May 6, 1930 W. E. COOK 1,757,794

BRAIDING MACHINE

Original Filed Feb. 9, 1926 3 Sheets-Sheet 1

Fig. 1.

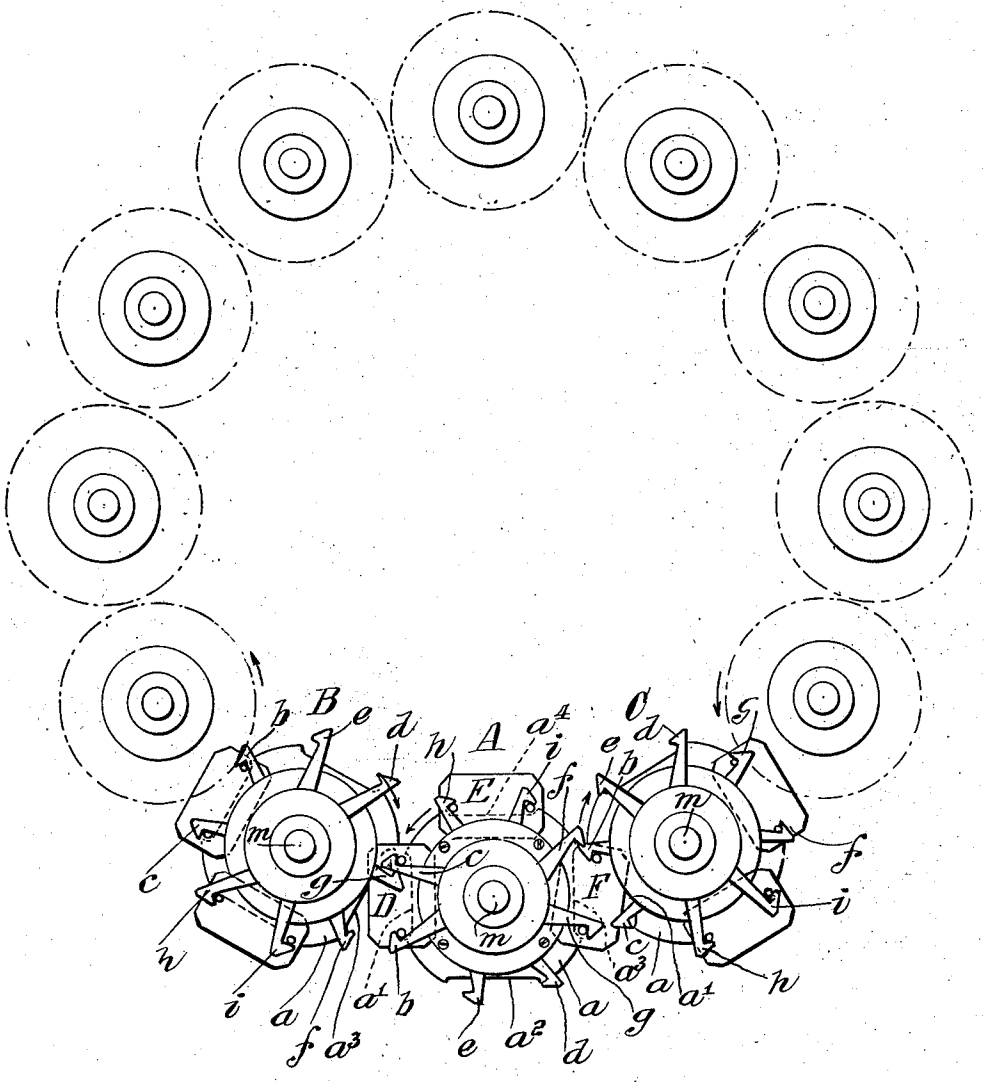

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Fig. 2.

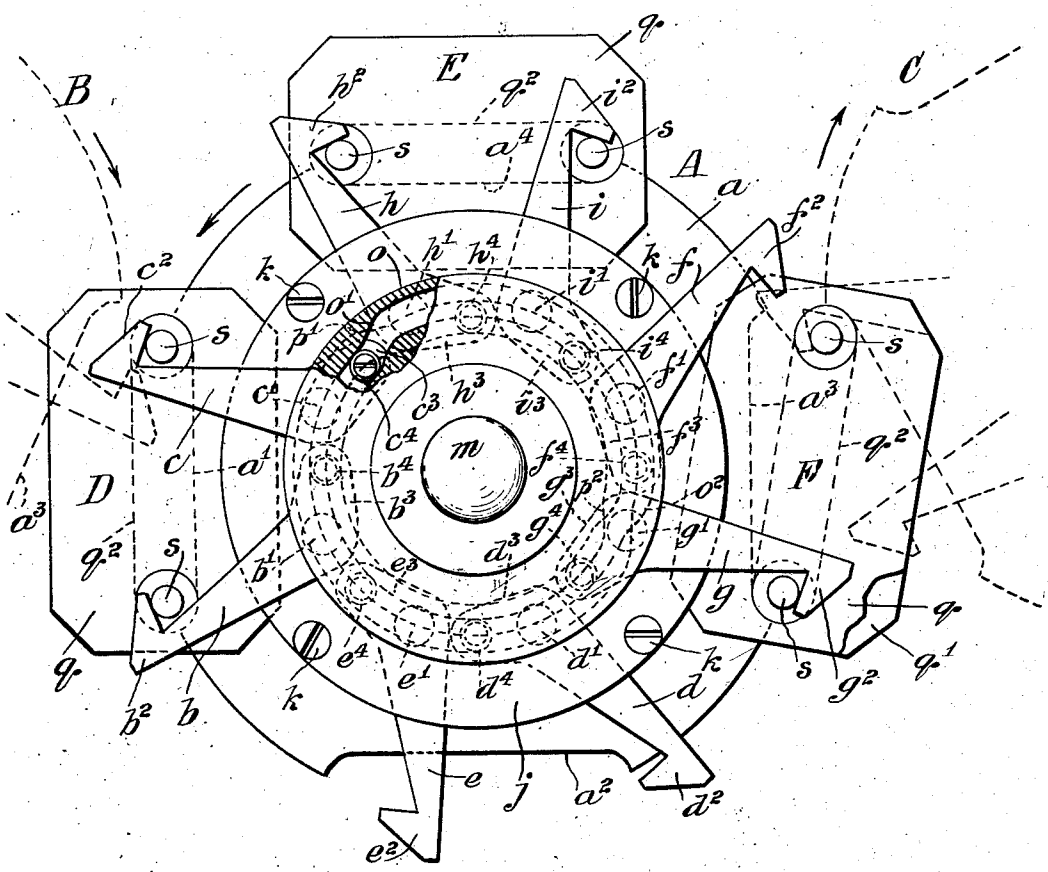

Fig. 3.

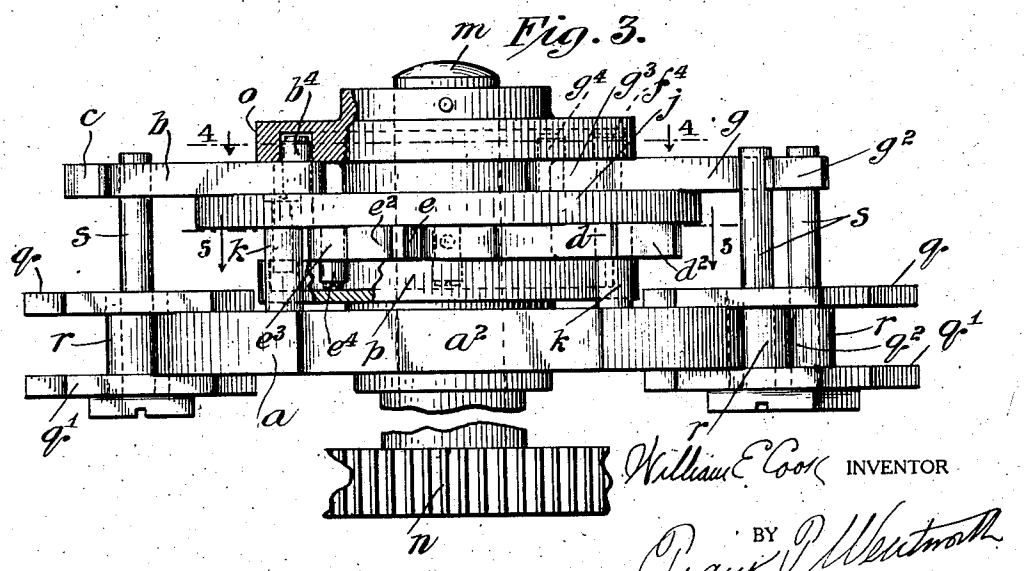

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Fig. 4.

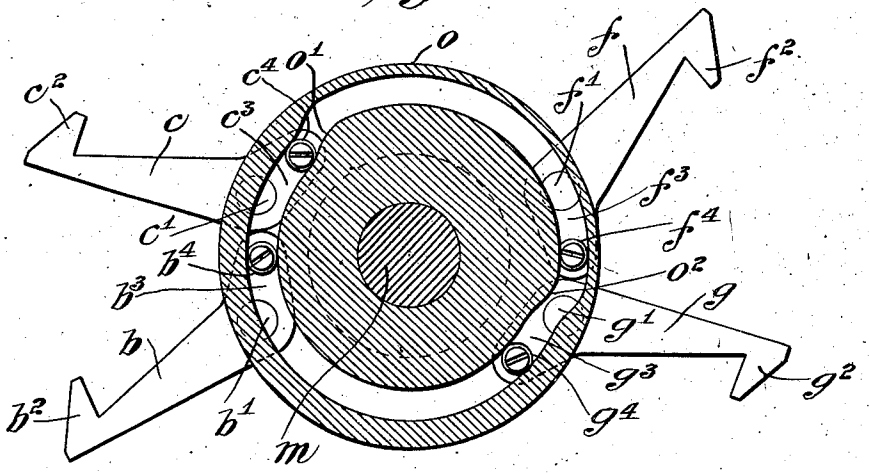
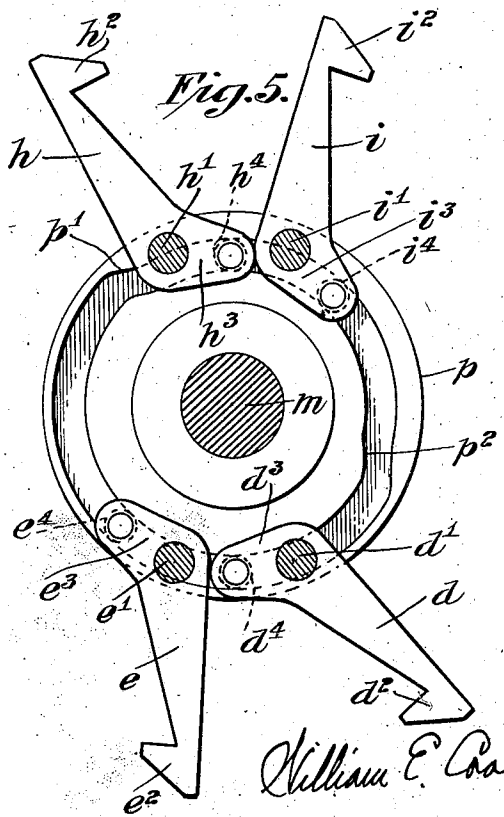


Fig. 5.



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Patented May 6, 1930

1,757,794

UNITED STATES PATENT OFFICE

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BRAIDING MACHINE

Application filed February 9, 1926, Serial No. 87,033. Renewed October 1, 1929.

My invention relates to braiding machines, and more particularly to the actuating mechanism for the carriers.

In braiding machines it has long been the practice to impart a sinuous movement to the bobbin carriers by means of entrained gears having diametrically, right angularly, extending slots engaging a stud upon the carrier and imparting movement thereto, the trend of movement of the carrier, however, being determined by sinuous slots formed in the top plate of the machine and a web upon the carriers having a sliding fit therein.

In such machines when operating at even low speeds, the wear on the parts of the machine, particularly the walls of the slots formed in the top plate and the web, is very great, and when it is attempted to operate such machines at high speeds, the rate of wear is so much increased that the frequent shutting down of machines is necessary in order to effect repairs resulting from this wear. As a consequence, various modifications, in the type of machines above referred to, have been proposed in order to permit the actuation of such machines at higher speeds, but experience has demonstrated that such high speed machines require constant attention to keep them in operating condition, owing to the frequent breakage of parts, and excessive wear both of the top plate of the machines and of the various carriers.

With the above conditions in mind, my present invention contemplates a braiding machine in which the slotted top plate is entirely dispensed with, and in which the various carriers will be caused to follow a sinuous path without frictional engagement with other parts of the machine in a degree which will cause material wear of parts. The carriers of a machine embodying the invention, are physically transported or conveyed throughout their entire course of movement by a sequence of co-operating rotatable members carrying mechanisms by which the carriers receive a timely transfer from one of said members to the adjoining member to cause the carriers to follow the desired sinuous or in and out movement in relation to other carriers being similarly transported by said members, but in the opposite direction. By the use of such members and such transfer mechanisms, movement of the carriers with relation to the members transporting same or causing sinuous movement thereof, is avoided so that the sole limitation upon the speed at which the machine may be operated is that at which the braiding of the threads can be carried on, it being possible to develop very high speeds in said rotatable members and great accuracy in the functioning of mechanisms for transferring the carriers from one of said members to the adjoining member, without any material wear on parts or without likelihood of the breakage of parts due to such high speeds.

Furthermore in a machine in which there is bodily transportation of the carriers as compared with a sliding movement thereof in relation to a top plate, the carriers will have a steady uniform rate of travel, and will not be subjected to likelihood of chattering because of looseness in co-operating parts, which conditions will contribute to a smooth running of the machine and its operation at high speeds.

The transfer mechanisms are so constructed and actuated as to permit any of the rotatable members to deliver carriers to an adjacent member at one point of the cycle of said member, and to receive a carrier from said adjacent member at another part of the cycle, the construction and arrangement of parts being such that this transfer is effected without any variation in the speed of the rotatable members, and without any material jars or impacts between the members and the carriers.

Said transfer mechanisms are, furthermore, so constructed and actuated as to avoid the necessity for the use of springs, the positive actuation of these mechanisms not only contributing toward the possibility of the operation of the machine at high speeds, but ensuring the timely actuation thereof during the transfer period, avoiding likelihood of the escape of a carrier from a rotatable member, and permitting this transfer mechanism to retain the carriers in position in relation to said rotatable members without the assist-

ance of guiding means for preventing movement of the carriers except with the rotatable members.

The invention consists primarily in a braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, a plurality of transfer mechanisms carried by each of said members and adapted to co-operate with carriers being transported by said members, adjacent the forward and rear walls of said recesses respectively, and means whereby said transfer mechanisms adjacent the forward and rear walls of said recesses respectively are successively actuated to permit movement of a carrier from one of said members to the adjacent member, and said carriers are bodily transported by means of said members and are caused to follow a sinuous course; and in such other novel features of construction and combination of parts as are hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings,

Fig. 1 is a plan view of a circular braiding machine embodying the invention, three only of the rotating members, however, being shown in detail, the remainder of said members being merely conventionally shown;

Fig. 2 is a plan view upon a slightly enlarged scale of one of the rotatable members and the transfer mechanism carried thereby;

Fig. 3 is a side view thereof;

Fig. 4 is a section on the line 4—4 of Fig. 3, showing the setting of one of the actuating cams; and

Fig. 5 is a section on the line 5—5 of Fig. 3, showing the setting of the other cam.

Like letters refer to like parts throughout the several views.

In the embodiment of the invention shown in the drawings, I have illustrated merely those portions of the machine which co-operate in transporting carriers, and in transferring them from one rotary member to an adjacent member, and have not illustrated any particular mechanism by which power is transmitted to the rotary members beyond a fragmentary portion of a gear carried by one of said rotary members. In Fig. 1 of the drawings, I have shown in detail three adjacent rotary members and their appurtenances, circularly arranged as required in a tubular braiding machine, this type of machine exemplifying one broad field of utility of the invention. The remaining rotary members and their appurtenances are merely conventionally indicated, it being unnecessary to an understanding of the invention to duplicate a detailed showing of all of these members. Suffice it to say that all of the rotary members embodied in the machine have their axes equidistant from a common center with the peripheries of the various members in close juxtaposition to each other without engaging relation.

Referring more particularly to Fig. 1 of the drawings, I have indicated the three rotary members shown in detail, by A, B and C, and will describe one of said rotary members and its appurtenances only, since the construction of each member is a duplicate of every other member. The corresponding parts of each member and its appurtenances will be indicated by similar reference letters as to those members operative in effecting the transfer of the carriers from one rotary member to the adjacent member.

During the operation of a machine each rotary member will, during each cycle of operations thereof, receive and transport four carriers, two of which will have movement outwardly of the center of the machine and two of which will have movement inwardly of the center of the machine, the movements outwardly or inwardly being as to alternate carriers. Each rotary member, however, will have associated therewith only three carriers at a time.

Each of the sequence of rotary members embodies therein a disk a having about the perimeter thereof recesses or pockets a', a^2, a^3, and a^4. Two of these diametrically opposite pockets a' and a^3 upon the member A are adapted to receive carriers from a rotary member B positioned at one side of the member A, and to transport them toward and deliver them to the rotary member C positioned upon the other side thereof. The other two pockets a^2 and a^4 upon the member A are adapted to receive carriers from the adjacent member C and deliver them to the adjacent member B. Hence each pocket a' to a^4 is required in the operation of the machine to receive a carrier from one adjacent rotary member B or C, and transport it toward and deliver it to the other adjacent member C or B, there being no movement of the carrier in relation to the rotary member A except that incidental to its transfer from one member to an adjacent member.

Referring more particularly to Fig. 2 of the drawings, the disk a is provided with a transfer mechanism associated with each of the pockets a', a^2, a^3 and a^4, which mechanism is so constructed and actuated as to ensure the transfer of a carrier from an adjacent rotary member to said pocket, the transportation of said carrier by said disk toward the other adjacent rotary member and the transfer of the carrier to said other and last named member. Each of the disks a having four pockets, there will be associated with each disk four transfer mechanisms, each of which however,

will be substantially identical with every other, but so mounted as to avoid interference between same and the transfer mechanisms of the adjacent rotary members.

Co-operating with said transfer mechanisms, is means whereby said mechanisms are actuated to cause a carrier to be engaged thereby or disengaged therefrom according to whether a rotary member is required to receive a carrier from another such member, or to permit a carrier to pass therefrom to another such member. Said actuating means is so constructed and arranged a transfer mechanism will at all times during the transportation of a carrier from its point of receipt by a member, to the point where it is delivered to another member, be caused to positively engage the carrier and hold it firmly in position upon the rotary member.

Each of the mechanisms above referred to, in the form of the invention shown, comprises a pair of jaws pivotally mounted with relation to and rotatable with, the disk a.

The jaws associated with the pocket a' are designated by the reference letters b and c; those associated with the pocket a^2, by the reference letters d and e; those associated with the pocket a^3, by the reference letters f and g, and those associated with the pocket a^4, by the reference letters h and i.

The various jaws are privotally mounted at b', c', d', e', f', g', h' and i' respectively, upon a plate j supported from and connected with the disk a by the studs k, so as to have rotary movement with said disk, and cause the various jaws to have such movement.

The disk a and plate j are idly mounted upon a bearing stud m. Rotary movement is imparted to said disk and said plate by means of a gear n carried by the shaft of the disk a, said gear being entrained with similar gears carried by the other rotary members of the machine, so that adjacent members are rotated in opposite directions, thus causing the sinuous movement of the carriers necessary to a braiding machine.

The jaw b has a hooked end b^2 extended beyond the periphery of the disk a, adjacent and adapted to project across the forward end of the pocket a'. The jaw c has a similar hooked end c^2 projected beyond the perimeter of the disk and extending toward and adapted to project across the rear wall of the pocket. The jaws d and e are provided with similar hooked ends d^2 and e^2 similarly positioned with relation to the forward and rear walls of the pocket a^2, the jaws f and g with similar hooked ends f^2 and g^2 having the same relation with the forward and rear walls of the pocket a^3, and the remaining jaws h and i with hooked ends h^2 and i^2 similarly positioned in relation to the disk and the forward and rear walls of the pocket a^4.

The jaws b, c, d, e, f, g, h and i respectively have heels b^3, c^3, d^3, e^3, f^3, g^3, h^3 and i^3, said heels respectively being provided with a member such as the anti-friction rollers b^4, c^4, d^4, e^4, f^4, g^4, h^4 and i^4 adapted to be acted upon by a cam or cams for imparting a timely engagement or disengagement of the jaws with relation to a carrier.

Since a disengagement of jaws upon one rotary member with a carrier must be effected substantially simultaneously with the engagement of the jaws upon another rotary member therewith during the transfer operation of the carrier from one rotary member to an adjacent member, it is apparent that to avoid interference or collision of parts, the arrangement of these jaws must be such that those jaws which thus operate substantially simultaneously will have movement in parallel planes at least as to those portions thereof which engage the carrier.

In the form of the invention shown, the actuating means for the various transfer mechanisms of each rotary member, comprises two cams o and p, each of which is fixedly secured to the bearing stud m so that the transfer mechanisms have rotary movement with the relation to said cams. These cams are concentric with the rotary member, and the rise and fall of each is so set as to be operative upon the jaws to be actuated thereby to open said jaws when a carrier is to be received or to be delivered, and to close said jaws after a carrier has been received, and maintain them closed while a carrier is being transported in the pocket adjacent said jaws.

The cam o has its groove presented downwardly and co-operates with the members b^4—c^4 of the jaws b and c, and with the members f^4—g^4 of the diametrically opposite jaws f and g. The beginning of the fall o' of the cam o, used for closing said jaws is positioned toward the adjacent rotary member B and slightly in advance of a line connecting the axes of the members A and B. The beginning of the rise o^2 of said cam o, used for opening the jaws, is positioned towards the adjacent rotary member C and in advance of a line connecting the axes of the members A and C.

The cam p has its groove presented upwardly, and co-operates with the members d^4—e^4 of the jaws d and e, and with the members h^4—i^4 of the diametrically opposite jaws h and i. The rise p' of the cam p is substantially below the fall o' and the fall p^2 is substantially below the rise o^2.

The cams o and p are positioned above and below the plate j and spaced therefrom sufficiently to afford clearance for the movement of the jaws b, c, f and g below said plate and the cam o, and for the movement of the jaws d, e, h and i between said plate and the cam p. This arrangement not only permits the necessary variance in the timing of the actuation of two diametrically opposite pairs of jaws with relation to the other two

diametrically opposite pairs of jaws, but also the positioning of said jaws upon different planes to avoid interference or collision with co-operating jaws on an adjacent rotary member.

It will be readily understood that if the jaws *b*—*c* and *f*—*g* of the member A are upon an upper plane, that the jaws *f*—*g* and *b*—*c* upon each of the adjacent members B and C must be upon a lower plane, and that this alternation of the positions of the co-operating jaws upon adjacent rotary members must follow throughout the entire sequence of such members in the machine. This merely requires a reversal of the cams *o* and *p* in alternate rotary members, and a proper setting of the cams and the rotary members when assembling the machine.

The carriers shown at D, E and F in the drawings, are of the usual construction, modified however, so as to be capable of use with rotary members A, B and C constructed as described. They each have the usual upper and lower plates *q*—*q'*, and the usual web q^2, the pockets *a'*, a^2, a^3 and a^4 being so formed as to receive these webs. The usual bottom stud is not used, however. The web q^2 is drilled, however, at the opposite ends, and has set therein sockets *r* opening upwardly of the upper plate *q* and adapted to receive rods *s* of a length to be engaged by jaws positioned above or below the plate *j*. The rods *s* are removable from the sockets to facilitate the mounting of a carrier in, or its removal from, the machine, since as will hereinafter appear, the mode of operation of the machine is such, that while the carriers are transferred from rotary member to rotary member in their sinuous course about the axis of the bearing stud *m*, they are always controlled in their movement by the transfer mechanisms and are never permitted to escape from their engaging relation with some rotatable member and with some transfer mechanism.

The operation of the herein described braiding machine is substantially as follows:—

Before starting a run of the machine the various carriers D, E, F, etc., are mounted in relation to the various disks *a*, the upper and lower flanges *q*—*q'* of the carriers straddling the edge of the disk and the web q^2 entering the various pockets *a'*, a^2, a^3 or a^4, as the case may be. In a machine having twelve disks *a*, twenty-four carriers are required. In mounting the carriers the rods *s* are removed from the sockets *r* and each carrier is positioned so that, as these rods are restored to said sockets, they will be in engaging relation with the jaws carried by the disk co-operating with the particular pocket receiving the carrier.

When all of the carriers are in position and the threads or cords properly secured in relation to the object upon which the braid is to be formed, power may be applied to the machine, and thereafter the functioning of the machine will be entirely automatic.

It is to be noted that when the rods *s* are once positioned in the sockets *r*, the carrier carrying said rods is thereafter always under the control of some rotatable member and the jaws carried thereby, so that there is no likelihood of the accidental escape, or displacement, of any carrier irrespective of the speed at which the machine is operating.

When describing the detailed operation of the machine, reference will be had only to the functioning of one rotary member with relation to the rotary members upon opposite sides thereof, it being understood that the operation thus described is being simultaneously repeated with relation to each of said members as to the members upon opposite sides thereof. In this operation each pocket of each rotary member is required to receive a carrier from one adjacent member and transport it in a circular path toward or from the axis of the stud *m* and deliver it to the other adjacent rotary member. One set of diametrically opposite pairs of jaws receives a carrier from one adjacent rotary member, moves it outwardly of the bearing stud *m* and delivers it to the other adjacent rotary member, while the other set of diametrically opposite pairs of jaws receives carriers from the rotary member to which carriers are delivered by the other diametrically opposite set of jaws, and transports them inwardly of the axis of the stud *m* and delivers them to the member from which the other set of jaws receives carriers. By way of example, referring to the rotary member A, the jaws *b* and *c* thereon adjacent the recess *a'* and the jaws *f*—*g* adjacent the recess a^3, always receive carriers from the member B and convey them outwardly of the axis of the stud *m* and deliver them to the member C, while the jaws *d*—*e* adjacent the recess a^2 and the jaws *h*—*i* adjacent the recess a^4 always receive carriers from the member C and transport them inwardly or toward the axis of the stud *m* and deliver them to the member D. As a consequence, the carriers transported by each rotary member alternately travel upon opposite sides of the center line of the sinuous path which it follows under the control of the sequence of rotary members, the carriers moving outwardly of the stud *m*, and the carriers moving inwardly of the axis of said stud having movement in opposite directions along said sinuous path so as to secure the desired braiding action.

Referring more particularly to Fig. 2 of the drawings, the relation of parts therein shown are such as exist when the circular rotatable member A has just received a carrier D from the adjacent member B and is trans-

ferring or delivering another carrier F to the adjacent member C, and the third carrier E is about midway in its course from the member C toward the member B. With this condition the recesses a' and a^4 each have a carrier held in relation thereto by the jaws b—c and h—i respectively. The recess a^2 is unoccupied by a carrier, and the recess a^3 has a carrier passing therefrom to the adjacent member C, the jaw f of the member A being out of engaging relation with said carrier and the jaw g being still in engaging relation therewith but about to become disengaged therefrom with a slight continuing rotary movement of the member A. The bearings b^4—c^4 of the jaws b and c are engaged with the fall of the cam o, which fall extends for a sufficient distance to ensure the continued engagement of said jaws with the carrier until the carrier is in a position to be transferred to the member C about 180°. The rollers h^4—i^4 are engaged with the fall of the cam p, thus holding the jaws h and i in engaging relation with the rods s of the carrier E, and thus locking said carrier with relation to the disk a. The roller f^4 of the jaw f is engaged with the rise of the cam o, thus holding this jaw in a position out of engaging relation with the carrier E, while the roller g^4 of the jaw g is engaged with the fall of the cam o and just about to pass to the rise of this cam, thus holding the jaw in engaging relation with a rod s of the carrier F. The rollers d^4 and e^4 are engaged with the rise of the cam p and are thus maintained in the open position, the recess or pocket a^2 having no carrier positioned therein.

With the continued rotation of the disk a the jaws b and c will be held in the closed position by the fall of the cam o until the forward jaw b is in a position substantially on a line connecting the axes of the members A and C. As this jaw approaches this position, the roller b^4 will engage the rise of the cam, whereupon this jaw will be moved out of engaging relation with the carrier D or the rod s thereon with which it cooperates. This will occur when the forward end of the pocket a' is closest to the forward end of a co-operating pocket s^3 upon the member C, the jaw f associated with which latter pocket will be, at this point, in its open position. As the jaw b passes this center line between the members A and C, it will be disengaged from the carrier D and the jaw f will be engaged with said carrier, these jaws lapping each other as shown. Consequently with the continued rotation of both of said members A and C, the carrier D will be caused to follow the member C as the curved surfaces of the two disks a diverge after leaving this center line. The same operation occurs as the jaw c and the corresponding jaw g approach this center line. The rise of the cam o will hold the jaws b and c in the open position until these jaws approach the center line with relation to the members A and B.

The quantity of circular movement of the jaws b and c from the time of the delivery of the carrier D thereto from the member B to the time of the delivery of said carrier thereby to the member C, is approximately 180° of the arc of movement of the disk a. With the parts positioned as shown in Fig. 2, following about 90° of this movement, the pocket a^4 will approach the pocket a^2 of the member B and the jaws h and i will be opened by the rise of the cam o in the same manner as the jaws b and c are actuated as above described, the jaws d and e adjacent the pocket a^2 of the member B being closed similarly to the jaws f and g of the member C to ensure that the carrier E will follow the disk a of the member B. Substantially simultaneously with the transfer of the carrier E from the member A to the member B, a carrier will be transferred from the member C to the pocket a^2 of the member A, the fall of the cam o causing the closing of the jaws d and e upon said carrier, the jaws upon the member C corresponding with the jaws h and i being open to permit this transfer.

Following the transfer of the carrier F from the member A to the member C, the jaws f and g will be held in their open position by the rise of the cam o until the fall of this cam causes the actuation of these jaws adjacent the member B when the pocket a^3 is required to receive a carrier from said member B.

I have referred to a movement of approximately 180° and approximately 90°. It will be understood, however, that with a circular arrangement of rotary members as in a tubular braiding machine, this amount of feeding movement is merely approximate since some variation therefrom must occur by reason of this circular arrangement. This condition must also be taken into account in the laying out and setting of the cams o and p, the setting of the beginning of the rise and fall thereof as stated being determined by the center line between the axes of adjacent members rather than any diameter of the member associated with said cams.

In summarizing the above detailed description and mode of operation, it is apparent that in each of the rotary members diametrically opposite pockets and the jaws co-operating therewith, will substantially simultaneously receive and deliver a carrier, and that the other diametrically opposite pockets and their associated jaws will deliver and receive a carrier, during each rotation of the disk of said rotary member. It will also appear that between the receipt of a carrier by a member and its delivery to an adjacent member, said member will have movement of about 180°. All of the carriers received from one adjacent member will

travel in one direction and either toward or away from the axis about which the rotary members are grouped, while all of the carriers received from the other adjacent rotary member will travel in the opposite direction, and either away from or toward said axis. Since succeeding pockets will receive carriers from different adjacent members, it is apparent that these carriers will be alternately moved in opposite directions and will cross each other so as to secure the desired braiding action, this crossing occurring both circumferentially and radially of the axis about which the rotary members are grouped.

By reason of the rotary movement of the various members A, B, C and other similar members, there is no impact of the carriers with the plates *a* during the transfer operation, the forward jaw associated with each pocket causing the deflection of the carrier from its direction of movement with the member by which it is being delivered, or permitting such deflection, and the rearward wall or the rear shoulder, of the pocket engaging the web of the carrier, ensuring the continued movement of the carrier notwithstanding this deflection of its forward end, until this rear shoulder is at its point of closest approach to the rear shoulder of the pocket which is receiving the carrier. Hence the transfer operation is secured without any appreciable radial action of the carrier with relation to either rotary member. The rods *s* are of a diameter to project beyond the perimeter of the disk *a* to an extent to project into the pocket of the disk of an adjacent rotary member at the point of transfer which will facilitate the ease of transfer and the elimination of any substantial impacts.

The hooked ends $b^2, c^2, d^2, e^2, f^2, g^2, h^2$ *and* i^2 are so formed as to be positioned with relation to the rods *s* of different carriers, to prevent any outward movement thereof from centrifugal force, thus confining the carriers within their respective pockets and ensuring their rotation as a unit with the rotary member.

The only friction in the operation of the device is that incidental to the mounting of the rotary members, the slight turning action of the various jaws upon their pivots, that between the various rollers and their co-operating cams, between the various jaws and the rods *s* and between the plates *q*—*q'* and the disk *a*, which aggregate friction, is very slight and is a factor having no influence in operating the machine at high speed. In fact, the amount of wear in the operation of the machine, even after long continued use even at very high speeds, will be so small as not to be appreciable.

The conditions of transfer and the manner of transporting the carriers are such as to develop very little noise in the operation of the machine.

The particular design and construction of parts shown in the accompanying drawings is such as to permit the utilization, with slight modificaton, of carriers now in use, and this design is subject to wide variation in adapting the invention to machines using different constructions of carriers or different designs of braiding machines.

By the use of the rotary members the carriers may be conveyed through their sinuous course with substantially no rubbing contact between same and other parts of the machine, and each carrier will be rigidly supported in its movement in a manner to ensure its travel at a uniform rate of speed without material vibration. These conditions permit the operation of the machine at much higher speeds than have heretofore been possible, contribute toward a smooth running of the threads from the bobbin, and avoid conditions in the machine which will result in neccesity for frequent stoppages for purposes of repair.

The absence of springs in the construction of the rotary members and their appurtenances ensures a positive actuation of the transfer mechanisms.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, a plurality of transfer mechanisms carried by each of said members adjacent the forward and rear walls of said recesses respectively and adapted to co-operate with carriers being transported by said members, and means whereby said transfer mechanisms adjacent the forward and the rear walls of said recesses respectively are successively actuated to cause movement of a carrier from one of said members to the adjacent member, and said carriers are bodily transported by means of said members and are caused to follow a sinuous course.

2. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, two sets of diametrically opposite transfer mechanisms carried by each of said rotatable members adjacent the forward and rear walls of said recesses respectively, means operative to successively engage the mechanisms of one set with a carrier to be transferred from one adjacent rotary member and disengage them from the carrier when it is to be transferred

to the other adjacent rotary member and simultaneously engage them with said carrier during its transportation by said member, and means operative upon the mechanisms of the other set to successively engage the mechanisms of said other set with a carrier to be transferred from said last named adjacent rotary member and disengage them from said carrier to permit its transfer to said first named adjacent rotary member and simultaneously engage the carrier while it is being transported from the point of its receipt to the point of its delivery, whereby alternate carriers are transported in sinuous paths in opposite directions.

3. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, a plurality of transfer mechanisms carried by each of said members adjacent the forward and rear walls of said recesses respectively and adapted to co-operate with carriers being transported by said members, means carried by each of said transfer mechanisms preventing radial movement of the carriers with relation to said rotatable member, and means whereby said transfer mechanisms adjacent the forward and the rear walls of said recesses respectively are successively actuated to permit movement of a carrier from one of said members to the adjacent member, and said carriers are bodily transported by means of said members and are caused to follow a sinuous course.

4. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, two sets of diametrically opposite transfer mechanisms carried by each of said rotatable members adjacent the forward and rear walls of said recesses respectively, means carried by each of said transfer mechanisms preventing radial movement of the carriers with relation to said rotatable member, means operative to successively engage the mechanisms of one set with a carrier to be transferred from one adjacent rotary member and disengage them from the carrier when it is to be transferred to the other adjacent rotary member and simultaneously engage them with said carrier during its transportation by said member, and means operative upon the mechanisms of the other set to successively engage the mechanisms of said other set with a carrier to be transferred from said last named adjacent rotary member and disengage them from said carrier to permit its transfer to said first named adjacent rotary member and simultaneously engage the carrier while it is being transported from the point of its receipt to the point of its delivery, whereby alternate carriers are transported in sinuous paths in opposite directions.

5. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets respectively, and means operative upon said jaws to successively impart opening movement thereto and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, or from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to the rotatable member and hold them closed until the carrier is delivered to an adjacent member, whereby carriers are bodily transported by said rotatable members and are caused to follow a sinuous course.

6. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets respectively, hooked ends upon said jaws whereby movement of the carriers engaged thereby radially of the rotatable member is prevented, and means operative upon said jaws to successively impart opening movement thereto and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, or from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to the rotatable member and hold them closed until the carrier is delivered to an adjacent member, whereby carriers are bodily transported by said rotatable members and are caused to follow a sinuous course.

7. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets, said jaws being arranged in two sets of diametrically opposite pairs, a cam operative upon the jaws of one set, the rise and fall of which are so positioned as to successively open the jaws of that set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, and from said member during another part of each rotation thereof, and to successively close the jaws of

each set during the transfer of a carrier to a rotatable member and hold them closed until the carrier is to be delivered to an adjacent member, and a second cam operative upon the jaws of the other set, the rise and fall of which are so positioned as to successively open the jaws of said set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof and from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to said member and hold them closed until the carrier is delivered to an adjacent member, said cams being so set with relation to each other that succeeding carriers are alternately received and delivered with relation to each adjacent rotatable member, whereby alternate carriers are bodily transported by each of said rotatable members in opposite directions and inwardly and outwardly with relation to each other.

8. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets, said jaws being arranged in two sets of diametrically opposite pairs, the jaws of one set being arranged in a different plane from the jaws in another set and from the jaws upon adjacent rotatable members co-operating therewith, a cam operative upon the jaws of one set, the rise and fall of which are so positioned as to successively open the jaws of that set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, and from said member during another part of each rotation thereof, and to successively close the jaws of each set during the transfer of a carrier to a rotatable member and hold them closed until the carrier is to be delivered to an adjacent member, and a second cam operative upon the jaws of the other set, the rise and fall of which are so positioned as to successively open the jaws of said set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof and from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to said member and hold them closed until the carrier is delivered to an adjacent member, said cams being so set with relation to each other that succeeding carriers are alternately received and delivered with relation to each adjacent rotatable member, whereby alternate carriers are bodily transported by each of said rotatable members in opposite directions and inwardly and outwardly with relation to each other.

9. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets, a heel upon each of said jaws, a bearing carried by each of said heels, said jaws being arranged in two sets of diametrically opposite pairs, a cam having a groove therein co-operating with the bearings upon the heels of the jaws of one set, the rise and fall of which cam are so positioned as to successively open the jaws of that set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, and from said member during another part of each rotation thereof, and to successively close the jaws of each set during the transfer of a carrier to a rotatable member, and hold them closed until the carrier is to be delivered to an adjacent member, and a second cam having a groove therein co-operating with the bearings upon the heels of the jaws of the other set, the rise and fall of which are so positioned as to successively open the jaws of said set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof and from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to said member and hold them closed until the carrier is delivered to an adjacent member, said cams being so set with relation to each other that succeeding carriers are alternately received and delivered with relation to each adjacent rotatable member, whereby alternate carriers are bodily transported by each of said rotatable members in opposite directions and inwardly and outwardly with relation to each other.

10. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, two sets of diametrically opposite pairs of jaws positioned adjacent the forward and rear walls of said pockets, the jaws of one set being pivotally mounted at one side of said plate and the jaws of the other set being pivotally mounted at the opposite side of said plate, whereby the jaws of one set are arranged in a different plane from the jaws of the other set, and from the jaws upon adjacent rotatable member co-operating therewith, a cam operative upon the jaws of one set, the rise and fall of which are so positioned as to successively open the jaws of that set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, and from said member during another part of each rotation thereof, and to successively close the jaws of each set during the transfer of a carrier to

a rotatable member and hold them closed until the carrier is to be delivered to an adjacent member, and a second cam operative upon the jaws of the other set, the rise and fall of which are so positioned as to successively open the jaws of said set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof and from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to said member and hold them closed until the carrier is delivered to an adjacent member, said cams being so set with relation to each other that succeeding carriers are alternately received and delivered with relation to each adjacent rotatable member, whereby alternate carriers are bodily transported by each of said rotatable members in opposite directions and inwardly and outwardly with relation to each other.

11. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, a plurality of transfer mechanisms carried by each of said members adjacent the forward and rear walls of said recesses respectively, means removably connected with carriers and co-operating with said transfer mechanisms respectively, whereby said carriers may be mounted in relation to said rotatable members, means carried by each of said transfer mechanisms preventing radial movement of the carriers with relation to said rotatable member, and means whereby said transfer mechanisms adjacent the forward and the rear walls of said recesses respectively are successively actuated to cause movement of a carrier from one of said members to the adjacent member, and said carriers are bodily transported by means of said members and are caused to follow a sinuous course.

12. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof, the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets, and positively acting means operative upon said jaws to successively open them and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, or from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to the rotatable member and hold them closed until the carrier is delivered to an adjacent member, whereby carriers are bodily transported by said rotatable members and are caused to follow a sinuous course.

13. A braiding machine embodying therein a plurality of rotatable members each having about the perimeter thereof recesses, the forward and rear walls of which are adapted to receive and engage a carrier respectively, means whereby rotary movement is imparted to said members respectively, a plurality of transfer mechanisms carried by each of said members adjacent the forward and rear walls of said pockets respectively, means removably connected with carriers and co-operating with said transfer mechanisms respectively, whereby said carriers may be mounted in relation to said rotatable members, and means whereby said transfer mechanisms adjacent the forward and the rear walls of said recesses respectively are successively actuated to cause movement of a carrier from one of said members to the adjacent member, and said carriers are bodily transported by means of said members and are caused to follow a sinuous course.

14. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets and projecting beyond the periphery of said member, said jaws being arranged in two sets of diametrically opposite pairs, hooked ends upon said jaws respectively, the ends of the jaws of each pair extending respectively towards, and being adapted to project across, the forward and rear walls of its pocket, whereby movement of the carriers engaged thereby radially of the rotatable member is prevented, means carried by a carrier engageable by said jaws and the hooked ends thereof, and means operative upon said jaws to successively open them and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, or from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to the rotatable member and hold them closed until the carrier is delivered to an adjacent member, whereby carriers are bodily transported by said rotatable members and are caused to follow a sinuous course.

15. A braiding machine embodying therein a plurality of rotatable members each having a plurality of pockets about the periphery thereof the forward and rear walls of which are adapted to receive and engage a carrier respectively, jaws pivotally mounted upon said rotatable member adjacent the forward and rear walls of each of said pockets and projecting beyond the periphery of said member, said jaws being arranged in two sets

of diametrically opposite pairs, hooked ends upon said jaws respectively, the ends of the jaws of each pair extending respectively towards, and being adapted to project across, the forward and rear walls of its pocket, whereby movement of the carriers engaged thereby radially of the rotatable member is prevented, means carried by a carrier engageable by said jaws and the hooked ends thereof, a cam operative upon the jaws of one set, the rise and fall of which are so positioned as to successively open the jaws of that set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof, and from said member during another part of each rotation thereof, and to successively close the jaws of each set during the transfer of a carrier to a rotatable member and hold them closed until the carrier is to be delivered to an adjacent member, and a second cam operative upon the jaws of the other set, the rise and fall of which are so positioned as to successively open the jaws of said set and permit the transfer of a carrier to a rotatable member during a part of each rotation thereof and from said member during another part of each rotation thereof, and to successively close them during the transfer of a carrier to said member and hold them closed until the carrier is delivered to an adjacent member, said cams being so set with relation to each other that succeeding carriers are alternately received and delivered with relation to each adjacent rotatable member, whereby alternate carriers are bodily transported by each of said rotatable members in opposite directions and inwardly and outwardly with relation to each other.

In witness whereof I have hereunto affixed my signature this 8th day of February, 1926.

WILLIAM E. COOK.