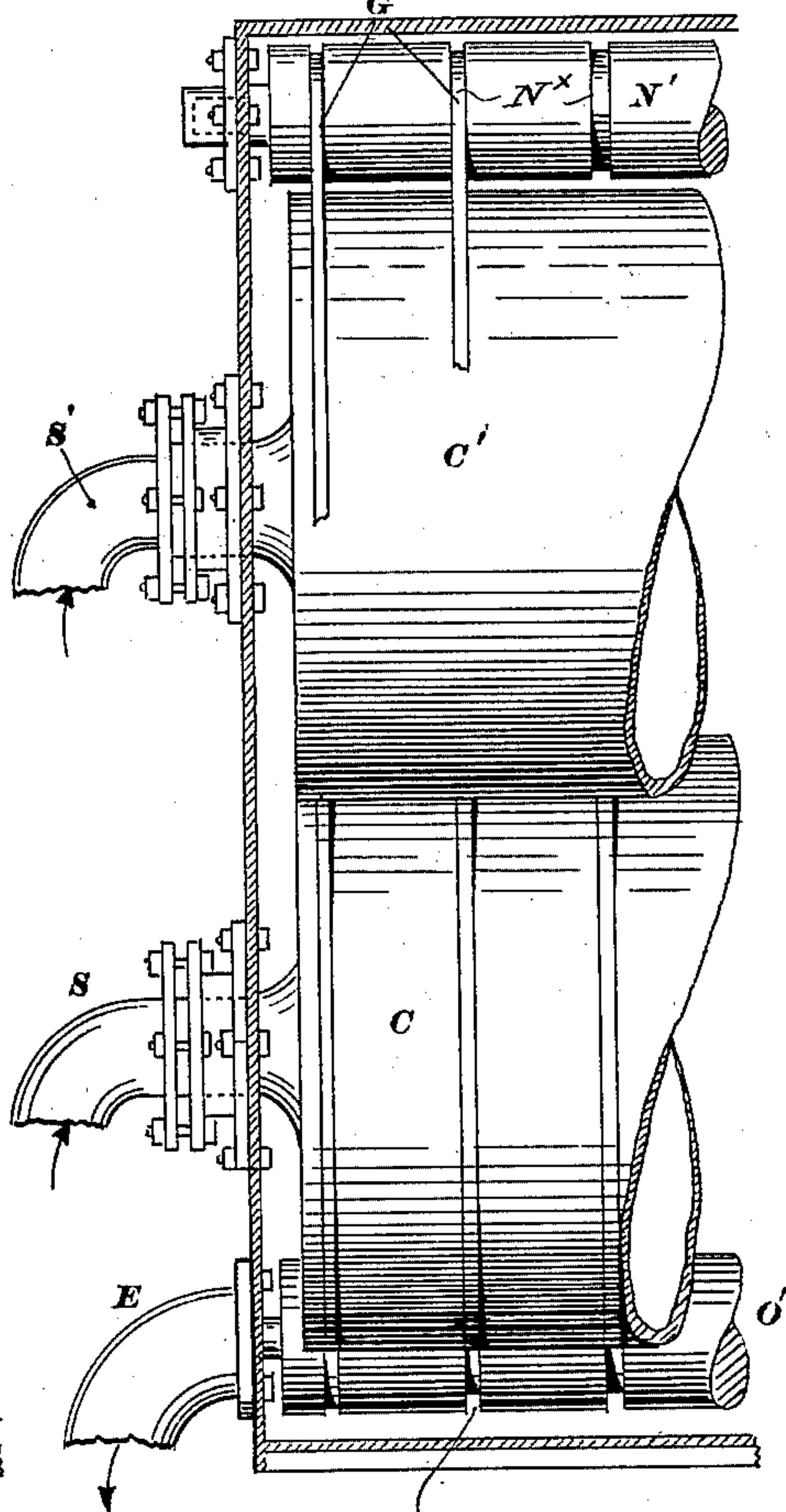


FIG. 6.



O' FIG. 4.

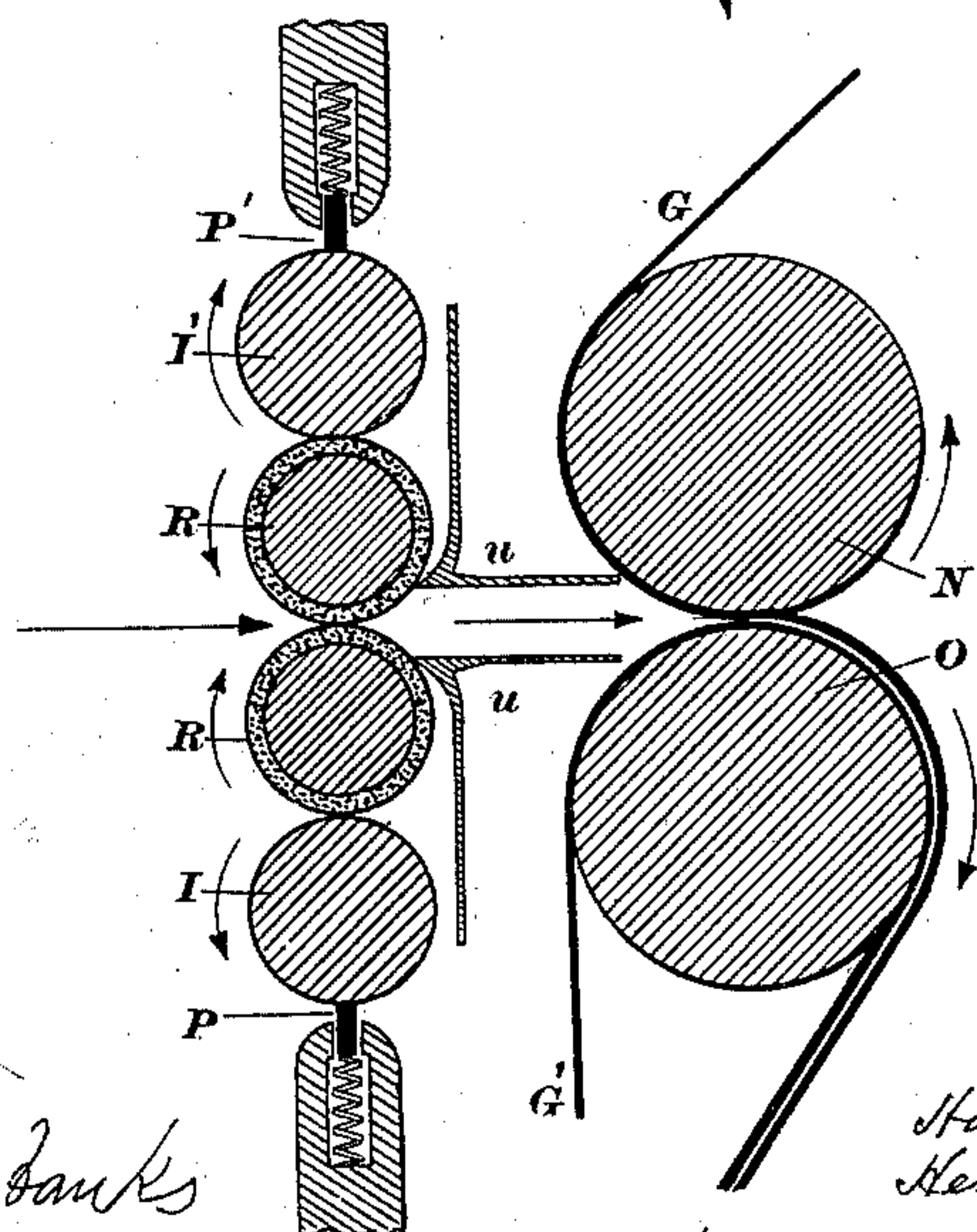


FIG. 5.

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UNITED STATES PATENT OFFICE.

HOWARD PARKER AND HENRY FAIRBANKS, OF ST. JOHNSBURY, VERMONT,
ASSIGNORS TO THE VACUUM DRIER COMPANY, OF VERMONT.

VACUUM WEB-DRIER.

SPECIFICATION forming part of Letters Patent No. 612,931, dated October 25, 1898.

Application filed February 10, 1897. Serial No. 622,768. (No model.)

To all whom it may concern:

Be it known that we, HOWARD PARKER and HENRY FAIRBANKS, of St. Johnsbury, in the county of Caledonia and State of Vermont, have invented a new and useful Vacuum Web-Drier for Paper, Cloth, and Yarn, of which the following, taken in connection with the accompanying drawings, is a specification.

Our invention is a machine for rapidly drying yarn, warps, cloth in the web, or paper as it runs from the paper-machine or wet-machine; and it consists of a chamber partly exhausted of air through which this yarn web or sheet is drawn in contact with heated surfaces, with suitable devices for guiding it through as well as for maintaining the vacuum.

It is usual to provide a paper-machine with stacks of steam-heated rolls (twenty or more being required for a quick-running web) to evaporate the water against the pressure of the atmosphere without heating it so much as to seriously injure the fiber, and cloth and warps require similar provision. We find that by removing part of the atmospheric pressure we lower the temperature of the boiling-point of water so much that the degree of heat which will not injure the fabric is sufficient to drive off all the water with a short exposure, and the web runs out of the exhausted chamber perfectly dry. In order to maintain the vacuum, it is necessary to have air-tight packings for all the moving parts which project from the inside of the closed chamber and to provide for drawing in and carrying out the web to be treated between elastic rolls, which will close over it and not allow a stream of air to pass in with it. The thin air left in the vacuum-chamber is so poor a conductor of heat that the web can hardly be sufficiently heated to drive off its moisture except by being in contact with the heated surfaces, and we use one or more cylinders heated from within and so propelled that the web moves forward in contact with them, they and the elastic rolls at the entrance and exit being geared together in a way to insure equal surface travel for all, and to make sure that the web shall keep its course as provided for it we run two series of metallic tapes, or in some cases two cloth or wire

aprons, to receive the web between them and carry it smoothly from the inlet over and under the heated rolls to the outlet, where the elastic rolls must catch it and carry it out. 55

In the drawings, Figure 1 is a side view of the machine with the gearing that connects the various shafts removed and also the bearing-boxes on the right and showing the interior parts by dotted lines; and Fig. 2 shows the pitch-circles of the gearing by which the several gear-wheels engage each other to give equal surface travel to the several moving surfaces that carry the web. Fig. 3 gives an end view of the machine, showing also the heater, pump, and connections. Fig. 4 shows a portion of the ends of the cylinders, with the guide-rolls and metallic guide-tapes. Fig. 5 is an enlarged view of the roller-gate, packing, guides, and first pair of rollers; and Fig. 6 illustrates the arrangement when the guide-tapes are made to meet outside the chamber. 60

A is the closed chamber, exhausted through an exhaust-pipe E, opposite to which the covering-plate on the front of Fig. 1 closes an opening through which the interior can be reached to remove any pieces that fail to be carried quite through. 65

C, C', and C'' (shown by fine dotted lines) are the cylinders, heated by steam or hot oil through their hollow journals S, S', and S'', (shown in Fig. 1 in section as broken off,) it being understood that if heated by steam they will be provided with the usual siphon arrangement to keep them free from water. Around these cylinders are carried two series of metallic tapes or two aprons, of cloth or woven wire. (Shown in edge view by the lines of dashes G G' in Fig. 1 and more fully in Figs. 4, 5, and 6.) These are carried over loose rollers N N' N'' and O O' O'' O''', meeting between O and N in a way to surely receive the web between them and to carry it down under the cylinder C, then over the next C', and under the third C'' in a way to secure the longest surface contact with their peripheries. More such cylinders can be introduced in case they are required to dry sensitive fiber with less heat, and the guides can be carried around them all in succession. 70 75 80 85 90 95 100

It will be understood that if metallic tapes are used each series will be made up of sev-

eral placed only a few inches apart and guided by grooves N^x and O^x , respectively, in the rollers $N' O'$, Fig. 4, and O'' . These metallic tapes or aprons can be arranged to run over the inlet-rollers so as to receive the web outside the machine, if this web—say of thin wet paper—is not strong enough to be managed in any other way. Most webs will have body enough to allow the attendant simply to insert the end between the two rubber rolls R , which will deliver it to the carrier-guides $G' G'$ between the rollers N and O and start it upon its course. These two rolls, with rubber or other elastic surface, cannot be well packed to move air-tight against the walls of the chamber. We therefore place outside of them and in rolling contact with them the two iron rolls $I I'$ at the side of entrance and I'' and I''' at the exit, with the two rubber-faced rolls R' pressed between them. These upper and lower rolls $I I' I'' I'''$ have packings $P P'$, &c., pressing upon them from proper recesses and are practically air-tight in the side of the chamber, and the elastic surfaces of the middle rolls $R R'$ close against them and against each other, allowing no air to enter between, and when any web of paper or cloth is drawn in between them the rubber is compressed enough to allow it to pass without forcing the rolls apart. In this way we provide for drawing through the machine a web of cloth or of paper or warps and yarns of any length. The drying-surface is made sufficient so that at the required speed of passing these entering wet will emerge dry. A glance at Fig. 2 will show that the three cylinders are geared together so as to secure equal peripheral speed, and the two iron rolls of each pair at the entrance and exit are also geared together, and an intermediate wheel connects the gears of the cylinders with those of the small rolls in a way to secure for them the same surface speed. The small iron rolls being driven by power, the rubber rolls between them are carried at equal speed by surface contact. If the web shrinks in drying, it may be necessary to slightly reduce the peripheral speed of the rolls at the exit, as may be easily done by adding one or two teeth to the small gear I''' . For some uses it may be necessary to provide the rubber rolls with scrapers (doctors) to prevent the web winding upon them, and we also suggest guides $u u$, which, bent back, serve also, if needed, as screens for the rubber rolls against excessive heat, and if this is not sufficient we propose to make the small iron rolls hollow and carry through them streams of cool water; but we hardly expect this to be necessary and have not illustrated it in our drawings.

It may generally be sufficient to have but one roll with elastic surface between the two metal rolls, and in that case those rolls should be geared to revolve in the same direction. By a different arrangement of driers the web might be brought out on the same side of the machine as that by which it enters, and pos-

sibly one elastic-faced roll might suffice for the machine, the wet web passing in between this and one metal roll and passing out on the other side of the same rubber roll and between it and the other metal roll, in that case being pressed into the elastic surface and not forcing the rolls apart or allowing air to pass with it.

For some fabrics greater heat may be properly used than can be conveyed by steam without raising the pressure unduly, and we propose for that condition to use some oil that has a high boiling-point and which perhaps may be used without confining it, using a pump, if necessary, to force it around. The use of a liquid will have the advantage that it is so in contact with the surface to be heated that heat is conducted much more rapidly than from a vapor like steam, and the evaporation from the wet fabric carries away heat with exceeding rapidity. The same arrangement allows the use of a liquid heated moderately and to a definite predetermined temperature which would allow wet leather to be dried in contact with the cylinders without injury. This arrangement for circulating a liquid is illustrated in Fig. 3, where H is the heater, B the pump, and $S S'$ the pipes connecting into the hollow axles of the cylinders. This use of a liquid conveyer of heat might be of advantage in the drying-cans of the ordinary paper-machines or cloth-mills.

Some of the advantages of our drier would be secured by carrying the web on a wire apron over heating-coils, and for this the higher temperature secured by the liquid would be needed, heating the fabric mainly by radiation, since the thin air is so poor a conductor. This would avoid calendering the surface of fine papers, if desired.

It is practicable to remove half the atmospheric pressure and at a temperature of some 180° Fahrenheit to boil out the water.

In the application of Ada H. Colby, administratrix, &c., for Letters Patent for process and machine for drying webs of cloth and paper, filed April 10, 1897, Serial No. 631,506, there is shown, described, and claimed a process similar to that carried out in our apparatus and by a machine of like principle to ours, and hence our claim herein is to certain specific improvements peculiar to our apparatus.

We do not limit ourselves by the details of construction; but,

Having described what we consider the best form of carrying out our invention, we claim as follows:

1. A vacuum web-drier, consisting of a closed chamber, connected internally with an exhauster and having entrance and exit openings for the web, pairs of feed-rolls, one of each pair with elastic surface, tightly closing these entrance and exit openings and adapted continuously to draw in and feed out the web to be dried, and moving heated surfaces around which this web is stretched, geared to move with the same surface velocity as the

web, and adapted to carry it forward while evaporating the water from it, substantially as herein described.

2. A vacuum web-drier, consisting of a closed chamber, having entrance and exit openings for the web, pairs of feed-rolls, one or both of each pair with elastic surface, closing these entrance and exit openings, and adapted continuously to draw in and feed out the web to be dried, and a series of cylinders, heated through their journals and arranged to hold the web in contact with a considerable part of their heated surfaces while moving it forward, the said cylinders being connected to each other and to the pairs of rolls by gearing and rolling contact, whereby all have practically the same surface travel, in combination with exhausting apparatus, substantially as herein set forth.

3. In a vacuum web-drier, in combination with the exhausted chamber, and with the moving heated surfaces within it, two series of endless metallic tapes, carrying-rolls having grooves by which the tapes are guided, the said tapes stretched around and traveling in the path by which the web is to move, each series of tapes made up of several such tapes and spaced near each other, and the two series adapted to receive the said web between them, and hold it to its course, while sufficiently exposing it to permit free evaporation, substantially as described.

4. In a vacuum web-drier, in combination with the closed chamber and its exhauster, a series of rolls between which the web to be dried may enter the chamber, and a similar series between which it may pass out, the outer two rolls of each series having a hard smooth surface, packed against the walls of the chamber, and the middle roll or rolls, being of elastic surface, in rolling contact with the outer two rolls, and adapted to close upon the web as it rolls in and out and prevent the air from entering, substantially as set forth.

5. In a vacuum web-drier, the combination of a closed chamber, connected internally with an exhauster and having entrance and exit openings for the web, pairs of feed-rolls, one

of each pair with elastic surface, tightly closing these openings, and adapted continuously to draw in and feed out the web to be dried, and moving surfaces heated from within by a liquid (such as oil) which will not vaporize at the heating temperature required, the said moving surfaces being geared to move with the same surface velocity as the web, and adapted to carry this web forward, while evaporating its moisture, and appliances for heating and circulating the heating liquid, whereby the exact temperature best suited for drying any substance *in vacuo* is maintained in the said moving surfaces in contact with the web of this substance, substantially as described.

6. In apparatus for drying webs of cloth or paper, the combination of a closed chamber, connected internally with an exhauster and having entrance and exit openings for the web, pairs of feed-rolls, one of each pair with elastic surface, tightly closing these openings, and adapted continuously to draw in and feed out the web to be dried, and rotary hollow cylinders, over the surface of which such web passes, geared to move with the same surface speed as the web and adapted to carry the web forward, while evaporating its moisture, a liquid conveyer of heat, of which the boiling-point is higher than the required temperature of said cylinders, introduced into the cylinders through their journals, and apparatus for heating such liquid and circulating it through said cylinders, whereby the heat of their surfaces in contact with the web to be dried is maintained at the predetermined temperature best suited for cooperating with the exhaust in treating the material of this web, substantially as specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, on this 5th day of February, A. D. 1897.

HOWARD PARKER.
HENRY FAIRBANKS.

Witnesses:

PAUL S. CARTER,
C. H. HORTON.