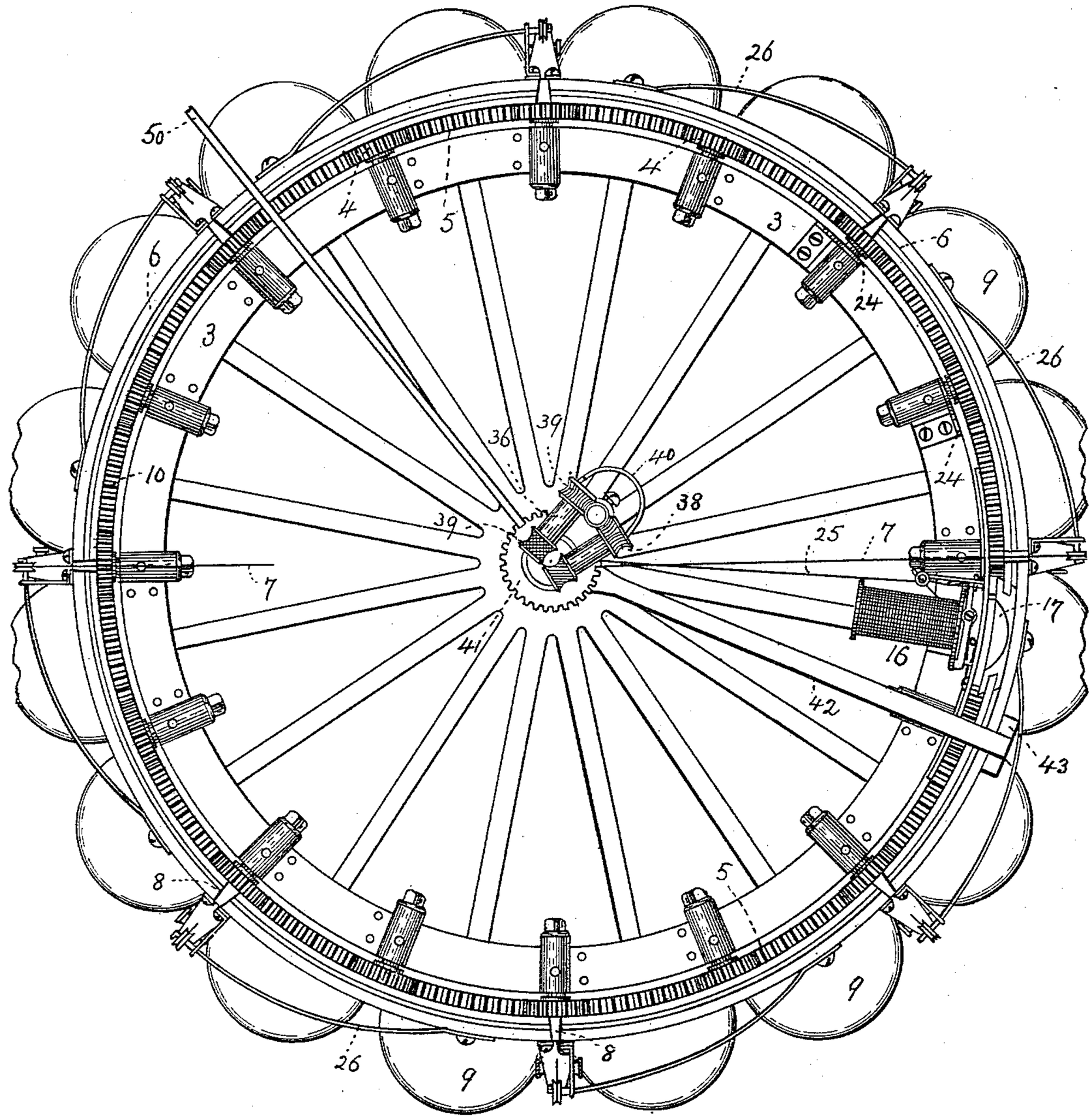
(No Model.) 5 Sheets—Sheet 1.

# N. LOMBARD.

## BRAIDING MACHINE.

No. 458,398. Patented Aug. 25, 1891.

Fig. 1.




WITNESSES.

R. Henry Marsh.

E. S. Coupland

INVENTOR.

Nathaniel Lombard.

by H. C. Lodge Atty.

(No Model.) 5 Sheets—Sheet 2.

# N. LOMBARD.

## BRAIDING MACHINE.

No. 458,398. Patented Aug. 25, 1891.

Fig. 2.

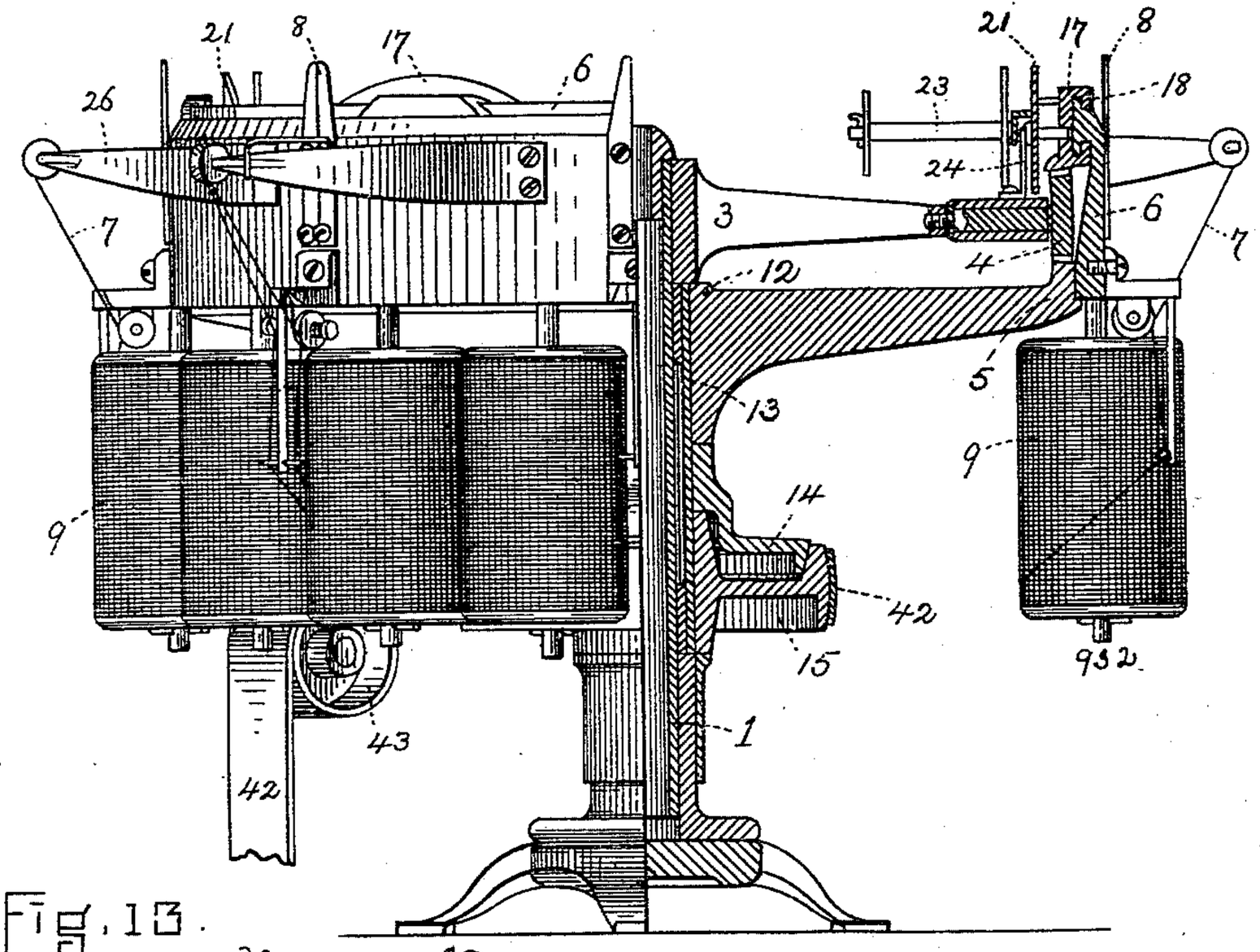



Fig. 10.

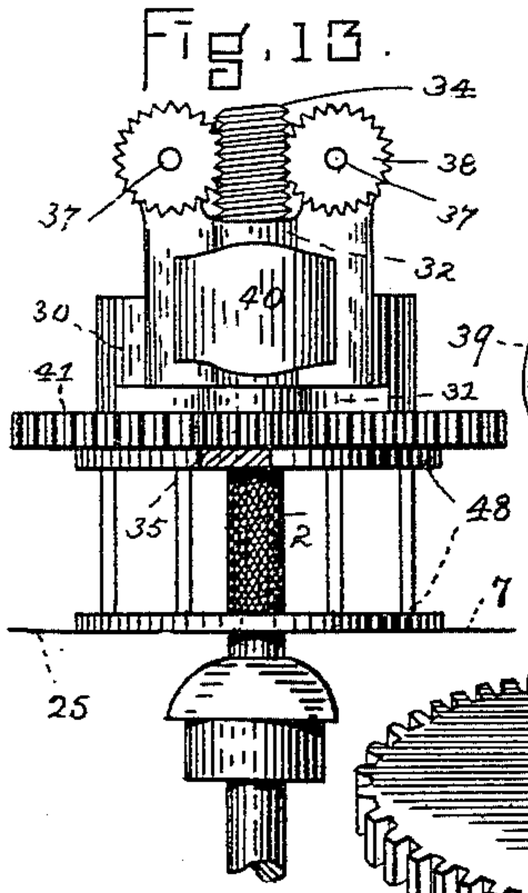
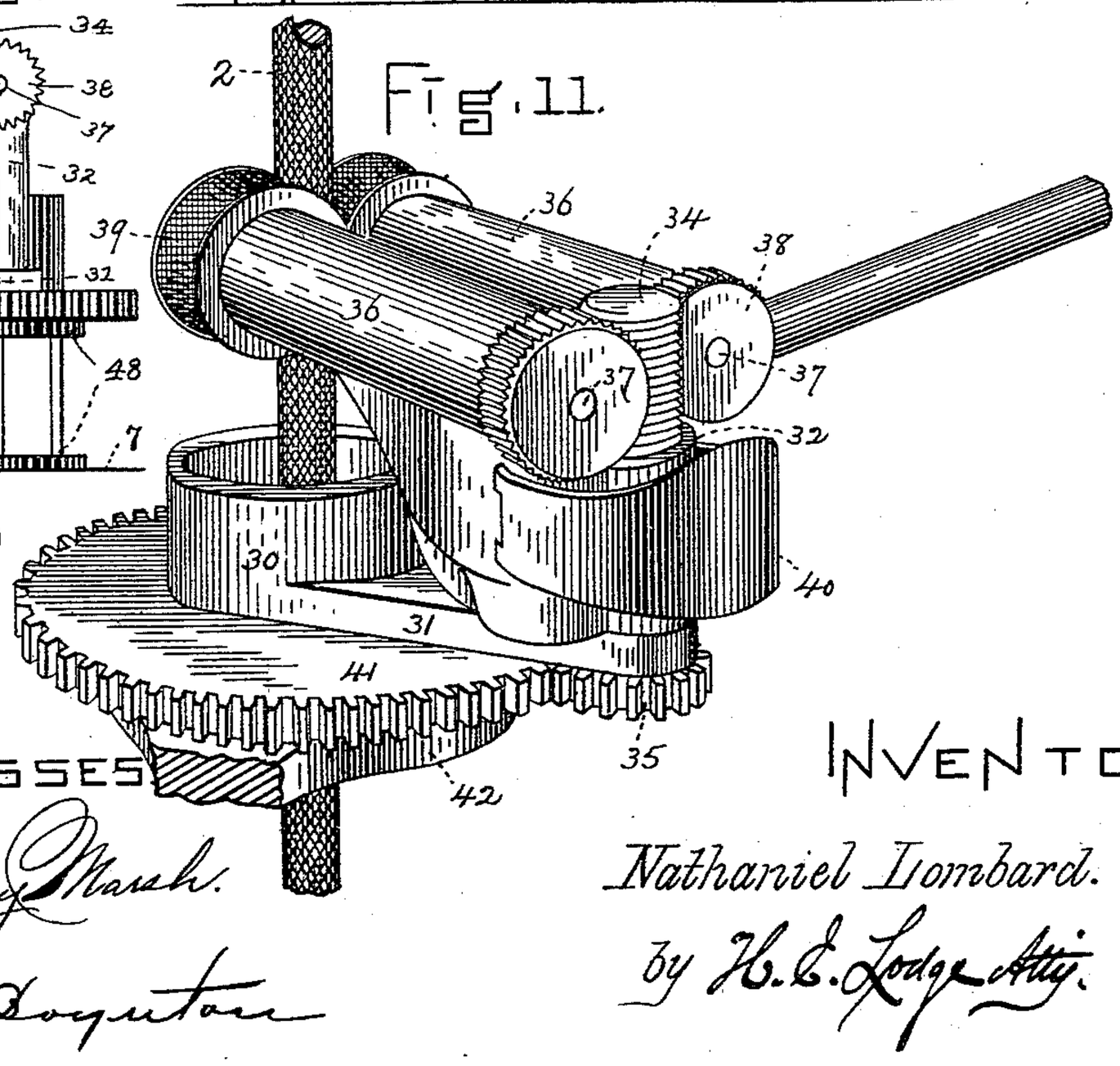



Fig. 11.




WITNESSES

R. Henry Marsh.

E. K. Boynton

INVENTOR.

Nathaniel Lombard.

by H. C. Lodge Atty.

(No Model.)

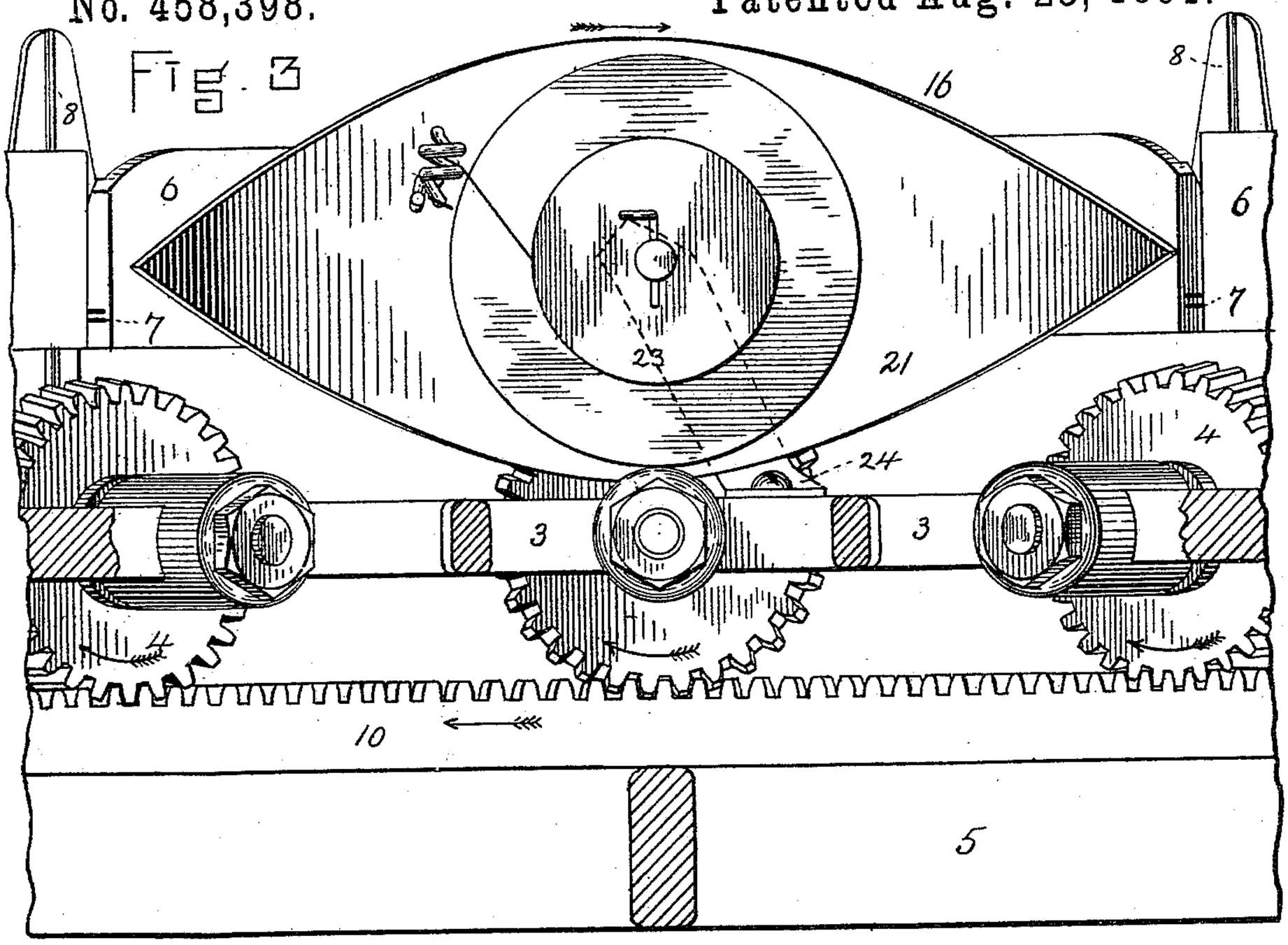
5 Sheets—Sheet 3.

# N. LOMBARD.

## BRAIDING MACHINE.

No. 458,398. Patented Aug. 25, 1891.

Fig. 3



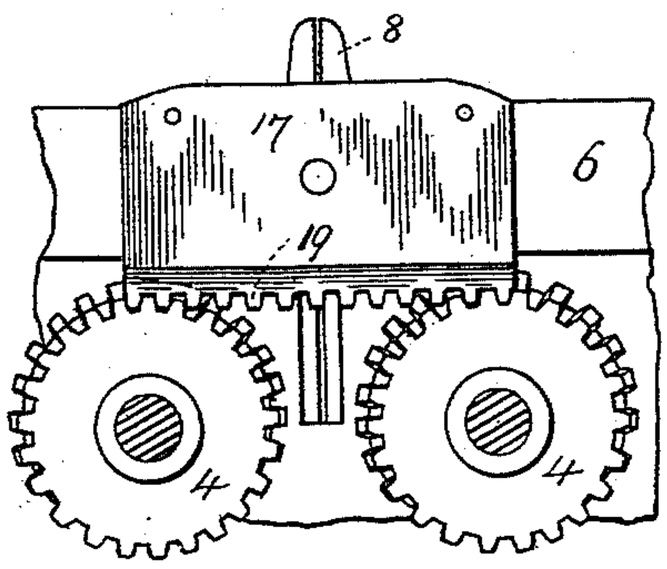




Fig. 5.

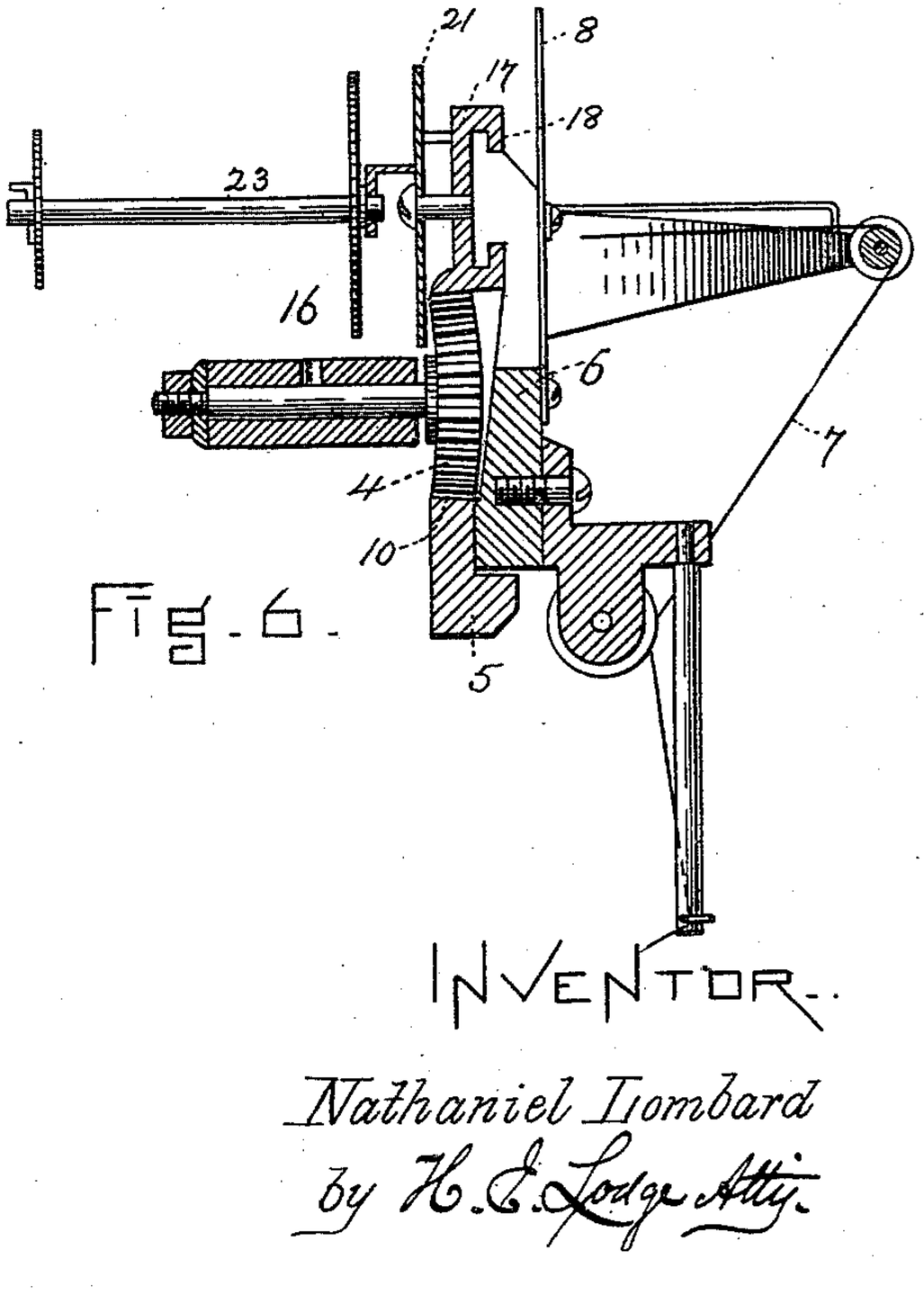



Fig. 6.

WITNESSES.

R. Henry March.

E. K. Boynton

INVENTOR.

Nathaniel Lombard

by H. E. Lodge Atty.

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# N. LOMBARD.

## BRAIDING MACHINE.

No. 458,398. Patented Aug. 25, 1891.

Fig. 7.

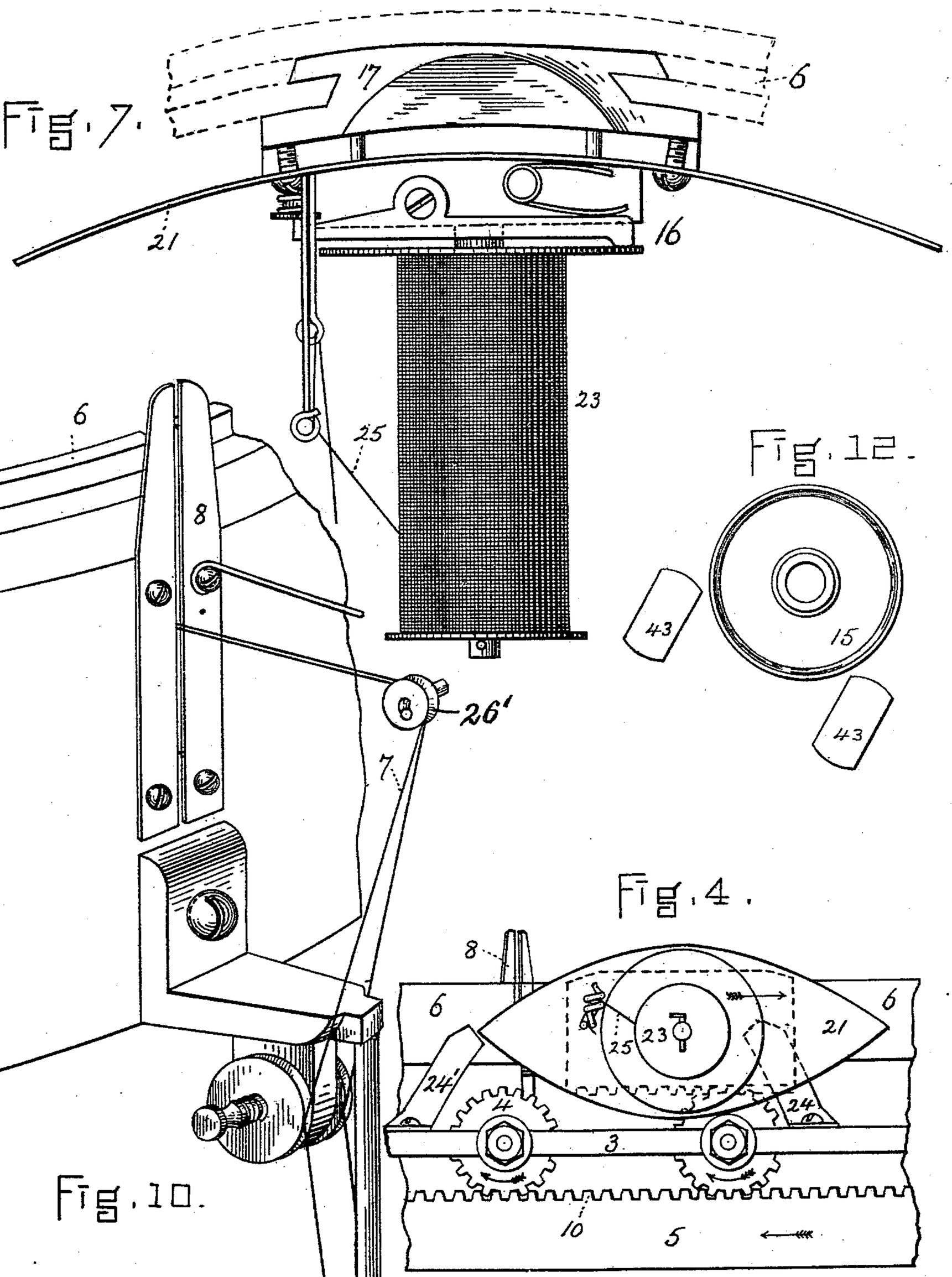



Fig. 12.




Fig. 10.

Fig. 4.




WITNESSES.

R. Henry Marsh.

E. F. Longstaff

INVENTOR.

Nathaniel Lombard.

by H. C. Lodge Atty.

(No Model.) 5 Sheets—Sheet 5.

# N. LOMBARD.

## BRAIDING MACHINE.

No. 458,398. Patented Aug. 25, 1891.

Fig. 8.

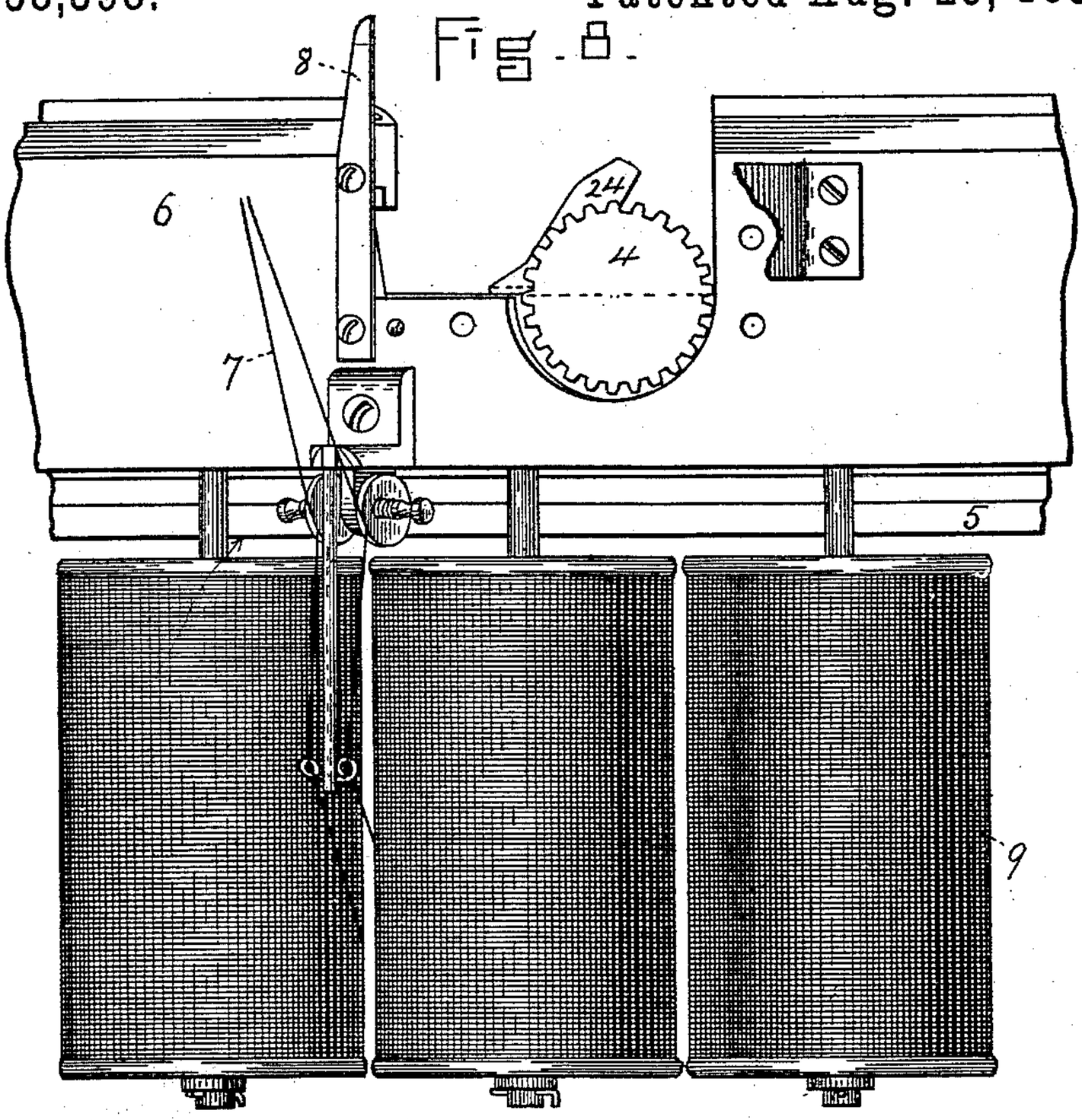
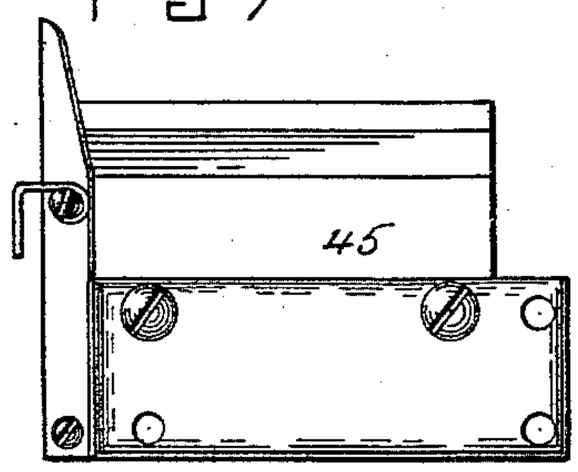



Fig. 9.




WITNESSES:

R. Henry Marsh.

E. K. Boynton

INVENTOR.

Nathaniel Lombard.

by H. C. Lodge Atty.

# UNITED STATES PATENT OFFICE.

NATHANIEL LOMBARD, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THOMAS A. JOHNSTON AND HENRY A. CLARK, OF SAME PLACE.

## BRAIDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 458,398, dated August 25, 1891.

Application filed June 21, 1890. Serial No. 356,265. (No model.)

*To all whom it may concern:*

Be it known that I, NATHANIEL LOMBARD, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Braiding-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

This invention relates to braiding-machines, particularly that class in which a central tubular shaft fitted with a ring adapted to receive a set of bobbins, and provided with a continuous circular raceway, is to co-operate with a set of shuttles seated upon said raceway, the bobbins and shuttles moving in opposite directions, while the threads from the bobbins are passed by suitable mechanism alternately over and under the shuttles in order to interweave the threads and form a braided stitch.

The prominent features of my present invention consist in a fixed circular ring, upon which are radially mounted a series of toothed gears equidistantly spaced, and a second rotary ring concentric with the fixed ring, and upon which is secured an endless circular toothed gear. Further, the rotary ring is formed with a vertical circular rim or raceway for the shuttles, while the bobbins are positioned beneath and carried by the rotary ring. Motion of each shuttle is produced by a curved plate toothed on its under edge and of a length to span from center to center of two of the toothed gears, with which it meshes at certain times, but usually being advanced by contact with a single gear in order to permit passage of the bobbin-threads at stated intervals of time beneath each shuttle. By such an arrangement it is evident that rotary movement of the endless toothed rack in one direction compels the shuttles to travel rapidly upon the raceway, which, with the bobbins, revolves in an opposite direction.

My invention likewise consists in mechanism, by which the threads from the bobbins are alternately passed below and above the shuttles to form a braiding-stitch, and, further, in feed mechanism, by which the movement of the object to be covered with a braid is advanced proportionately to the speed of the machine, or, in other words, made to correspond in movement with the rapidity with which the braiding is accomplished.

The drawings accompanying this specification represent, in Figure 1, a plan of a braiding-machine embodying my improvements. Fig. 2 is an elevation, partly in section, of the same. Fig. 3 is an inside elevation of a part of the machine from a central point of observation, showing a shuttle in the act of passing over a bobbin-thread. Fig. 4 is a similar view, in which the shuttle is passing under the bobbin-thread. Fig. 5 is an inside view of a shuttle-carrier plate with shuttle-spool removed. Fig. 6 is a vertical sectional view of the shuttle and its actuating parts. Fig. 7 is a plan of the shuttle. Fig. 8 is an elevation, in part, of the braiding-machine, with a part removed for insertion of shuttle. Fig. 9 is a side elevation of said removable portion. Fig. 10 shows in elevation the bobbin, tension, and guide-plates. Fig. 11 is a perspective view of the feed mechanism for the object in process of covering. Fig. 12 is a diagram of the friction-pulley and the co-operating pulleys, about which the driving-belt is to pass. Fig. 13 is an elevation of the feeding mechanism.

Owing to the extensive use of covered or insulated wires for electrical conductors, an urgent demand has been created for a braiding-machine having certain marked characteristics, of which high speed, rapidity in braiding, and employment of a light or fine thread without danger of breaking are the most essential. I have endeavored to combine all these requisites in my present invention, a description of which here follows.

Reference to Fig. 2 shows at 1 a tubular post or standard, through which is fed upwardly an endless wire 2 or other object to be covered with a braid. Mounted upon this post is a fixed circular ring 3, supported on radial spokes or arms, and with a series of

toothed gears 4, radially mounted thereupon. Concentrically with and about this fixed ring (see Fig. 3) is positioned a movable ring 5 with a vertical rim 6, the top edge of which serves as a raceway, hereinafter described and designated as the pathway for the shuttles. Pendent from or otherwise secured to this ring are a series of bobbin-supports (here shown as spindles) carrying bobbins 9, the threads 7 from which pass through vertical guide-plates 8 to the center of the machine about the rod or core or other object to be covered with braid. Vertically beneath and meshing with said series of toothed gears 4 is an endless toothed rack or gear 10, (see Fig. 3,) cast or affixed upon a rotary ring 5, likewise with radial arms extending from a tubular hub 12, rigidly affixed to a sleeve 13. Rotation of the gear 10 is produced by a circular disk 14 and friction-pulley 15, with a twist-belt 42, passing about the friction-pulley and two vertically-revolving pulleys 43, (see Fig. 12,) said pulley 15 being in constant rotation and actuated by some suitable prime motor.

In connection with this above-described mechanism and its series of revolving bobbins I employ a series of shuttles 16 equal in number to that of the bobbins. Such number may be varied at pleasure to suit the size of the machine or for other purposes. These shuttles are to travel in circular paths at a high rate of speed, and are to have the threads from the bobbins passed over and under them alternately and successively, the bobbins traveling in circular paths oppositely, but at an equal rate of speed, thus creating a braiding-stitch. Each shuttle is similar to every other, and the mechanisms for operating each are alike in every respect, as likewise the parts by which the threads from the bobbins are reciprocated in a vertical right-line movement to enable a passage of a thread either over or under a shuttle to take place. Therefore I shall proceed to describe a single shuttle and its operating mechanism.

The shuttle-carrier plate 17 (see Figs. 5 and 7) consists of a bent casting, rectangular in side elevation, (see Fig. 5,) and of the same curvature as the rim 6 or raceway upon which it travels. Further, this carrier-plate is rounded upon the top, (see Fig. 2,) and is furnished top and bottom with lateral lips 18, which grasp the raceway and steady the plate thereupon. Moreover, the under edge is toothed at 19, Fig. 5, and engages the gears 4 before mentioned. The length of this plate is such that it extends from center to center of any two adjacent gears, the latter being double in number those of the shuttles. Thus the motion of the shuttle-carrier plate is continuous; but while it is being carried solely by one of these gears an interval occurs during which the bobbin-thread is enabled to pass the shuttle which moves across it.

Affixed upon the inside face of the shuttle-carrier plate is the switch-plate 21, which actuates the bobbin-thread. Said switch-plate is widest in the center, tapering toward either end, made of sheet metal, and approximates in shape to that of an ordinary shuttle, the width being sufficient to carry the bobbin-thread clear of the teeth 19 below and of the shuttle-spool 23 above. This switch-plate 21 co-operates with an upright stationary switch-bar 24, (see Fig. 4,) secured upon the ring 3, and as the movable ring 5 with the raceway moves past it the bobbin-threads impinge thereagainst and are raised, so that when the front end of the traveling switch-plate 21 has reached the thread the latter is lifted above its points and contacts with the upper edge, whereby it is carried above and over the shuttle-spool. This spool has its spindle placed horizontally, and it extends inwardly and radially toward the center of the machine. The threads 25 therefrom pass in the same direction toward the center of the machine. Thus, by reference to Fig. 3, it will be seen, as indicated by the arrows, that the rotary ring 5, with its endless toothed wheel or gear, its bobbins, and the raceway 6 are traveling toward the left. The action of said wheel upon the gears mounted on the stationary ring 3 is to revolve said gears and cause the shuttle-carrier plate to advance rapidly in the opposite direction from that in which the raceway is moving with the bobbins. Hence the movement of the bobbins and shuttles are when co-operating producing an effect equal to the actual speed of the machine doubled.

Presuming the parts to be arranged as described, the shuttle-thread is free to pass directly from its spool to the center of the machine, while the bobbin-thread is moved within its guide 8 vertically, at the same time feeding toward the central point of the machine. This reciprocating motion of the threads from the bobbins is effected as follows, assuming that the parts are rotated in the direction as indicated in Figs. 3 and 4: It is to be understood that the normal path of travel by each bobbin-thread (see Fig. 4) is in a plane slightly below the longitudinal axis of the switch-plate 21, affixed to the shuttle-carrier plate. Hence ordinarily the end of the switch-plate will pass above the thread, and the latter is depressed by wiping-contact along the under edge of said switch-plate. The thread is thus held at a level below the toothed edge of the shuttle-carrier plate, and all the parts of said shuttle, as an entirety, are free to pass over said thread. The shuttle meantime continues along its path, receding from the bobbin-thread, supplied by the bobbins which are carried by and moved in circular paths by the rotation of the race-plate. By such movement the bobbin-thread is now advanced toward the stationary switch arm or post 24, against which it impinges. By such contact it is lifted above its normal position to such an extent that when the next advancing shuttle is met said thread is in a plane above the longitudinal axis or point of the moving switch-plate 21, and the thread is

raised and wipes across the upper edge of said switch-plate 21. By the arrangement of parts I have designed that the movements of every bobbin-thread shall be similar and simultaneous. Hence when one passes beneath a shuttle all do, and conversely.

To allow for the excess of thread requisite to enable a bobbin-thread to pass either above or beneath a shuttle, I have arranged external springs 26 (see Fig. 1) tangentially of the rim of the movable ring 5, and each carrying at its outer end a pulley 26′, over which the bobbin-thread passes. In this way the thread is always under proper tension, while the length of thread necessary to accomplish the passage of the shuttle above or beneath a bobbin-thread is easily compensated for by the movement of the free end of the spring toward the circumference of the raceway. Immediately upon passage of a shuttle the pull upon these springs 26 ceases, and the slack required for passage of the shuttle is at once taken up by said springs, which now move away from the circumference of the raceway. In this manner the thread is maintained under a constant tension and no slack occurs.

To more clearly explain the passage of a shuttle above and across a bobbin-thread, I will, as before premised, state that the width of the switch-plate 21 upon the shuttle-carrier plate is sufficient to clear the thread from all the lower parts of the shuttle 16, considered as an entirety. Thus as the shuttle approaches a bobbin-thread its movement is imparted by one of the gears 4, which is traveling upon the rear half of the toothed rack. Consequently the forward part of the shuttle is now projecting to permit an unobstructed passage of the bobbin-thread beneath. As the front part of the shuttle-plate advances, the thread passes rearwardly until said front end has engaged the next adjacent one of the series of gears 9, when disengagement from the last active gear ensues. Travel of the shuttle is now produced by the gear just reached and now in mesh, while the rear end of said shuttle is unsupported and free to allow the bobbin-thread to pass out from beneath the shuttle. Thus to pass the bobbin-thread beneath the front half of the shuttle the latter is being actuated or pushed by one of the gears traveling in the rear half of its rack, while to pass said bobbin-thread along the rear half the shuttle is being pulled or operated by the front half of its rack engaging in the next adjacent one of the gear-series 9.

This machine is peculiarly adapted for braiding about a core—as, for instance, in covering wire or whips. To this end a central vertical longitudinal bore is provided, through which the wire is to be fed upwardly, and as the movement of such wire or core is to be proportioned to the rapidity with which the braiding is accomplished I have arranged the following mechanism, whereby such parts are governed by and dependent upon the speed at which the shuttles and bobbins are revolved. Concentrically about the wire 2 I have placed (see Fig. 11) a stationary circular collar 30, supported by a post and arm 50, secured to the floor or united with the base of the machine. (See Fig. 1). Laterally thereof is formed an extension 31, in which is journaled a shaft 32, surmounted by a worm 34, and furnished at its lower end with a pinion 35. Pivotally secured to the extension 31, and swinging transversely of the wire, are positioned twin cylindrical bearings 36, in which are journaled shafts 37, furnished at one end with worm-gears 38, meshing with the worm 34 at the opposite end with grooved friction-wheels 39, roughened upon the circumference to grasp the wire 2, and are held in contact therewith by a spring 40. Co-operating with the pinion 35 is a toothed gear 41, which latter is formed with a tubular hub rigidly fastened to and supported at the end of a horizontal arm 42, extending from a post 43, bolted to some portion of the rotary ring. Thus, as the latter revolves, the post travels in circular paths and revolves the gear 41, likewise its pinion, together with the shaft 32 and worm 34. In this way the shafts 36 are rotated and the proper feed movement is imparted to the wire or other object to be covered. Since the gear 41 is controlled directly by the rotary ring, the various interconnecting parts, which produce right-line feed movement of the wire to be covered, are moved in such manner as to cause said feed movement to bear a constant ratio to the speed of the machine.

To insure laying of the threads at a fixed point a light skeleton circular frame 48 is positioned beneath the gear 41. (See Fig. 13). Consequently the threads, both from the shuttles and bobbins, bear against its under surface, and thus I obviate any irregularity in the laying of the braid, particularly in the case of the bobbin-threads, which would otherwise be influenced by the reciprocating movement in permitting the passage of the shuttles thereacross.

It will be observed by reference to Fig. 4 that I have mounted upon the fixed ring 3 two series of switch-posts 24 24′, one set oppositely inclined from the other, while each switch-plate 21, affixed upon the shuttle-carrier plate, is pointed at each end, both being alike. The object of this is to enable the machine to be reversed. This is of great importance where a thread has broken. In fact, by my improved construction the machine can be worked either right or left handed, provided the prime-actuating mechanism is arranged accordingly.

In Fig. 8 I have shown the manner in which the shuttle-carrier plate 17 and the shuttle-spool are to be placed in position. This is accomplished by making a part of the raceway removable in the form of a plate 45. The rim 6 of the rotary ring 5 is further cut away in order to permit removal of the gears 4, mounted in the fixed ring. In this manner,

should repairs be needed, the shuttles can readily be taken off from the raceway and as readily replaced.

The machine in the present instance is supplied with a double set of bobbins, making the bobbin-thread double, while the shuttle-thread is a single one.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a braiding-machine, a fixed circular ring, a series of revoluble toothed wheels mounted radially thereupon, and a series of movable shuttles operated by said toothed wheels, combined with a rotary ring, the endless circular toothed gear carried by said ring and meshing with said toothed wheels, a series of bobbin-supports affixed to said rotary ring, and a circular rim upon the latter, forming an endless raceway upon which the shuttles travel, substantially as described.

2. The combination, with a stationary circular ring, a series of toothed wheels journaled thereupon, and a toothed shuttle-carrier plate meshing successively with said wheels, of a rotary plate, the endless circular toothed rack by which the shuttles are caused to move, and the circular rim or raceway carried by said rotary plate and upon which said shuttles travel, substantially as and for the purposes specified.

3. In a braiding-machine, a rotary toothed ring, a series of bobbin-supports carried thereby, said ring being provided with an upturned rim to serve as an endless raceway, the vertical guides to receive the bobbin-threads, and a series of shuttles each fitted with a toothed carrier-plate and with a switch-plate 21, which causes the bobbin-threads to reciprocate, combined with a stationary circular ring and a series of toothed wheels mounted thereupon to produce independent motion of each shuttle in a direction oppositely of the moving raceway, substantially as described.

4. A braiding-machine having a fixed tubular standard through which the article to be covered passes, a stationary circular ring with a series of toothed wheels radially mounted thereupon, a series of bobbin-supports, an endless toothed ring which carries said bobbin-supports, a circular raceway or rim attached to said movable ring, a series of shuttles traveling oppositely upon the moving raceway and each provided with a toothed rack which successively engages the toothed wheels, and switch-arms to cause the bobbin-threads successively raised and lowered to pass transversely beneath or above the shuttles, as herein specified and set forth.

5. In combination with a rotary toothed ring, its vertical rim or endless raceway, and the vertical bobbin thread-guides 8, the shuttle-switch plates 21, with their shuttle-spool supports traveling independently and oppositely upon the moving raceway, gears which engage said ring, toothed shuttle-carrier plates which engage said gears, and the switch-posts stationary upon the fixed ring, substantially as described.

6. A shuttle for braiding-machines composed as follows: a bent carrier-plate provided with a toothed rack, a vertical switch-plate 21, pointed at each end and connected to the inner face of said carrier-plate, and a shuttle-spool support on the inner face of the switch-plate, substantially as and for the purposes described.

7. In braiding-machines, a fixed circular ring, a series of oppositely-disposed switch-posts, a revolving ring having an endless circular raceway and vertical guides 8, and a series of bobbin-supports attached to said rotary ring, combined with a series of shuttles traveling oppositely upon the moving raceway, vertical switch-plates pointed at both ends, with their longitudinal axes each in a horizontal plane and secured to said shuttles, a series of toothed wheels which successively engage with the shuttles, and the endless toothed gear by which motion is imparted to the shuttles, substantially as stated.

8. The combination, with a fixed circular ring having a central bore to admit of a moving wire, a stationary standard secured to said ring, and the revoluble feed-wheels mounted upon said standard and to grasp said wire, of a rotary circular ring and interconnecting mechanism by which said feed-wheels are moved proportionately to the speed of the rotary circular ring, substantially as herein set forth and stated.

9. In combination with a stationary circular ring having a central bore, the standard 30, secured to said ring, the shaft 32, its worm 34, worm-wheels 38, pinion 35, and the revoluble feed-wheels operated by said worm and all supported in said standard, a rotary circular ring, a bracket-post 42, carried by said ring, and a gear 41, secured by a tubular hub inclosed by said post and meshing with the pinion 35, all substantially as herein described.

In testimony whereof I affix my signature in presence of two witnesses.

NATHANIEL LOMBARD.

Witnesses:
H. E. LODGE,
FRANCIS C. STANWOOD.