

No. 611,109.

Patented Sept. 20, 1898

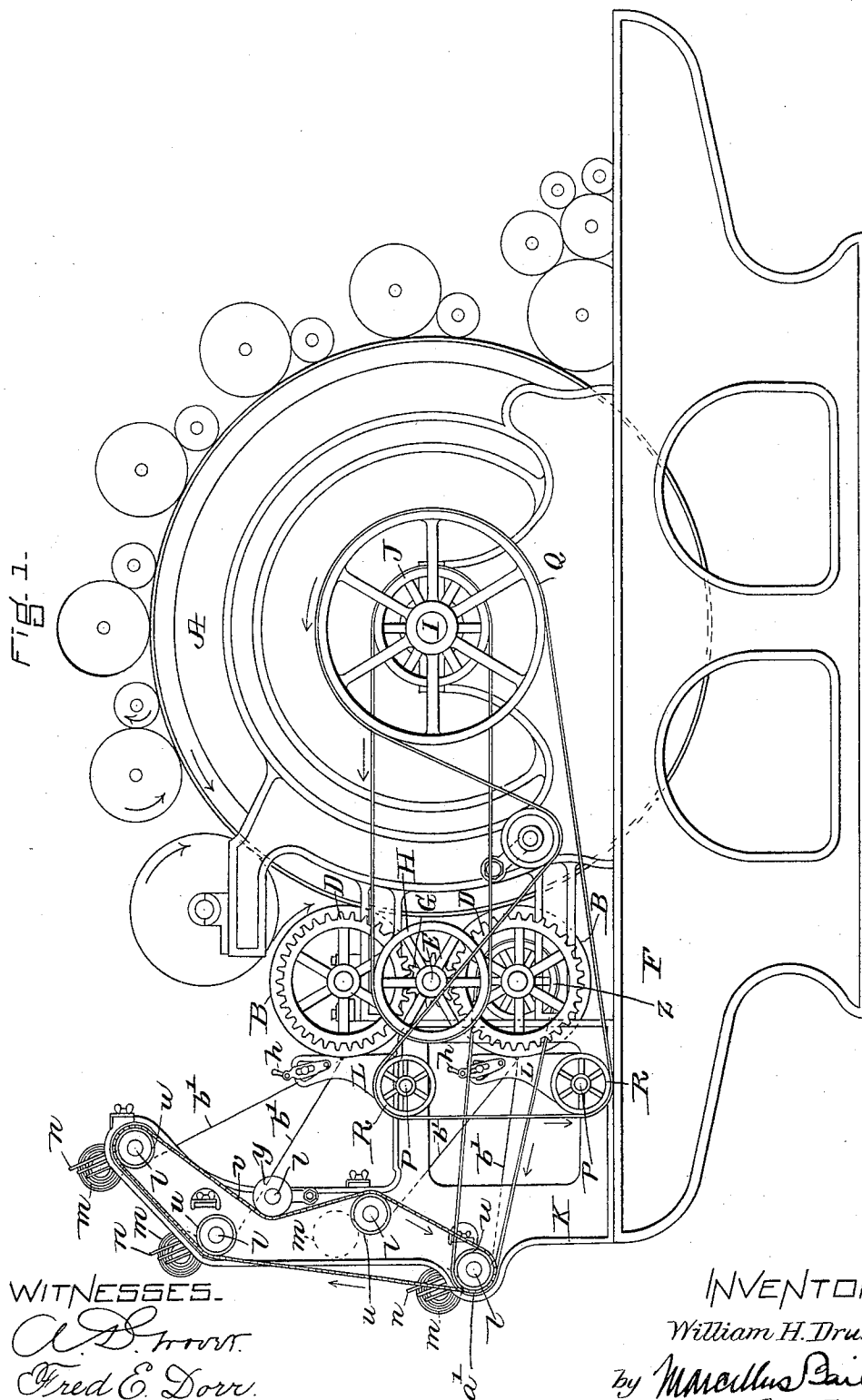
W. H. DRURY.

MACHINERY FOR MANUFACTURING YARN FROM FIBROUS MATERIALS.

(Application filed July 22, 1898.)

(No Model.)

5 Sheets—Sheet 1.



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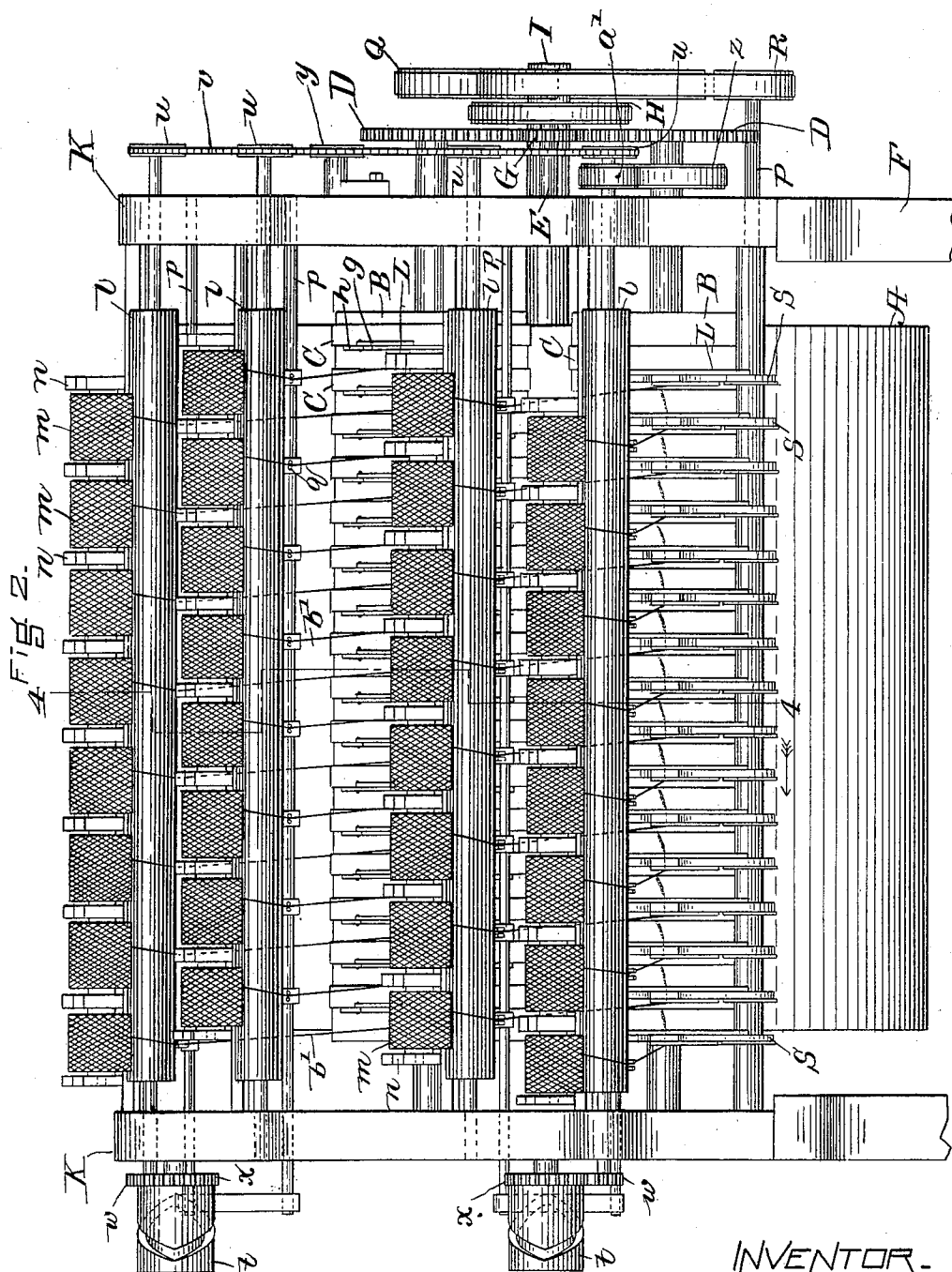
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WITNESSES.

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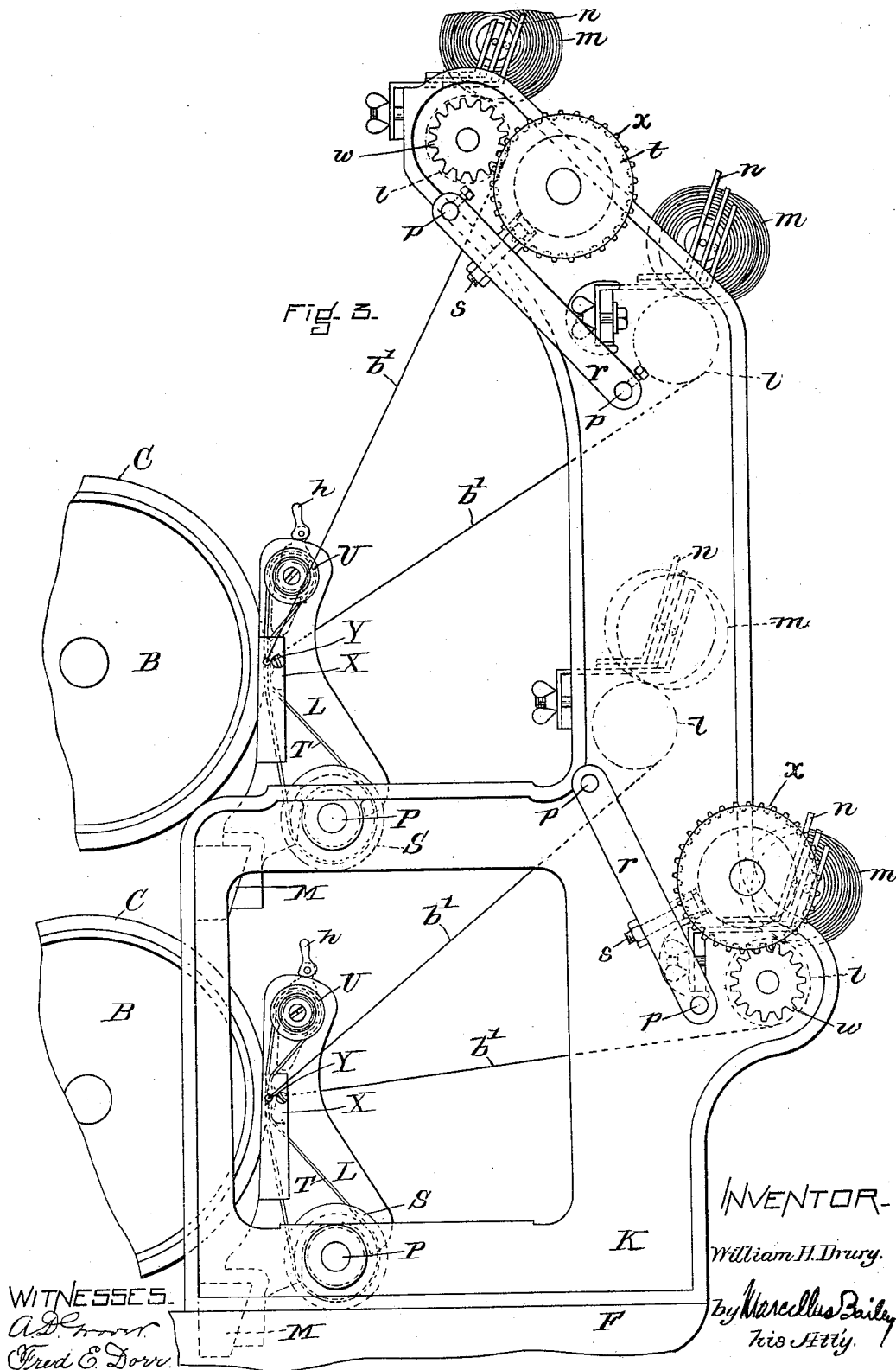
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Fig. 6.

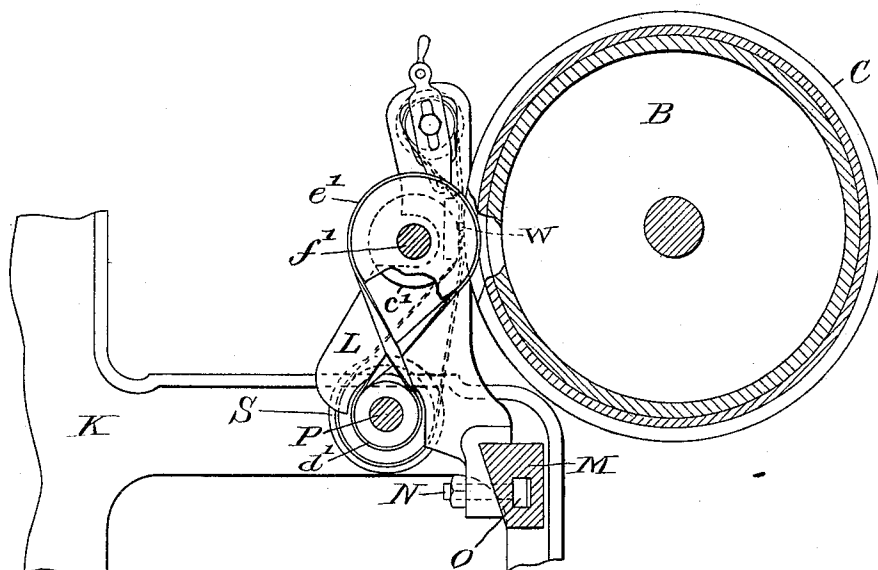
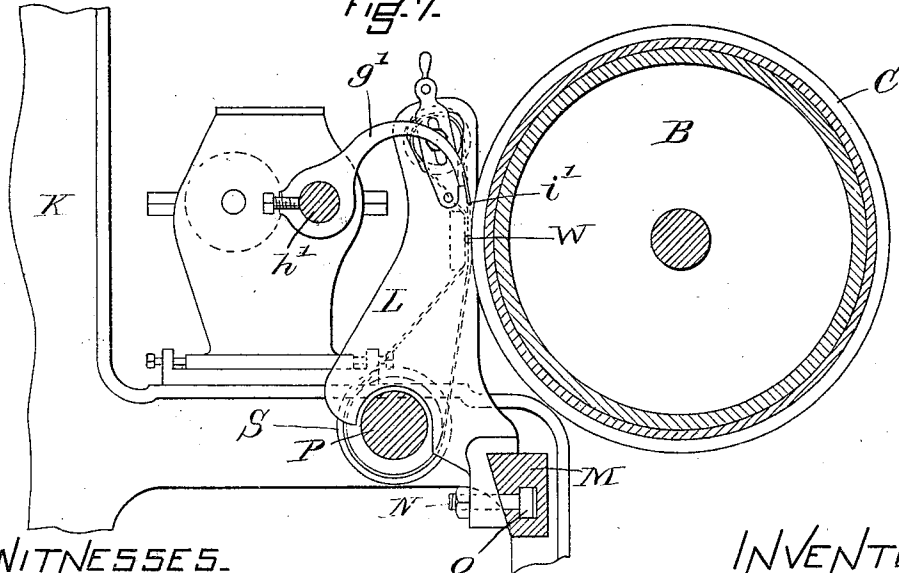


Fig. 7.



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UNITED STATES PATENT OFFICE.

WILLIAM HENRY DRURY, OF WALTHAM, MASSACHUSETTS.

MACHINERY FOR MANUFACTURING YARN FROM FIBROUS MATERIALS.

SPECIFICATION forming part of Letters Patent No. 611,109, dated September 20, 1898.

Application filed July 22, 1898. Serial No. 686,600. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HENRY DRURY, a citizen of the United States, residing at Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Machinery for Manufacturing Yarn from Fibrous Materials, of which the following is a specification.

In my application for Letters Patent filed in the United States Patent Office on November 19, 1897, Serial No. 659,104, is set forth an invention relating to machinery for making twisted and completed yarn from unspun fibrous materials in one continuous operation or continuous series of operations, whereby the fibrous web, sheet, or width produced by carding is subdivided into many narrow strips, sections, or parts. The material of each strip is rolled up and wrapped in thin films or layers one upon the other to form a fibrous roll lying crosswise of the strip. Each of said rolls is revolved and whirled to compact and reduce it and to twist from its hind end the yarn made therefrom and is drawn lengthwise of itself and further compressed, evened, and condensed while being so drawn, and the material of the whole web, sheet, or width is transformed directly and continuously into many or numerous strands of twisted and completed yarn, the machine for attaining this result comprising, essentially, means for carding the material in combination with means for subdividing the carded material definitely and on predetermined lines into numerous narrow, separate, and independent sections, together with means for simultaneously side-drawing said several sections and spinning the same into yarn.

My present invention involves the same general combination of instrumentalities having the same general mode of operation as that which is the subject of my said former application; and it consists in certain improvements upon the invention which is the subject of my said former application, whereby the machine is simplified, the number of its operative parts is reduced, and its efficiency is enhanced.

In my said former application the described means for carding the material consist of an ordinary wool-finisher card, the means for subdividing the carded material into numer-

ous narrow sections consist of a plural number of series of doffer-rings arranged in such relation to each other that the rings of either series are opposite intervals between the rings of any other series, and the described means for rolling up the fibrous sections and revolving the fibrous rolls thus formed and drawing them sidewise of the lengths of the sections and spinning the same into yarn consist of several elements, namely: first, either a doffing-comb or wipe-roll to remove the fibrous material from each doffer-ring; second, the doffer-ring itself and a twisting-roll, (the latter performing either the single function of a twisting-roll or the double function of a twisting-roll and wipe-roll,) both of which revolve in the same direction with each other and are in such relation to each other as to form the removed material into a fibrous roll and to revolve such fibrous roll; third, a condensing device, through which the material of the rotating fibrous roll is drawn, performing the function of compressing and condensing such material and also coöperating with the doffer-ring and twisting-roll to assist them in revolving the fibrous roll, and, fourth, drawing mechanism, either consisting of a pair of drawing-rolls placed at one side of each doffer-ring or else consisting of the winding mechanism placed at a considerable distance away from each doffer-ring and performing the double function of drawing and winding.

The improvements which distinguish the present invention relate more especially to the specific form of the means for rolling up the fibrous sections and revolving the fibrous rolls thus formed.

I have found in the manufacture of yarn in accordance with the system set forth in my prior application that it is detrimental to the quality of yarn produced to use drawing-rolls at the sides of the doffer-rings for drawing the fibrous material through the condensing mechanism and that better yarn is produced by providing for a long uninterrupted stretch—say of eighteen inches, or thereabout—of each strand of yarn between the point where it leaves the condensing mechanism and the point where it is taken by the drawing mechanism. The effect of such length of stretch is to produce evenness in the yarn.

The twist will run into the finer portions and prevent them from stretching, while any longer and looser portions will be stretched out and twisted somewhat like the action of mule-spinning. Hence the drawing mechanism should consist either of the winding mechanism or of some other device placed where it will not touch the yarn until it has gone over a long stretch such as above mentioned. By dispensing with the use of drawing-rolls at the sides of the doffer-rings other advantages are also obtained. A considerable gain of room in the intervals between doffer-rings is effected and narrower rings may be used than could otherwise be done. By thus dispensing with side-drawing rolls at the sides of the doffer-rings and by employing a novel vertical arrangement of the condensing-straps described in said former application, which there formed part of the means with which I spun the fibrous material from the doffer-rings into yarn, I have found it practicable to use for subdividing the carded material into numerous narrow sections the ordinary ring-doffer, which consists of a single long cylinder clothed with numerous narrow rings of card-clothing at predetermined intervals apart. In practice I have found that the ordinary ring-doffer is for many reasons preferable to a series of short pulley-like cylinders fixed at predetermined intervals apart upon a single doffer-shaft with open spaces between them down to the doffer-shaft and having a doffer-ring on each of the short cylinders. The rings of the ordinary ring-doffer after being put on so as to run true along their edges keep so better than those with said open spaces between them. Said open spaces gather fiber which gets into the yarn in bunches at odd times, resulting in uneven yarn; but the ordinary ring-doffer is free from such objection. The ordinary ring-doffer is stiffer and stronger than a series of short cylinders with open spaces between. The ordinary ring-doffer admits of packing to fill up the spaces between the rings and hold the rings in position and protect the teeth of the card-clothing along the edges of the rings; but the series with open spaces does not admit of this. In using narrow rings—say an inch wide or less—a series with open spaces between would be almost intolerable; but with the ordinary ring-doffer such narrow rings can be used conveniently and to good advantage. For these and other reasons I have in practice adopted the ordinary ring-doffer as the best means to divide the carded material into numerous narrow and separate sections and to use in conducting my system of making yarn. Having found it practicable to use that form of doffer, I found it practicable to use much narrower rings—say from seven-eighths of an inch to one inch wide, and even less—in connection with side-drawing than had ever been used before. Through using doffer-rings of this narrow width I have discovered it to be prac-

ticable in such connection with such rings to dispense with much of the mechanism, such as the twist-rolls, &c., which with wider rings had previously been thought necessary in order to roll up the fibrous sections and revolve the fibrous rolls thus formed and spin the same into yarn, the result being an improvement in the manufacture of yarn as well as a gain in point of simplicity.

It being recognized as a fact that each strand of yarn in the process of its manufacture by my system has two ends—namely, the end which is in the ball or spool on which the completed strand is wound, called its “front” or “forward” end, and the end in the constantly-forming fibrous roll from which the strand is drawn and spun, called its “hind” end—said system of making yarn, besides differing from the old systems in other respects, is seen to be prominently distinguished therefrom in the respect that by the old systems the yarn is twisted wholly at its front end by revolving that end, while by my system the yarn is twisted at its hind end by revolving the latter. Hence in making each strand of yarn by my system it is necessary that a fibrous roll shall be kept constantly forming and that such constantly-forming fibrous roll from which the yarn is drawn and spun shall be kept bodily and along its whole length in rapid and constant rotation.

Owing to the flexible nature of unspun fibrous material all the several elements which in my said former application were provided for this purpose seemed to be necessary in the case of a long fibrous roll (say four inches long, or thereabout) to perform the office of forming each fibrous roll and twisting each strand of yarn at its hind end; but when fibrous rolls of an inch in length, or thereabout, and of some kind of fiber came to be operated upon I discovered that by operating each condensing device and the drawing mechanism at proper speed the condensing device alone by its rubbing and twisting action would remove the fibrous material from the doffer-ring, form the fibrous roll, and revolve the latter bodily throughout its entire length in such manner as to twist the strand at its hind end, so that, if desired, the doffing-comb and twisting-roll, either or both, and whether the twisting-roll was or was not also a wipe-roll, could be wholly dispensed with. It is this feature which mainly characterizes my present improvement. This has been found practicable in spinning several kinds of fibers, including cotton, wool, flax-tow, goat-hair, and others. It has also been found that this method works even better when still narrower doffer-rings are used, because the narrower the doffer-rings are the better they are cleared of their fibrous material by the action of the condensing devices, and the shorter the fibrous rolls are the more certain and effectual the condensing devices are in revolving them bodily. There is found to be much advantage in dispensing with

combs and twisting-rolls and wipe-rolls in the manufacture of fine yarn, because it makes it possible to produce more ends from a card of given width than could otherwise be done.

5 For instance, the combs and rolls, although they could be used, would be much in the way in making forty-eight ends from two ring-doffers on a forty-eight-inch card, but there is no trouble in doing this if they are wholly
10 dispensed with. Indeed, by using three ring-doffers under my present improvement and without such combs and rolls there is no trouble in making as many as ninety ends on a card of that width. This is a matter of
15 much practicable importance. For example, if yarn weighing one grain per yard were made the weight of production from ninety ends on a forty-eight-inch card would be almost double that from forty-eight ends and
20 the machine would be working to but little more than half its capacity in making the smaller number of ends.

Owing to the nature of unspun fibrous material there is a limit respecting the width
25 of doffer-rings from which the condensing devices alone will suffice to clear the fibrous sections, roll them up, and revolve the fibrous rolls thus formed, and this limit is not the same in all cases. It depends much upon the
30 kind of fiber used and also upon the quality of the kind used. With some fibers it may be necessary to use either a comb, a twisting-roll, or wipe-roll in addition to the condensing mechanism, even when the doffer-rings
35 are only an inch wide, while with other fibers the condensing devices alone will suffice when the doffer-rings are wider. Almost always the condensing devices alone will suffice when the doffer-rings are not more than an inch
40 wide and sometimes will suffice when said rings are an inch and a half wide or a little more, provided in both cases the speeds of the condensing devices and drawing mechanism are as hereinafter advised. A more
45 exact limit cannot be stated; but any person of ordinary skill in the art may learn in a little time by practice what the limit is in any single case.

In my said former application it was shown
50 that by using with each doffer-ring a roll performing the double function of a twisting-roll and wipe-roll the use of a doffing-comb could be wholly dispensed with in most cases. I have since discovered that under many circumstances the use of a doffing-comb can be
55 dispensed with when a roll performing only the function of a twisting-roll is used. This may be done in all cases in which the condensing devices alone will suffice for the purpose of clearing the doffer-rings and forming and revolving the fibrous rolls. In many cases in which the condensing devices alone will suffice for that purpose it will be desirable to use twisting-rolls also, because in all
60 cases the yarn can be harder twisted with twisting-rolls than without them. In many cases in which the condensing devices alone

will not suffice for said purpose the addition of twisting-rolls will so aid the condensing devices that both together will suffice for said
70 purpose without doffing-combs. The limit respecting the width of doffer-rings with which this is the case cannot be stated exactly, because one fiber differs so much from another, as above mentioned; but as a general thing
75 it is the case with doffer-rings four inches wide and under, provided the position and speed of the twisting-rolls and the other speeds hereinbefore alluded to are as hereinafter advised.
80

I have also discovered that when the limit respecting the width of doffer-rings from which the condensing devices alone will suffice to clear off the fibrous sections and form and revolve the fibrous rolls has been
85 exceeded doffing-combs without twisting-rolls or wipe-rolls may be used to advantage to aid the condensing devices in clearing the rings. This is true in making soft-spun yarn or when a fiber unusually adhesive to the
90 card-clothing or not so cohesive to itself as common is used. The influence of the condensing devices in revolving the fibrous rolls will with the aid of the combs in clearing the doffer-rings be extended beyond said limit
95 sufficiently to effect a soft twist in the yarn. Moreover, in making soft-spun yarn the combs without twisting or wipe rolls may be used to advantage before said limit has been
100 reached, in which case the condensing devices need not be run so fast as though the combs were not used. In such case the combs and condensing devices together will clear the rings and form and revolve the fibrous rolls.
105

In the drawings are represented the improvements which constitute the present invention. In this specification the delivery end of the machine represented is called its
110 "front" end, the side at the right hand of a person in front of and facing the machine is called its "right-hand" side, and the opposite side its "left-hand" side.

Figure 1 is a view of the right-hand side of a finisher carding-machine of a common
115 style used for carding wool having two ring-doffers and having at its front end mechanism whereby the sections of fibrous material from the rings of the doffers are continuously rolled up, the fibrous rolls thus formed
120 revolved, and the said rotating fibrous rolls drawn sidewise of said rings and spun into numerous strands of completed yarn in accordance with this invention. Fig. 2 is a front elevation of said machinery. Fig. 3 is
125 a view of the left-hand side of a portion of the front end of said machine and mechanism. Fig. 4 is a vertical section of certain parts taken on line 4 4 of Fig. 2, looking in direction of the arrow shown in the latter
130 figure, and shows other parts beyond the plane of the section. Fig. 5 is a horizontal section of certain parts taken on line 5 5 of Fig. 4 and shows other parts below the plane

of the section. Fig. 6 shows a twisting-roll in combination with a doffer-ring and condensing device. Fig. 7 shows a comb in combination with a doffer-ring and condensing device. Figs. 1 and 2 are on smaller scale than the others.

A carding-machine with main cylinder of any desired width and diameter may be used; but for convenience and to save room in the drawings the card here represented is supposed to be a thirty-two-inch card with main cylinder A forty-eight inches in diameter, and the machine illustrated is adapted to make thirty-two ends of yarn, or one end for each inch of the length of the main cylinder. The doffers B may be of such convenient diameter as desired, but those illustrated are supposed to be twelve inches in diameter, fifteen inches apart between centers, and to represent ordinary ring-doffers with sixteen rings on each. More or fewer rings on each doffer may be used, and three doffers may be used if desired. In the machine illustrated it is recommended that the rings C of the upper doffer be seven-eighths of an inch wide and those of the lower doffer one inch wide each, because in such case each ring of the upper doffer will receive from the main cylinder about the same amount of fibrous stock as each ring of the lower doffer, and it is desirable that all the ends of yarn shall be of uniform size. The rings on either doffer should be at uniform distances apart between their middle lines, and the middle of each ring on either doffer should be placed opposite the middle of each interval between rings on the other doffer. When three ring-doffers are used, the middle line of one half of each interval between rings on each doffer should be opposite the middle line of a ring on one of the other two doffers and the middle line of the other half of such interval should be opposite the middle line of a ring on the other of the other two doffers, as usual when three ring-doffers are used on a finisher-card. In clothing the doffers with their rings of card-cloth the rings C should be first placed in their relative positions and trued up so as to run true along their edges. The vacant intervals between the leather or other material in which the wire of the rings is set should be packed with leather or other material of the same thickness as that in which the wire is set in order to hold the rings in their proper positions and prevent them from slipping out of place. Over this packing should be placed another thickness of packing covering the entire interval between the teeth of one ring and the teeth of next in order to protect and sustain the teeth along their edges. This is illustrated in Fig. 5, in which *a* represents the shell of the doffing-cylinder; *b*, the material in which the wire *c* of the teeth is set; *d*, the packing next the doffing-cylinder, and *e* the packing between the teeth of one ring and the teeth of the next. Said doffers have the gears D fixed to their shafts.

On a stud E, fixed to the frame F of the carding-machine, runs the gear G, meshing into said gears D. The pulley H is concentric with and made fast to said gear G. Said doffers are driven from the main-cylinder shaft I by a belt passing over the pulley J thereon and thence over said pulley H, driving said gear G, which drives said gears D.

The mechanism for making yarn from the fibrous material coming from the doffer-rings is shown as including the side frames K, which support the various parts of said mechanism, which side frames rest on the front end of the framework F of the carding-machine proper in the place usually occupied by the rub-rolls or apron-condensers on such card. These side frames support the bracket-plates L, corresponding in number to and accompanying the doffer-rings and fixed to the girders M, which extend across from one of said side frames to the other and are bolted to the latter and form a stiffening part of the entire framework of said mechanism. The bracket-plates L are bolted to said girders by bolts N, which slide lengthwise of said girders in a slot O therein, running lengthwise thereof, so that said plates may be set in such places as desired and firmly clamped to the girders. The shafts P extend across from one of said side frames to the other and run in bearings fixed to said frames. The shafts are driven from the main-cylinder shaft I by a belt passing over the pulley Q thereon and thence over the pulleys R, fixed to said shafts P. To these two shafts are fixed the pulleys S, corresponding in number to and accompanying said plates L and serving to drive the condensing-straps T, running at top over the pulleys U, (see Fig. 5,) supported by said plates. These condensing-straps run vertically or tangentially to the doffer-rings and are made to meet together for a short distance by means of the blocks V, (see Fig. 4,) fixed to the left-hand sides of said plates. An eye W is in each of said plates in line with a horizontal line running across the middle of the distance along which said straps meet. The meeting faces of the straps are in a plane tangential, or approximately so, to their respective doffer-rings. To the left-hand side of each of said blocks (see Fig. 3) is fixed another plate X, in which there is another eye Y opposite to the eye in the bracket-plate. The pulleys U run upon studs fixed in the levers Z. (See Fig. 4.) These levers are fulcrumed at *f* and have a slot *g* to admit of raising or lowering said studs, so as to tighten or loosen said condensing-straps. A hole in the top portion of each of said bracket-plates, as shown, allows each of said levers to swing forward and backward on its fulcrum, so as to loosen or tighten a little the condensing-straps. On the top end of each of said levers is fulcrumed a smaller lever *h* with a cam on it, so that when the smaller lever is moved in one direction it clamps the larger lever to the top of its bracket-plate, and when it is

moved in the opposite direction it unclamps the larger lever. The purpose of this is to enable the operator to readily fix said levers in such position as he desires or to enable him to loosen or tighten said straps a little at will. A portion of each end of said girders M is made round or trunnion-like, as shown at *i* in Fig. 4, and these round parts extend through and fit in holes in said side frames and form journals on which the girders can swing. To these girders are clamped one end of the arms *j*, the other ends of which are fixed to said side frames by the set-screws *k*. The purpose of such construction is to enable the operator to swing the girders by said set-screws, and thus set said eyes, which are all in line with each other on each row, exactly as he desires in relation to the doffer-rings. Said side frames K also support the winding mechanism, which, besides winding the yarn produced, serves the additional purpose of drawing the yarn through said eyes W and Y and said condensing devices. The winding or drawing mechanism includes the four drums *l*, upon the surface of which bear by their own weight the spools *m*, on which the yarn is wound, which spools correspond in number to the doffer-rings and are held in position by the spool stands or guides *n*, which, as shown in Fig. 4, are clamped to the bars *o*, which extend across from one of said side frames K to the other and are bolted thereto and serve as additional stiffening parts of the entire framework. The winding mechanism also includes the four lengthwise-sliding rods *p*, to which are attached the traversing fingers or forks *q*, corresponding in number to said spools, for distributing the yarn across said spools. These rods slide lengthwise in holes in said side frames and are fixed to the bars *r*, (see Fig. 3,) to which are bolted the pins *s*, which work in grooves of the cams *t*. (See Fig. 2.) These grooves run spirally half-way around the cylinders *t* in the direction of a left-hand thread and the other half-way around in the direction of a right-hand thread. As the cam-cylinders *t* revolve they slide said rods to and fro with their traversing fingers at uniform rate of speed without much of any dwell at either end of the traverse. The cams *t* revolve upon studs fixed in the left-hand side frame, as shown in Fig. 2. The sprocket-wheels *u* are fixed to the shafts of said drums *l* on their right-hand ends, and the sprocket-chain *v* passes over said wheels *u* and over the idler *y*, Figs. 1 and 2, which gives proper direction to said chain in one place and keeps the same suitably taut, so that all of said sprocket-wheels will revolve together when either of them is driven. Two of said drum-shafts have the gears *w* fixed on their left-hand ends, as shown in Figs. 2 and 3, and these gears mesh into the gears *x*, which are made fast to said cams *t* and are concentric therewith. On the lower doffer-shaft is fixed the pulley *z*, which is in line with the pulley *a'*, fixed to the lowest of said drum-shafts. Said

drum-shafts are driven from the lower doffer-shaft by means of a belt passing over said pulleys *z* and *a'*. As the drum-shafts revolve they drive the gears *w*, which in turn drive the gears *x* and the cams *t*.

The spindles of the winding-spools should be an inch and a half or so in diameter and of solid metal to have sufficient weight to be driven by the frictional action of the drums *l* when the latter act upon the spindles or the material thereon. The shanks of said spindles should be about a quarter of an inch in diameter and run loose in the ways of said spool stands or guides. It is recommended that paper tubes be used upon said spindles whenever the yarn is wound, because this will prevent the spools or balls of yarn from collapsing when they are removed from their spindles and handled or transported.

The drums *l* are so located that the strands of yarn *b'* will have an uninterrupted stretch of eighteen inches, or thereabout, between the eyes Y, Fig. 3, and the point at which they first touch the drums.

It is recommended that the bracket-plates L be of cast-iron and each a single casting, with the plates one-eighth of an inch thick and the parts resting on the girders M an inch wide, and that blocks V, Figs. 4 and 5, be of cast-iron three-eighths of an inch thick from right to left and smoothly polished on the surfaces on which the condensing-straps run; that the plates X, fixed to said blocks, be of sheet-steel three thirty-seconds of an inch thick; that the condensing-straps be eleven thirty-seconds of an inch wide, so as to run easily between said plates, and three thirty-seconds of an inch thick and be made of a good quality of pliable leather with a good sensitive surface, like the leather used for worsted comb-aprons out of which the stretch has been pretty well taken; that the eyes W be about a quarter of an inch in diameter and their edges rounded, so that a cross-section of the edges will be semicircular; that the eyes Y be three-sixteenths of an inch in diameter and rounded, like the eyes W; that the line on which the condensing-straps meet run a trifle forward of and across the centers of the eyes W and almost on a tangent to the doffer-rings, and that the centers of said eyes be about a quarter of an inch or less below the level of the center of their accompanying doffer.

Now let it be supposed that all of said machinery is running, with fiber going through the card, and that the doffers, condensing-straps, and winding mechanism are running at proper speed, and that the operator is going to piece up the various ends and start the yarn-making mechanism on its proper work. It is recommended that he use a needle firmly fastened in a handle about the size of a lead-pencil, about three-quarters of an inch of such needle being bent not quite so much as at right angles to its handle, and that the needle have a downwardly-turned hook-shaped point like a machine knitting-needle.

This needle should be inserted through one of the eyes Y, Figs. 3 and 5, and between the meeting surfaces of the accompanying condensing-strap and through the accompanying eye W until it gathers from the face of the accompanying doffer-ring a little fiber upon its point, and then the needle should be withdrawn, when the fiber from the doffer-ring will follow it through the eyes and between the meeting surfaces of the condensing-strap. While this is going on the strap acts upon the fiber in such manner as to roll up the material coming from the doffer-ring and keep the doffer-ring stripped of its fibrous material and keep the fibrous roll thus formed revolving. At the same time the strap so acts as to make a strand of yarn of the material being drawn by hand between its meeting surfaces. When this strand becomes of sufficient length, as it does quickly while the machinery is running, its forward end is put over the appropriate drum *l* in the place prepared for it, one of the spool-spindles *m* is laid on it, the forward end is brought forward over the spindle and nipped between the drum and spindle, and the winding of the yarn begins. This is a simple matter and quickly performed by one who has had a little practice, and a boy or girl or other person will soon learn to do it deftly. All the other ends are started in the same manner. After all the ends are up the machine will go on spinning yarn day after day without more than an occasional breaking down of a single end, which is quickly pieced up in the manner above described.

The matter of proper speeds, already alluded to several times, is important. The condensing device cannot act to clear the doffer-rings, roll up the fibrous material, and revolve the fibrous rolls thus formed, as above mentioned, unless the speed of the condensing devices and the speed with which the yarn is drawn away are right. Moreover, the proper speeds are not the same with the use of all fibers. When cotton or wool of fair quality is spun in the manner above described, the speed of the condensing-straps may be about twice as fast as the surface speed of the doffer-rings and that with which the yarn is drawn away about one-half as fast as said surface speed. The speeds may be greater in both cases, if desired, and it has been customary in practicing the invention with wool and cotton to run the straps four times as fast and to draw away the yarn five-eighths or three-fourths as fast as said surface speed. In spinning a fiber weaker and more adhesive to the card-cloth and less cohesive to itself than such cotton or wool in the manner above described it will sometimes be a necessity rather than a choice to run the condensing-straps four times as fast and to draw away the yarn less than one-half as fast as said surface speed. Furthermore, the width of the doffer-rings makes a difference in regard to the speeds of the condensing and drawing

devices. The wider the rings the faster it will be necessary to run said devices in proportion to said surface speed until a width of doffer-rings is reached so great that the condensing device alone cannot clear them or form or revolve the fibrous rolls. In short, speeds suitable in one case are not suitable in another, and there is no exact rule applicable to all cases regarding speeds of the condensing and drawing devices. A person of ordinary skill in the art, however, will soon and easily learn by practice the speeds suitable in any possible case.

Regarding the speed of the doffers, it should be greater than in the ordinary system of yarn-making. It is recommended that such speed be from twenty-two to thirty revolutions per minute with twelve-inch doffers, and it may be greater in many cases. The speed of the doffers is changeable to suit by changing the relative sizes of the pulleys H and J, that of the condensing devices by changing the relative sizes of the pulleys R and Q, and that of the winding or drawing mechanism by changing the relative sizes of the pulleys *z* and *a*'.

As already remarked, when doffer-rings are used so wide that the condensing devices alone cannot clear them of their fibrous material and form and revolve the fibrous rolls, the proper use of twisting-rolls, in combination with the doffer-rings and condensing devices, will usually suffice to do it without other aid. Moreover, twisting-rolls may very often be used in such combination to great advantage when doffer-rings are used which are not so wide as that, in which case it will not be necessary to run the condensing devices so fast as required when the latter alone are depended upon. It will seldom be desirable to use doffer-rings so wide that such combination will not suffice. The twisting-rolls when thus used should be of the same width, run between the same side lines, and revolve in the same direction as their accompanying doffer-rings. In Fig. 6 of the drawings is represented one of the twisting-rolls *c*' on the right-hand side of its accompanying bracket-plate L and in front of its accompanying doffer-ring C. To make room for the twisting-roll shaft *f*' the bracket-plates L are cut into, as shown. This shaft may be driven from the condensing-strap shaft P by means of a crossed belt passing over the pulley *d*' on said shaft P near the right-hand side frame and thence over the pulley *e*' (partly broken away in the figure to show the twisting-roll) on said shaft *f*'. It is recommended that the twisting-rolls be of small diameter—say two and three-fourths inches—so as to take little room, and that they may be of metal and as light as practicable. Their proper position in relation to that of the eyes W is an important matter and one of the things on which their success depends. If too low, they will do no good, and if too high they will be of no use. When they are of the size above recommended,

their centers should be set about thirteen thirty-seconds of an inch below the level of the center of said eyes. The exactly right position is found by a few trials. They should be set by gage as close to their accompanying doffer-rings as practicable without touching them. Their surface speed should exceed that of the doffer-rings a little and at times should be from that to twice as fast. Their speed is changeable by changing the relative sizes of said pulleys *d'* and *e'*. A little practice and trial will enable a person of ordinary skill in the art to set them in proper position and to find in any given case the proper speed at which to run them and also the proper relative speed of the condensing-straps. These speeds will be found to vary according to the fibrous stock used and the degree of twist desired in the yarn.

The use of combs should be avoided whenever it can be done, because it is more convenient to make yarn without them than with them, especially when making a large number of ends from the machine, and yet there are times when their use is desirable. Some fibers adhere so to the card-clothing as to cause an end to break down frequently. The use of a comb remedies such trouble considerably. At times it is desirable not to twist the yarn so hard as is done when twisting-rolls are used with the doffer-rings and condensing devices. This result can be attained by removing the twisting-rolls and using combs instead. Enough has been said earlier in this specification to indicate sufficiently, without saying more here, when combs may be used advantageously in addition to the condensing devices and without twisting-rolls.

Fig. 7 illustrates a form of the invention in which the doffer-rings C of each of the doffers B are accompanied by a corresponding number of narrow vibrating combs *g* to aid the condensing devices in clearing the doffer-rings and making and twisting the yarn. In practice rapidly-vibrating combs four inches long from the center of their shaft *h'* to their edges *i'*, with their edges swinging through an arc of only three-fourths of an inch, have been found useful, and such are recommended, because with such short vibration they keep the fibrous rolls constantly just where they are wanted. They should be set low enough to keep the fibrous rolls on a level with the eyes W without hindering in drawing the fibrous rolls sidewise of the doffer-rings through said eyes.

I claim as my invention—

1. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a plural number of series of doffer-rings, at predetermined intervals apart in each series, to subdivide the carded material into numerous narrow and separate sections; corresponding condensing devices accompanying said rings respectively to continuously remove therefrom the

said fibrous sections, roll them up and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn; and means for operating said rings, and said condensing devices, substantially as and for the purposes hereinbefore set forth.

2. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of cylinders clothed with numerous narrow rings of card-clothing at predetermined intervals apart on each cylinder to subdivide the carded material into numerous narrow and separate sections; corresponding condensing devices accompanying said rings respectively and continuously remove therefrom the said fibrous sections, roll them up and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn; and means for operating said cylinders and condensing devices, substantially as and for the purposes hereinbefore set forth.

3. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a doffer; a condensing device to continuously remove the fibrous material from said doffer, roll it up and revolve the fibrous roll thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous roll, as it forms, sidewise of said doffer and through said condensing device into yarn; and means for operating said doffer and said condensing device, substantially as and for the purposes hereinbefore set forth.

4. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a plural number of series of doffer-rings at predetermined intervals apart in each series to subdivide the carded material into numerous narrow and separate sections; corresponding twisting-rolls to accompany said rings respectively; corresponding condensing devices accompanying said rings and said rolls and to cooperate therewith to continuously remove from said rings the said fibrous sections, roll them up and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; and means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn; and means for operating said rings, said twisting-rolls and said condensing devices, substantially as and for the purposes hereinbefore set forth.

5. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of cylinders clothed with numerous narrow rings of card-clothing

at predetermined intervals apart on each cylinder to subdivide the carded material into numerous narrow and separate sections; corresponding twisting-rolls to accompany said rings respectively; corresponding condensing devices accompanying said rings and said rolls and to cooperate therewith to remove from said rings the said fibrous sections, roll them up and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn; and means for operating said cylinders, said twisting-rolls and said condensing devices, substantially as and for the purposes hereinbefore set forth.

6. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a doffer; a twisting-roll to accompany said doffer; a condensing device accompanying said doffer and a twisting-roll and to cooperate therewith to remove the fibrous material from said doffer, roll it up and revolve the fibrous roll thus formed; means to simultaneously draw said rotating fibrous roll, as it forms, sidewise of said doffer and through said condensing device into yarn; and means for operating said doffer, and twisting-roll and said condensing device, substantially as and for the purposes hereinbefore set forth.

7. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a plural number of series of doffer-rings at predetermined intervals apart in each series to subdivide the carded material into numerous narrow and separate sections; corresponding doffing-combs to accompany said rings respectively; corresponding condensing devices accompanying said rings and said combs and to cooperate with said combs to remove from said rings the said fibrous sections and to roll up said fibrous sections and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn; and means for operating said parts, substantially as and for the purposes hereinbefore set forth.

8. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of cylinders clothed with numerous narrow rings of card-clothing at predetermined intervals apart on each cylinder to subdivide the carded material into numerous narrow and separate sections; corresponding doffing-combs to accompany said rings respectively; corresponding condensing

devices accompanying said rings and said combs and to cooperate with said combs to remove from said rings the fibrous sections and to roll up said fibrous sections and revolve the fibrous rolls thus formed and condense and twist the yarn produced therefrom; and means to simultaneously draw said rotating fibrous rolls, as they form, sidewise of said rings and through said condensing devices into yarn, and means for operating said parts, substantially as and for the purposes hereinbefore set forth.

9. In machinery for making yarn from fibrous materials, the combination with means for carding the material, of a doffer; a doffing-comb; a condensing device to cooperate with said comb to remove the fibrous material from said doffer and to roll up said fibrous material and revolve the fibrous roll thus formed and condense and twist the yarn produced therefrom; means to simultaneously draw said rotating fibrous roll, as it forms sidewise of said doffer and through said condensing device into yarn; and means for operating said parts, substantially as and for the purposes hereinbefore set forth.

10. The combination with the ring-doffer of power-driven condensing-straps located in or opposite to the intervals between the doffer-rings, with their meeting faces in a plane tangential, or approximately so, to their respective doffer-rings, substantially as and for the purposes hereinbefore set forth.

11. The combination with the ring-doffer of power-driven condensing-straps located in, or opposite to, the intervals between the doffer-rings with their meeting faces in a plane tangential, or approximately so, to their respective doffer-rings, and guides for conducting the fibrous material from the several doffer-rings to and from the appropriate condensing-straps, substantially as and for the purposes hereinbefore set forth.

12. The combination with the ring-doffer of power-driven condensing-straps located in, or opposite to, the intervals between the doffer-rings, with their meeting faces in a plane tangential, or approximately so, to their respective doffer-rings, guides for conducting the fibrous material from the several doffer-rings to and from the appropriate condensing-straps, and means for adjusting said straps and guides, substantially as and for the purposes hereinbefore set forth.

In testimony whereof I have hereunto set my hand this 19th day of July, 1898.

WILLIAM HENRY DRURY.

Witnesses:

ANNIE J. CONDON,
HENRY H. FOLSOM.