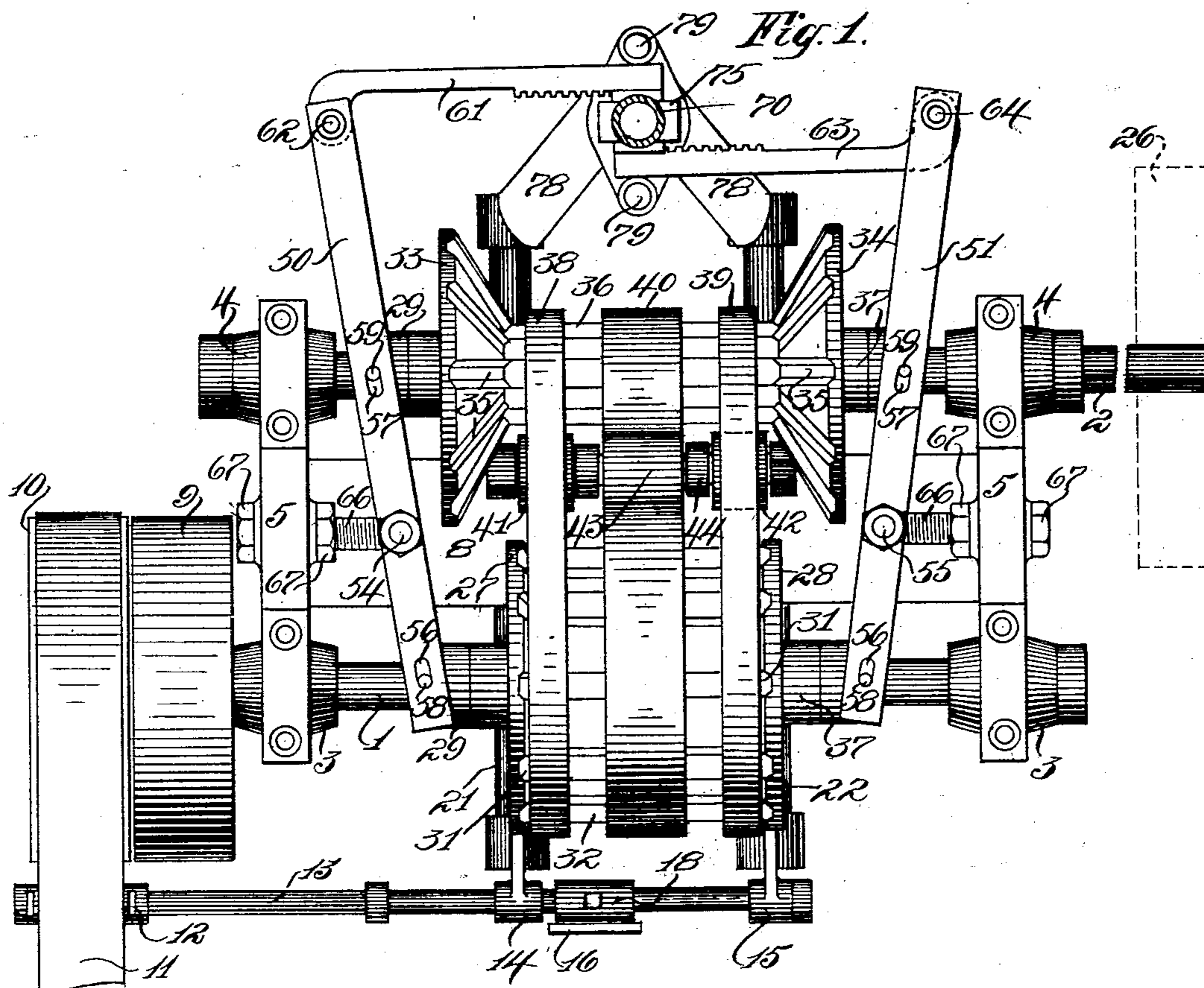


C. M. CONRADSON.
VARIABLE SPEED COUNTERSHAFT.

APPLICATION FILED JUNE 3, 1903.

NO MODEL.

3 SHEETS—SHEET 1.



Witnesses:
C. A. Jarvis.

B. C. Stickney.

Inventor:
C. M. Conradson.
By his Attorney,

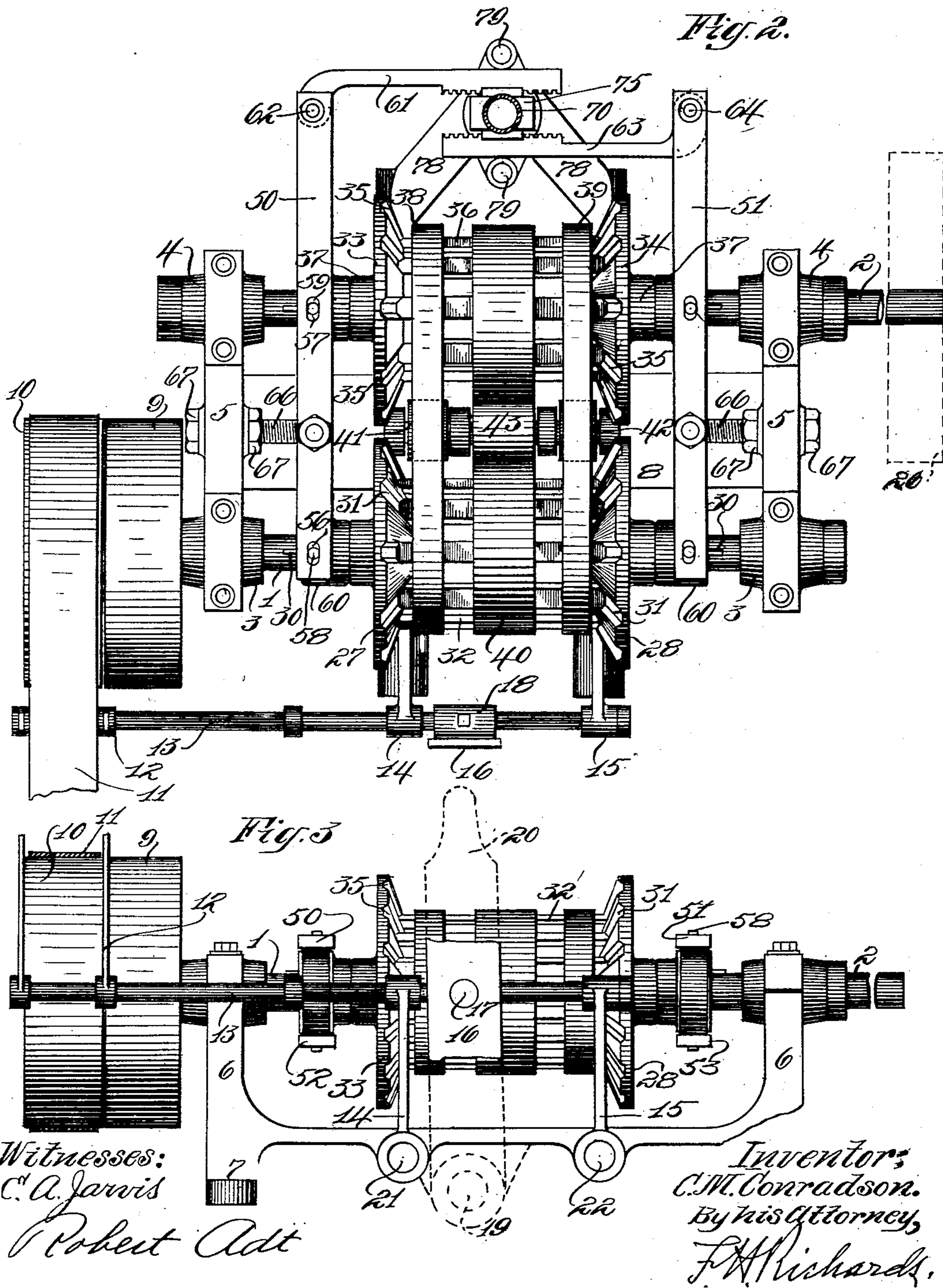
F. H. Richards

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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

Fig. 4.

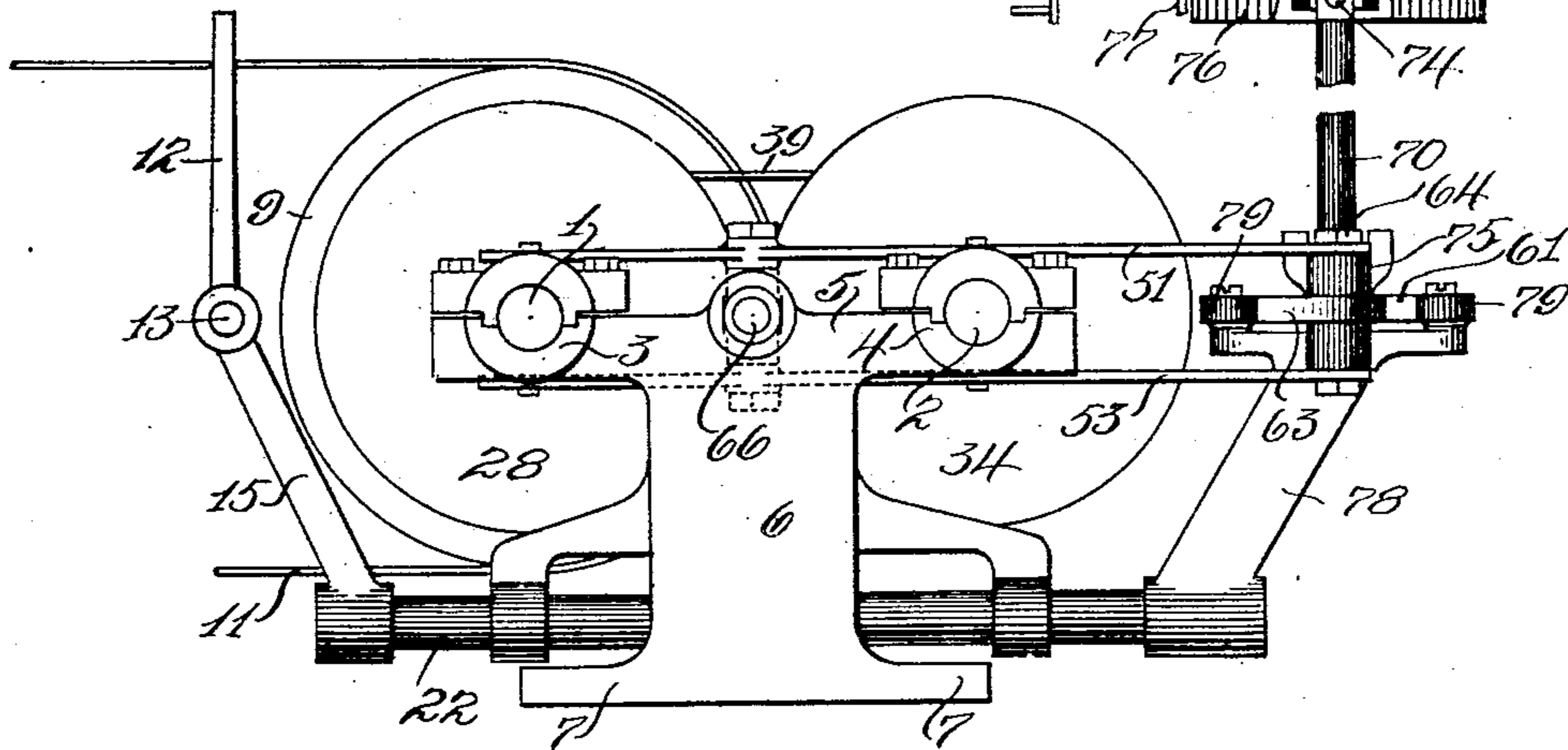


Fig. 5.

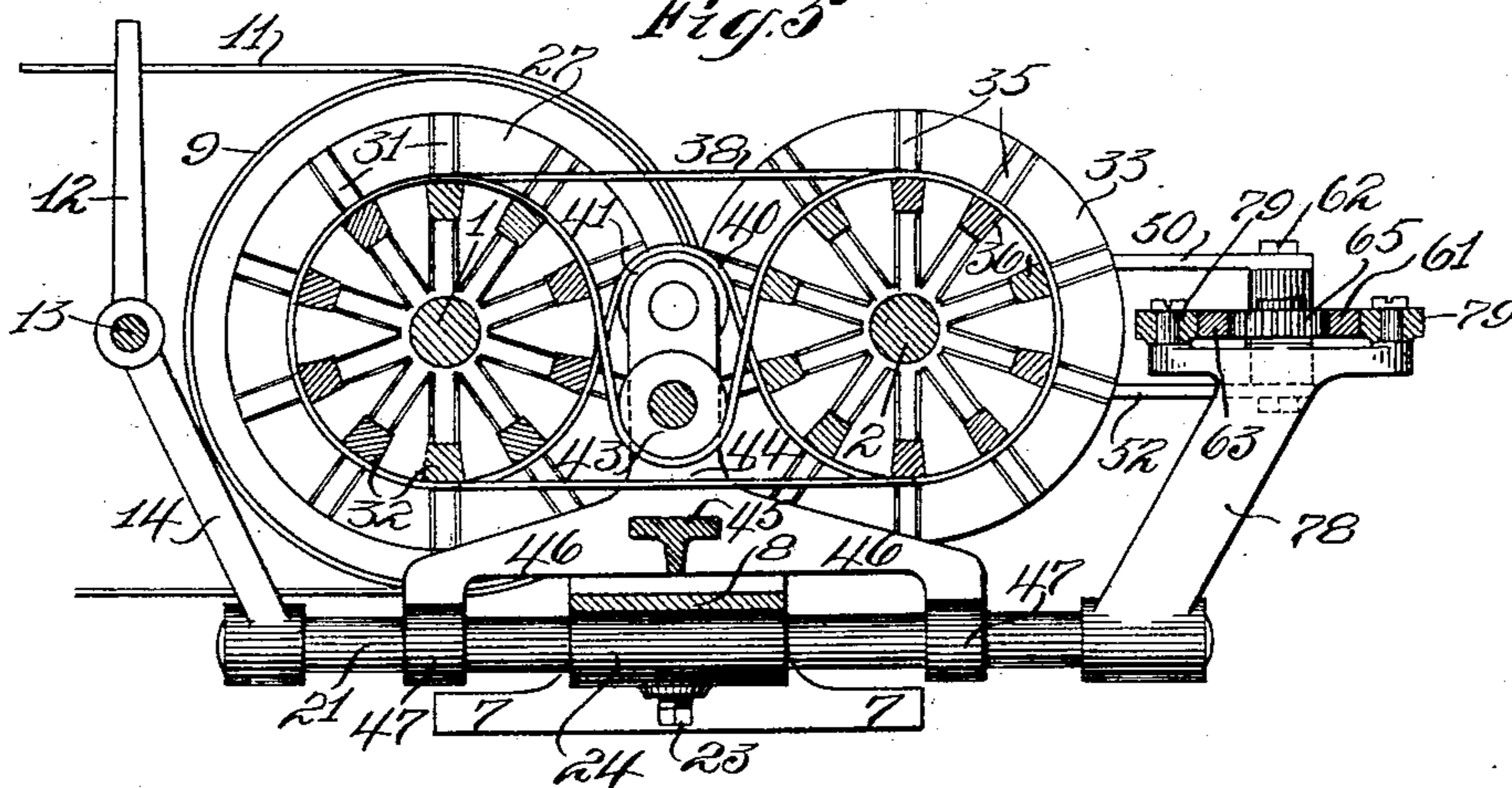
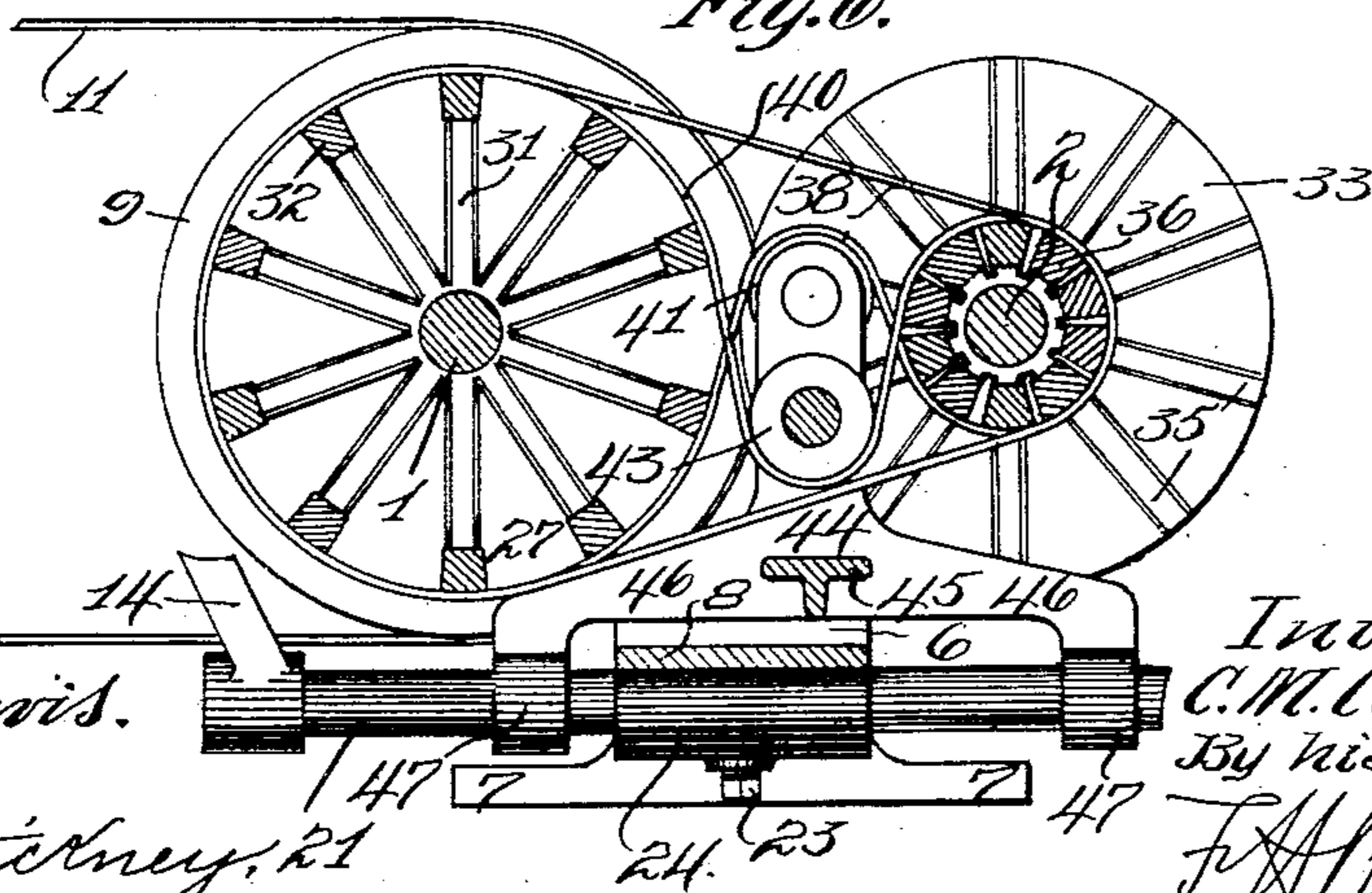


Fig. 6.



Witnesses
C. A. Jarvis.

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UNITED STATES PATENT OFFICE.

CONRAD M. CONRADSON, OF WARREN, PENNSYLVANIA.

VARIABLE-SPEED COUNTER-SHAFT.

SPECIFICATION forming part of Letters Patent No. 745,789, dated December 1, 1903.

Application filed June 3, 1903. Serial No. 159,842. (No model.)

To all whom it may concern:

Be it known that I, CONRAD M. CONRADSON, a citizen of the United States, residing in Warren, in the county of Warren and State of Pennsylvania, have invented certain new and useful Improvements in Variable-Speed Counter-Shafts, of which the following is a specification.

This invention relates to variable-speed mechanism for effecting variations in the rate at which a machine may be operated by a driving-pulley or other power-wheel which runs at constant speed.

The objects of the invention are to avoid the inefficiency and waste of power accompanying the use of speed-changing devices which depend upon mere peripheral contact of revolving parts, to enable finer variations in speed to be effected than is practicable where assorted gears are used for changing speed, and to produce at low cost a simple speed-changing apparatus which will require but little attention and will be capable of transmitting a great amount of power in proportion to its size with but little loss in transmission.

Further objects are to enable changes of speed to be conveniently and quickly effected, to provide means for indicating the number of revolutions per minute, and generally to produce a durable variable-speed counter-shaft adapted to be used with machine-tools, woodworking-machines, printing-presses, electric motors, and a large variety of other machinery.

In carrying out my invention I preferably employ a pair of expansible drums, the rim or power-transmitting portion of each whereof consists of a series of loose slats or staves, the staves in each drum being adjustable inwardly toward the drum-axis or outwardly therefrom, so as to vary the diameter of the rim. I provide for increasing the diameter of either drum, while decreasing that of the other accordingly, and connect the drums by a system of belting which not only transmits power from one to the other, but also retains the staves in position upon each drum, and I preferably use idle pulleys between the drums for giving the belting the proper direction to encircle and bind all of the staves.

In the drawings forming part of this speci-

fication, Figure 1 is a plan of one form of speed-varying machine constructed in accordance with my invention, the parts being shown as adjusted, so as to cause the delivering or variable pulley or drum to rotate at considerably higher speed than the master or constant pulley or drum. Fig. 2 is a view similar to Fig. 1, but showing the mechanism so adjusted that the drums are of equal diameters, so that the variable pulley rotates at the same speed as the constant pulley. Fig. 3 is an end view, and Fig. 4 a side view, of the apparatus shown at Fig. 2. Fig. 5 is a cross-section of the parts seen at Fig. 4, the mechanism being adjusted as at Fig. 2; and Fig. 6 is a cross-section similar to Fig. 5 with the mechanism adjusted as at Fig. 1.

In the several views like signs denote like parts.

1 denotes a constant-speed or master shaft, and 2 a variable-speed or follower shaft parallel thereto, the shafts being journaled in boxes 3 and 4, respectively, carried by cross-heads 5 upon standards 6, having feet 7 and formed at opposite ends of a base 8, which is parallel with said shafts. The constant-speed shaft 1 carries a fast pulley 9 and a loose pulley 10, adapted to a driving-belt 11, said belt being controlled by a forked shifter 12, carried by an endwise-movable rod 13, which is parallel with the shaft 1 and slidably mounted in standards 14 and 15. A shifting-lever 16 is pivoted at 17 to a collar 18, fixed on said rod 13 and fulcrumed at its lower end at 19 and provided with a handle 20. Said standards 14 and 15, which carry said belt-shifting rod 13, are secured at their lower ends upon a pair of fixed rods 21 22, forming part of the framing and extending transversely of the base 8 of the machine, being secured between their ends by set-screws 23 in bosses 24, formed upon the under side of said base 8. The variable-speed shaft 2 carries a fixed pulley 26, and, if desired, it may in some cases also carry the loose pulley 10 instead of placing the latter on the shaft 1, and the belt-shifting mechanism may be changed accordingly.

Upon the constant-speed shaft 1 is carried an expansible drum comprising opposite heads 27 28, each of which is splined to the shaft by means of a collar 29, fitted to a spline

30 upon said shaft, so that said heads, with their collars, may move along said shaft toward and away from each other, but may not revolve independently thereof. Each
 5 head is preferably disk-like, but slightly conical or flaring, and upon its inner side is provided with a set of radial grooves 31, which are oblique to the shaft 1 and converge inwardly, the grooves in one head being op-
 10 posed to those in the other head. Said grooves are preferably V-shaped in cross-section or provided with inclined sides, and staves or staves 32 extend from head to head and are fitted at their ends in said grooves, there be-
 15 ing one groove in each head for each of the staves. Owing to the inward inclination or obliquity of the set of grooves the staves are at all times supported against inward displacement or collapse. The grooves being
 20 symmetrically disposed and the staves being of uniform length, the latter taken together form a substantially cylindrical body or rim. The variable-speed or follower drum is similarly constructed and mounted upon the
 25 shaft 2, said drum having heads 33 and 34, provided with grooves 35 and staves or rim-sections 36, said heads being provided also with hubs or collars 37, which are likewise splined to said shaft 2.

30 It will be understood that when the heads of either drum are moved apart, as at the upper portion of Fig. 1, the staves or rim-sections 36 are free to move toward the drum-axis, thereby reducing the rim diameter, and,
 35 conversely, that when the heads of either drum are forced toward each other, as at the lower part of Fig. 1, said staves are wedged outwardly, owing to the oblique direction of the grooves in which they are supported, and
 40 since the effectiveness of the adjusting devices depends upon the angle which the opposed grooves hold to each other it will be seen that a slight obliquity of each head, as illustrated, is sufficient to enable the staves
 45 to be readily forced out. The heads may hence be formed to take up but little space, thus conducing to the compactness of the mechanism, which is a desideratum, while little force is required to wedge the staves out,
 50 and liability of wear or injury of the latter is avoided.

I preferably connect the pair of expansible rims by a system of belting comprising three belts, two of which, 38 and 39, are at the
 55 sides of the rim and preferably are depended upon to transmit the bulk of the power from one drum to the other, and the third of which, 40, is at the center of the rims. The principal function of belt 40 is to coöperate with
 60 the other belts to retain the staves upon their oblique supports, although, of course, it coöperates in transmitting the power. Each belt is preferably caused to encircle about three-quarters of the circumference of each
 65 rim, as seen at Figs. 5 and 6, to this end being carried over an idle pulley between the drums. The idle pulleys for the outer belts,

which are similarly guided, are designated as 41 and 42, respectively, and that for the inner belt as 43. It will be seen that the axis
 70 of the idle pulley 43 does not coincide with the coincident axes of the idle pulleys 41 42 and that each idle pulley is preferably placed so that its rim is adjacent to the straight reach of its belt, which passes from one drum
 75 to the other, so as to guide the other reach of its belt between the drums down and up from one drum to the other, thereby leaving but a small gap in each rim not encircled by such belt. The belts thus move reflexly between
 80 the drums, and the belt 40 crosses the belts 38 and 39, as seen at Figs. 5 and 6, whereby the portions of the drums not encircled by the belts 38 and 39 are encircled by the belt 40. The latter at the under side of the drums runs
 85 up past the idle pulleys 41 and 42 to gain its own idle pulley 43, and the straight reach of the belt 40 is hence at the opposite sides of the drums from the straight reach of the belts 38 and 39. My invention, however, is not
 90 limited to the precise disposition of belting or idle pulleys herein illustrated, the gist of this part of the invention consisting in causing the belts to perform the twofold duty of transmitting power from one drum to the other
 95 and completely encircling the sets of loose rim-sections to retain them upon their supports. It will also be noted that the drums are placed near together and close to said idle pulleys, thereby favoring the stave-retaining function
 100 of the belts, and in order to permit such close assembling of idle pulleys and variable-diameter drums I make the former translatable, so that when one drum is enlarged and the other reduced the idle pulleys may move
 105 bodily toward the smaller drum. It will be seen at Fig. 5 that the idle pulleys are half-way between the shafts 1 and 2, while at Fig. 6 they are much nearer the shaft 2, whose drum is collapsed, and remote from the shaft
 110 1, whose drum is expanded. The motion of translation is made possible by mounting the idle pulleys upon a slidable frame consisting of standards or ears 44, whereon the idle pulleys are directly mounted, a base 45,
 115 and arms 46, provided with bosses 47 to engage the fixed rods 21 of the framework at the opposite sides of the base 8. This frame is mounted for to-and-fro movement in a direction transverse to the drum-axes, so that
 120 when either drum is enlarged and the other correspondingly reduced in diameter the frame, with its idle pulleys, moves in response to the change in the course of the belts.

For adjusting the drumheads I provide a
 125 pair of frame-like levers 50 and 51, Fig. 1, each frame or lever preferably consisting of a pair of beams one above and one below the drum-shafts, the lower beams being seen at 52 and 53. The levers are fulcrumed between
 130 their ends on pivots 54 and 55, and each lever is slotted at 56 and 57 to engage pins 58 and 59, projecting from straps 60, Fig. 3, which encircle the collars 29 and 37, fixed to said

drumheads. One lever is at one side of the drums and the other lever at the other side thereof, and by reason of each lever being pivoted at a point between the drum-shafts 1 and 2 it follows that movement of either lever must force the head of one drum outwardly for contraction and the head of the other drum inwardly for expansion. In order that this movement may be simultaneous for all four drumheads, I provide a connection between said levers, consisting of a rack 61, pivoted at 62 to the end of lever 50, and a rack 63, pivoted at 64 to the end of lever 51, said racks being in mesh with the opposite sides of a pinion 65, Fig. 5, so that by a rotation of the pinion the racks may be moved in opposite directions simultaneously, thereby vibrating the levers 50 and 51 and causing the heads of one drum to separate to enable a reduction in the diameter of its rim, while forcing the heads of the other drum together to increase the diameter of its rim accordingly. Thus the belts are always kept taut, while very fine variations in the speed of the variable pulley 26 may be effected.

The lever-fulcrums 54 and 55 are preferably carried upon the ends of threaded supports 66, tapped into the standards 5 and provided with lock-nuts 67, said supports being parallel with the drum-shafts 1 and 2 and being independently adjustable one of the other, so as to render it possible to effect exact adjustment of each drumhead relatively to its mate. Preferably each of the fulcrums 54 and 55 is equidistant from the pins 58 59, so that the movements of the heads in one drum may be equal in extent to the movements of the heads in the other drum.

For operating the pinion 65 I connect it by a shaft 70 to a bevel-gear 71, Fig. 4, meshing with a pinion 72, the latter having a winch 73, by turning which the pinion, gear, shaft, and lever-pinion 65 may be rotated in either direction and the drumheads moved accordingly to vary the speed. Since the speed-changing counter-shaft is adapted to be placed either upon the floor or upon the ceiling of a machine-shop or elsewhere and since it is also desirable that the speed-controlling means 73 should be placed where it is convenient of access to the machinist—as, for instance, directly upon a machine driven by the variable pulley 26, where the pinion 65 and gear 71 may be out of line—I prefer to connect said shaft 70 at its ends by universal joints 74 and 75 to the gear 71 and pinion 65, respectively, so that when necessary said shaft may extend obliquely from the pinion 65 to the gear 71.

The gear 71 is preferably provided with a scale 76, and an index 77 may be secured upon the framing to cooperate with said scale, so that when turning the winch 73 the machinist may inform himself by noting the relation of the index 77 to the scale 76 of the speed at which the variable pulley is rotating or the relative adjustment of the drums.

The pinion 65 may be supported upon a

frame consisting of a pair of legs 78, secured upon the ends of the rods 21, and upon said frame may be mounted rolls 79 opposite the pinion 65 for guiding the racks 51 and 53.

Variations may be resorted to within the scope of my invention, and portions of my improvements may be used without others.

Having thus described my invention, I claim—

1. The combination with two expansible drums, the rim of each of which is composed of movable sections, and each being provided with adjustable means for supporting said rims against inward displacement, of belting for retaining said sections upon said supporting means and communicating movement from one drum to the other and idlers for the belting.

2. The combination with two power-wheels of two expansible drums, the rim of each drum being composed of loose movable sections, each drum being provided with adjustable means for supporting its rim against inward displacement, of belts connecting said drums and passing across one another between the drums, and serving to retain said sections upon said supporting means and idlers for the belts.

3. The combination with two expansible drums, the rim of each whereof is composed of loose movable sections, each drum being provided with adjustable means for supporting its sections against inward displacement, two outer belts connecting said drums, and a belt intermediate said outer belts and encircling the sections not encircled by the latter; and means for enabling said outer and intermediate belts to cooperate to retain said sections upon said supports.

4. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward displacement, of means, including a belt which connects said drums and an idle pulley over which said belt runs, for retaining said sections upon said supporting means.

5. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against collapse, of a system of belting and pulleys communicating movement from one drum to the other and retaining said sections upon said supporting means.

6. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward displacement, and means, including a belt which connects said drums and an idle pulley between said drums over which said belt runs, for retaining said sections upon said supporting means.

7. The combination with two expansible drums, the rim of each whereof is composed

of movable sections, each drum having adjustable means for supporting its sections against collapsing movement, of a system of belting and idle pulleys communicating movement from one drum to the other and retaining said sections upon said supporting means; said idle pulleys being mounted between said drums.

8. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum being provided with adjustable means for supporting its rim against inward displacement, of belts connecting said drums and passing across one another between the drums, and serving to retain said sections upon said supporting means, and idle pulleys between said drums over which said belts run.

9. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum being provided with adjustable means for supporting its sections against inward displacement, of two outer belts connecting said drums, a belt intermediate said outer belts and passing across the latter; said outer and intermediate belts cooperating to retain said sections upon said supports, and idle pulleys between said drums over which said belts run.

10. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against collapse, and a system of belting and idle pulleys communicating movement from one drum to the other and retaining said sections upon said supporting means, said idle pulleys being so mounted between said drums that each of said belts encircles about three-fourths of the circumference of each drum at all adjustments thereof.

11. The combination with two power-wheels of two expansible drums, the rim of each drum being composed of movable sections, and each drum having adjustable means for supporting its sections against inward movement, belts connecting said drums, and idle pulleys between said drums over which said belts respectively run; each pulley being mounted so that its rim is adjacent to the straight reach of its belt which extends directly from one drum to the other.

12. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward movement, of belts connecting said drums, and idle pulleys between said drums and over which said belts respectively run; each pulley being mounted so that its rim is adjacent to the straight reach of its belt which extends directly from one drum to the other, and said belts being at least three in number; the outer belts being similarly guided, and the intermediate belt having its straight reach connecting the opposite

sides of said drums from the straight reaches of said outer belts.

13. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward movement, of a system of belting and means for enabling said belt to retain said sections upon said supports and to communicate movement of one drum to the other; at least one belt in the system encircling a portion of each drum, and at least one other belt encircling the remainder of each drum.

14. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward movement, of a system of belting and idle pulleys for retaining said sections upon said supports and for communicating movement from one drum to the other; at least one belt encircling a portion of each drum, and another belt encircling the remainder of each drum.

15. An expansible drum comprising a set of staves, and two sets of oblique supports whereon said staves are loosely mounted, in combination with connections whereby said sets of supports may be adjusted toward and away from each other, power-transmission belts, means for enabling said belts to retain said staves upon their supports and a cooperating drum.

16. The combination with a pair of expansible drums, each comprising opposed heads whereof each is adjustable axially of the drums and constituting converging supports, and an intermediate set of staves whose ends rest upon said supports, and a system of belting and idle pulleys for retaining said staves upon said supports and transmitting power from one drum to the other.

17. The combination with a pair of power-wheels and a pair of expansible drums, each drum comprising opposed heads whereof each is adjustable axially of the drum, and said heads constituting oblique supports, and an intermediate set of staves whose ends rest upon said supports, of a system of belting and idle pulleys for retaining said staves upon said supports and transmitting power from one drum to the other, said idle pulleys being mounted between said drums.

18. The combination with a pair of power-pulleys and a pair of expansible drums, each of the drums comprising relatively adjustable heads having converging oblique ways, and staves mounted at their ends in said ways, of belts which retain said staves upon said ways and transmit power from one drum to the other, and idle pulleys over which said belts run between said drums.

19. The combination with two drums, whereof one is expansible, the rim of said expansible drum being composed of movable

sections, of adjustable means for supporting said rim against inward displacement, belting, and means for enabling said belting to retain said sections upon said supporting means and communicating movement from one drum to the other.

20. The combination with two drums, whereof one is expansible, the rim of said expansible drum being composed of movable sections, and adjustable means for supporting said sections against inward displacement, of two outer belts connecting said drums, a belt intermediate said outer belts; and means for enabling said outer and intermediate belts to cooperate to retain said sections upon said supporting means.

21. The combination with two drums, whereof one is expansible, the rim of said expansible drum being composed of movable sections, and adjustable means for supporting said sections against inward displacement, of means, including a belt which connects said drums and a pulley over which said belt runs, for retaining said sections upon said supporting means.

22. The combination with two drums, whereof one is expansible, the rim of said expansible drum being composed of movable sections, and adjustable means for supporting said sections against inward displacement; of means, including a belt which connects said drums and a pulley between said drums over which said belt runs, for retaining said sections upon said supporting means.

23. The combination with two drums, the rim of one whereof is composed of movable sections, adjustable means for supporting said sections against collapsing movement, of a belt connecting said drums, a pulley between said drums over which said belt runs; said pulley being mounted so that its rim is adjacent to the straight reach of its belt which extends directly from one drum to the other; and a second belt connecting said drums and means for enabling said second belt to cooperate with the first belt to retain said sections upon said supporting means.

24. The combination with two drums, the rim of one whereof is composed of movable sections, adjustable means for supporting said sections against collapsing movement, of a system of belting and means cooperating therewith for retaining said sections upon said supporting means and for communicating movement of one drum to the other; at least one belt in the system encircling a portion of said sections, and at least one other belt encircling the remaining portion of said sections.

25. The combination of a pair of expansible drums each comprising a set of staves, a set of converging oblique supports whereon said staves are loosely mounted, means for effecting relative adjustment between said supports and said staves, and cooperative belts which retain said staves upon said supports and transmit power from one drum to

the other; one belt encircling a portion of the set of staves upon each drum, and another belt retaining the remaining staves, and idle pulleys for said belts between said drums; each pulley being adjacent to the straight reach of its belt.

26. The combination of a pair of expansible drums each comprising relatively adjustable heads having converging oblique ways, and staves mounted at their ends in said ways, three belts which retain said staves upon said ways and transmit power from one drum to the other, a pair of idle pulleys over which the outer belts run reflexly between said drums; and an intermediate pulley over which the intermediate belt runs reflexly between the drums, each belt having a straight reach, that of the intermediate belt being upon the opposite side of the drums from those of the other belts.

27. The combination with a pair of expansible drums, each comprising relatively adjustable heads provided with grooves upon their inner side, said grooves converging obliquely inward, and staves whose ends are inserted in said grooves, of a plurality of belts connecting said drums and retaining said staves in said grooves, and pulleys between said drums, one for each belt, each pulley being mounted close to the straight reach of its belt.

28. The combination with two power-pulleys of two expansible drums, the rim of each whereof is composed of movable sections, each drum being provided with adjustable means for supporting its rim-sections against inward displacement, belts connecting said drums and passing across one another between the drums, means for enabling said belts to retain said sections upon said supporting means, and means for expanding either drum and simultaneously contracting the other accordingly.

29. The combination with two expansible drums, the rim of each whereof is composed of collapsible loose sections, supports for said sections, and mechanism connecting said supports so that when one rim contracts the other expands, two outer belts connecting said drums, an intermediate belt and crossing said outer belts; and means for enabling all of said belts to cooperate to retain said sections upon their supports.

30. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having means for supporting its sections against collapsing movement, a system of belting and idle pulleys communicating movement from one drum to the other and retaining said sections upon said supporting means, and means for effecting simultaneous adjustment of the rim-supporting means in both drums to increase the diameter of either rim and decrease the diameter of the other accordingly.

31. The combination with two expansible drums, the rim of each whereof is composed

of movable sections, each drum having adjustable means at each end for supporting its sections against inward displacement, of means, including a belt which connects said drums and an idle pulley between said drums over which said belt runs reflexly, for retaining said sections upon said supporting means; and mechanism connecting all of said adjustable means so as to effect simultaneous corresponding movements thereof.

32. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward movement, and a system of belting and pulleys communicating movement from one drum to the other and retaining said sections upon said supporting means, said pulleys being mounted between said drums.

33. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum being provided with adjustable means for supporting its rim against inward displacement, connections between the adjustable supporting means of one drum and those of the other, to effect simultaneous corresponding adjustments thereof, belts connecting said drums, and serving to retain said sections upon said supporting means, and idle pulleys between said drums over which said belts run.

34. An expansible drum comprising a set of staves, a set of converging oblique supports whereon said staves are loosely mounted, a shaft, means, including a collar on said shaft and rigid with said supports, for moving said supports along said shaft to effect relative adjustment between said supports and said staves, whereby to increase and diminish the diameter of the set of staves, coöperative power-transmission belts which retain said staves upon said supports, idle pulleys for guiding said belts wholly around said set of staves and a coöperating drum.

35. An expansible drum comprising relatively adjustable heads, provided with V-grooves upon the inner sides thereof, said grooves converging obliquely inward, staves having ends to fit said V-grooves and inserted therein, and means for retaining the staves in the grooves, in combination with a shaft upon which said heads are mounted, collars upon said heads, levers engaging said collars, racks upon said levers, a pinion meshing with said racks, and means for manually operating said pinion and a coöperating drum.

36. The combination with a pair of expansible drums, each comprising opposed heads whereof each is adjustable axially of the drum, said heads constituting converging supports, and an intermediate set of staves whose ends rest upon said supports, of a system of guided belting for retaining said staves upon said supports and transmitting power from one drum to the other, and means for moving the heads of either drum toward each

other and simultaneously moving the heads of the other drum away from each other.

37. The combination with a pair of expansible drums, each comprising opposed heads whereof each is adjustable axially of the drum, said heads constituting converging oblique supports, and an intermediate set of staves whose ends rest upon said supports, of a system of belting and idle pulleys for retaining said staves upon said supports and transmitting power from one drum to the other, said idle pulleys being mounted between said drums and means for simultaneously adjusting all of said heads in axial direction.

38. The combination with a pair of expansible drums each comprising a set of staves, two sets of oblique supports whereon said staves are loosely mounted, connections whereby said sets of supports may be adjusted toward and away from each other, of a system of belting and idle pulleys which retains said staves upon their supports and transmits power from one drum to the other; said connections including a pair of connected levers, and means for enabling each lever to control one set of oblique supports in each drum.

39. The combination with a pair of expansible drums each comprising sets of staves, a set of converging oblique supports whereon said staves are loosely mounted, of means for effecting relative adjustment between said supports and said staves, coöperative belts and idle pulleys which retain said staves upon said supports and transmit power from one drum to the other, and a power-pulley associated with each drum.

40. The combination with a pair of expansible drums each comprising relatively adjustable heads formed with converging oblique ways, and staves mounted at their ends in said ways, of shafts upon which said heads are mounted, power-wheels upon said shafts, belts which retain said staves upon said ways and transmit power from one drum to the other, idle pulleys over which said belts run, connected levers connected to the heads at opposite ends of the drums, and means for vibrating said levers.

41. The combination with a pair of expansible drums, each comprising relatively adjustable heads, formed with sets of grooves upon their inner side, said grooves converging obliquely inward, and staves whose ends are inserted in said grooves, shafts whereon said heads are splined, power-wheels fixed upon said shafts, collars upon said heads, levers pivoted between their ends and connected at their ends to said collars, a rack connected to each lever, a pinion in mesh with said racks, a plurality of belts connecting said drums and retaining said staves in said grooves, and idle pulleys for said belts.

42. The combination with a pair of expansible drums each comprising a pair of heads, formed with sets of V-grooves upon their inner side, said grooves converging obliquely

inwardly, staves having ends to fit said grooves and inserted therein, of a pair of shafts upon which said heads are splined, a power-pulley upon each shaft, a collar upon each head, levers pivoted between their ends and connected at their ends to said collars, racks pivoted to said levers, a pinion meshing with said racks, means for manually operating said pinion, and a plurality of cooperative belts and idle pulleys operatively connecting said drums and retaining said staves in said grooves.

43. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward displacement, of means including a belt which connects said drums and a translatory idle pulley over which said belt runs, for retaining said sections upon said supporting means.

44. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against collapse, of a system of belting and translatory pulleys transmitting movement from one drum to the other and retaining said sections upon said supporting means.

45. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against collapsing movement, of a system of belting and idle pulleys transmitting movement from one drum to the other and retaining said sections upon said supporting means; said idle pulleys being mounted between said drums; and a support whereon said pulleys are mounted, said support being mounted for to-and-fro movement in a direction transverse to the drum-axes.

46. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum being provided with adjustable means for supporting its sections against inward displacement, of two outer belts connecting said drums, a belt intermediate said outer belts and passing across the latter; said outer and intermediate belts cooperating to retain said sections upon said supports, and translatory idle pulleys between said drums over which said belts run.

47. The combination with two expansible drums, the rim of each whereof is composed of movable sections, each drum having adjustable means for supporting its sections against inward movement, of a system of belting and translatory idle pulleys for retaining said sections upon said supports and for communicating movement from one drum to the other; at least one belt encircling a portion of each drum, and another encircling the remainder of each drum.

48. The combination with a pair of expansible drums, each comprising opposed heads

whereof each is adjustable axially of the drums, said heads constituting converging supports, an intermediate set of staves whose ends rest upon said supports, a system of belting and idle pulleys for retaining said staves upon said supports and transmitting power from one drum to the other, and means comprising an index for adjusting and indicating the adjustment of the heads.

49. The combination with a pair of expansible drums each comprising a set of staves, and a set of converging oblique supports whereon said staves are loosely mounted, of means for effecting relative adjustment between said supports and said staves, cooperative belts which retain said staves upon said supports and transmit power from one drum to the other; one belt encircling a portion of the set of staves upon each drum, and another belt retaining the remaining staves, and translatory idle pulleys for said belts between said drums; each pulley being adjacent to the straight reach of its belt.

50. The combination with a pair of expansible drums each comprising relatively adjustable heads, formed with converging oblique ways, and staves mounted at their ends in said ways, of three belts which retain said staves upon said ways and transmit power from one drum to the other, a pair of translatory idle pulleys over which the outer belts run reflexly between said drums; and an intermediate translatory pulley over which the intermediate belt runs reflexly between the drums, each belt having a straight reach, that of the intermediate belt being upon the opposite side of the drums from those of the other belts.

51. The combination with two expansible drums, the rim of each whereof is composed of movable sections, of adjustable means for supporting said rim-sections against inward displacement, guided belting retaining said sections upon said supporting means, and communicating movement from one drum to the other, and means comprising an index for expanding one drum and contracting the other, and indicating the extent of such expansion and contraction.

52. An expansible drum comprising relatively adjustable heads, formed with converging oblique ways, and staves mounted at their ends in said ways, in combination with a lever connected to each head, an adjustable fulcrum for each lever, means connecting said levers so that said heads may be either separated or drawn toward each other and a cooperative drum.

53. An expansible drum comprising relatively adjustable heads formed with grooves upon their inner sides, said grooves converging obliquely inward, and staves whose ends are inserted in said grooves, in combination with levers connected to said heads, adjustable fulcrums for said levers, racks connected to said levers, a pinion meshing with said racks and a cooperative drum.

54. The combination with a pair of expand-
sible drums each comprising relatively adjust-
able heads, formed with converging oblique
ways, and staves mounted at their ends in
5 said ways, of shafts upon which said heads
are mounted, power-wheels upon said shafts,
belts which retain said staves upon said
ways and transmit power from one drum to
the other, idle pulleys over which said belts
10 run between said drums, levers connected to
the heads at opposite ends of the drums, and
means for vibrating said levers, said vibrat-
ing means including racks connected to the
levers, a pinion in mesh with the racks, a
15 gear, a shaft and universal joints connecting
said gear to said pinion, and a hand-operated
pinion in mesh with said gear.

55. The combination with a pair of expan-
sible drums, each comprising relatively adjust-
20 able heads, a set of grooves formed in each
of said heads upon its inner side, said grooves
converging obliquely inward, and staves
whose ends are inserted in said grooves,
shafts whereon said heads are splined,
25 power-wheels fixed upon said shafts, col-
lars upon said heads, levers fulcrumed ad-
justably between their ends and connected
at their ends to said collars, a rack connect-
ed to each lever, a pinion in mesh with said

racks, a plurality of belts connecting said 30
drums and retaining said staves in said
grooves, idle pulleys for said belts, a gear, a
shaft, universal joints connecting said shaft
to said gear and pinion, and a hand-operated
pinion in mesh with said gear, a scale and a 35
pointer associated with said gear.

56. The combination with a pair of expan-
sible drums each comprising a pair of heads
formed with V-grooves upon their inner sides,
said grooves converging obliquely inward, 40
staves having ends to fit said grooves and in-
serted therein, of a pair of shafts upon which
said heads are splined, a power-pulley upon
each shaft, a collar upon each head, levers
pivoted between their ends, straps connect- 45
ing the ends of said levers to said collars,
each lever consisting of parallel beams above
and below said collars, racks pivoted to said
levers, a pinion whose opposite sides mesh
with said racks, a hand-operated device for 50
rotating said pinion, and a plurality of coop-
erative belts and idle pulleys connecting said
drums and retaining said staves in said
grooves.

CONRAD M. CONRADSON.

Witnesses:

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