H. F. WATSON.

DRIVING MECHANISM.

APPLICATION FILED FEB. 10, 1905.

944,585.

Patented Dec. 28, 1909.

4 SHEETS—SHEET 1.

Fig. 1.

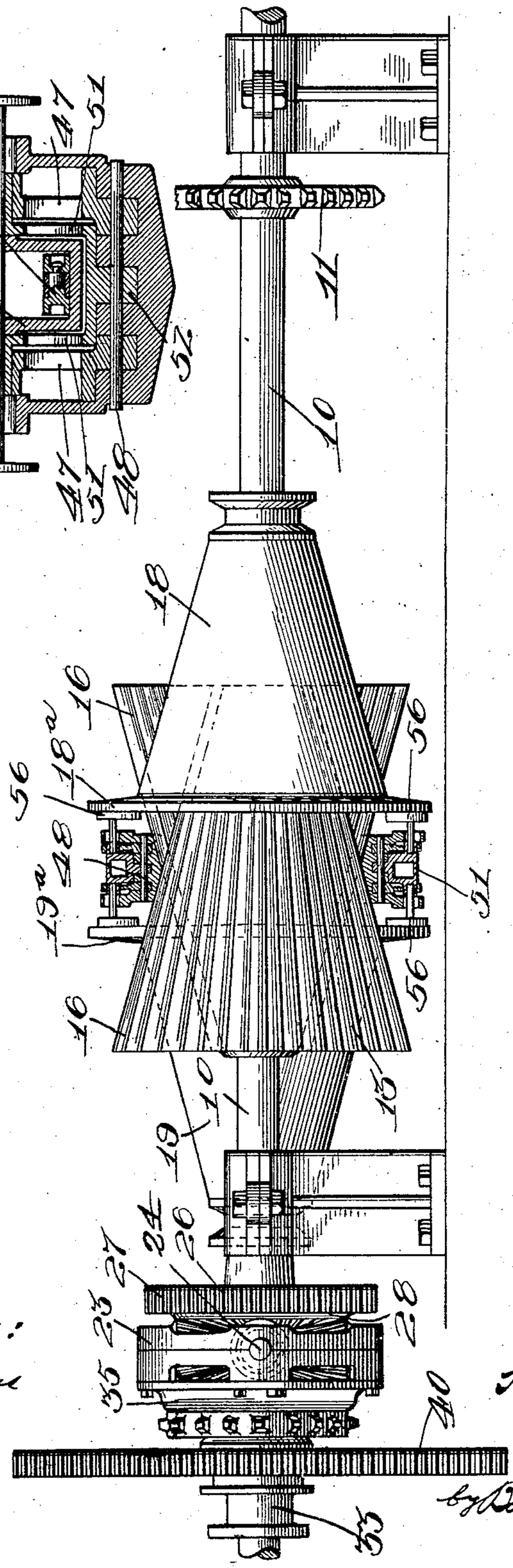

Fig. 2.

Witnesses:

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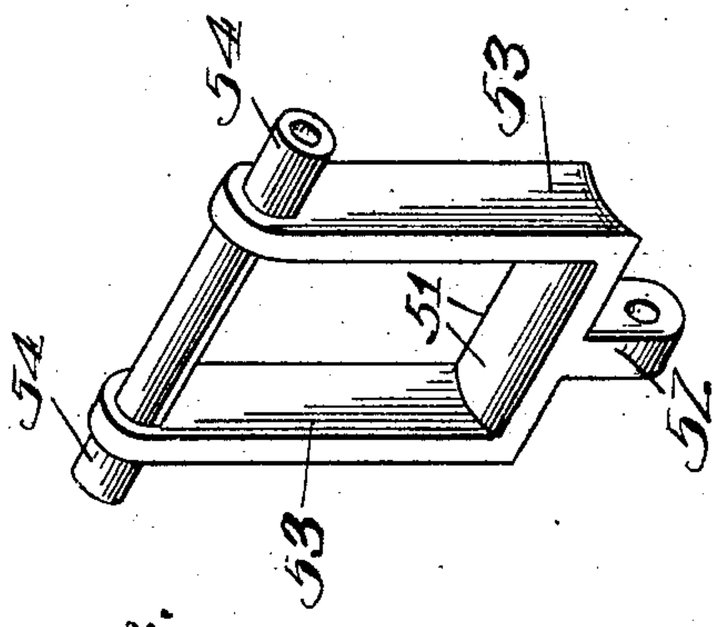

Fig. 3.

Fig. 2.

Witnesses:

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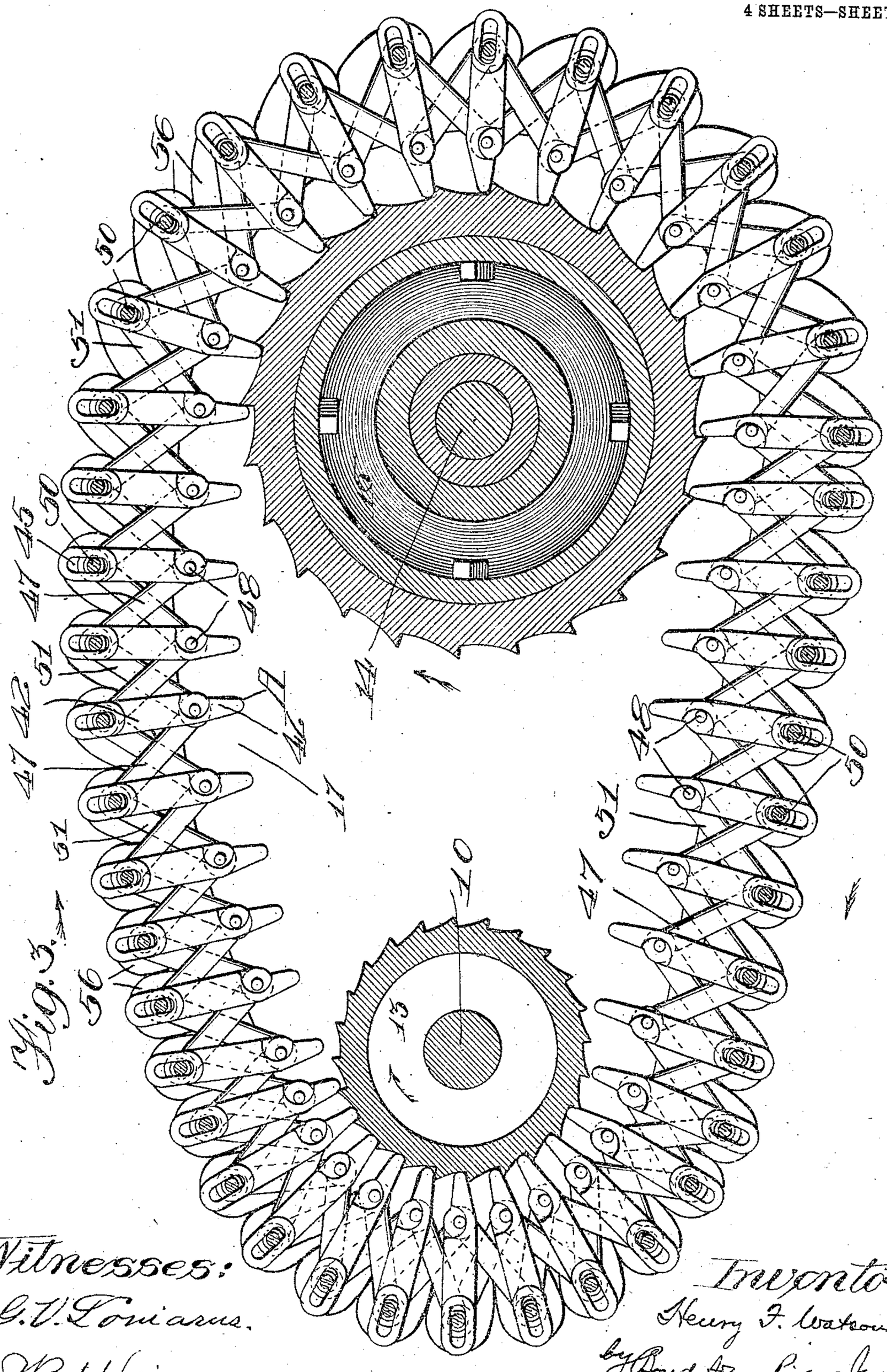

Fig. 3.

Witnesses:

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4 SHEETS—SHEET 4.

Fig. 6.

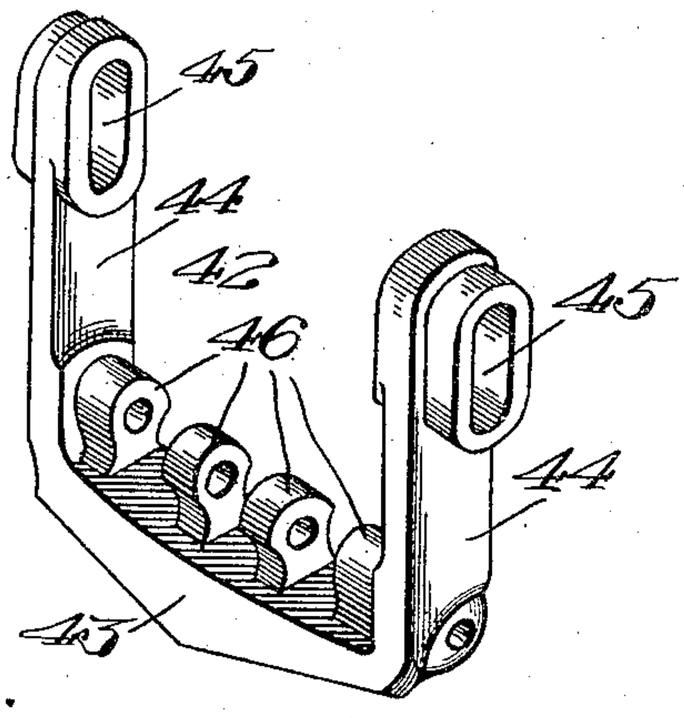


Fig. 7.

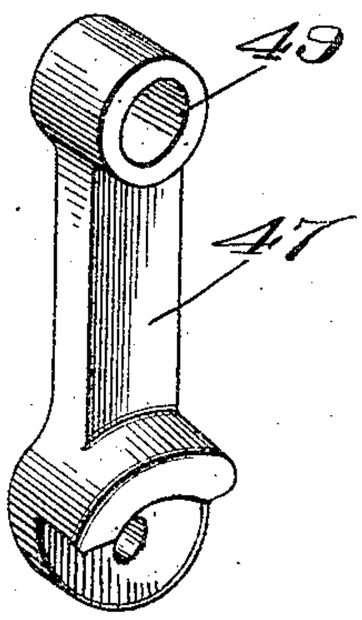


Fig. 5.

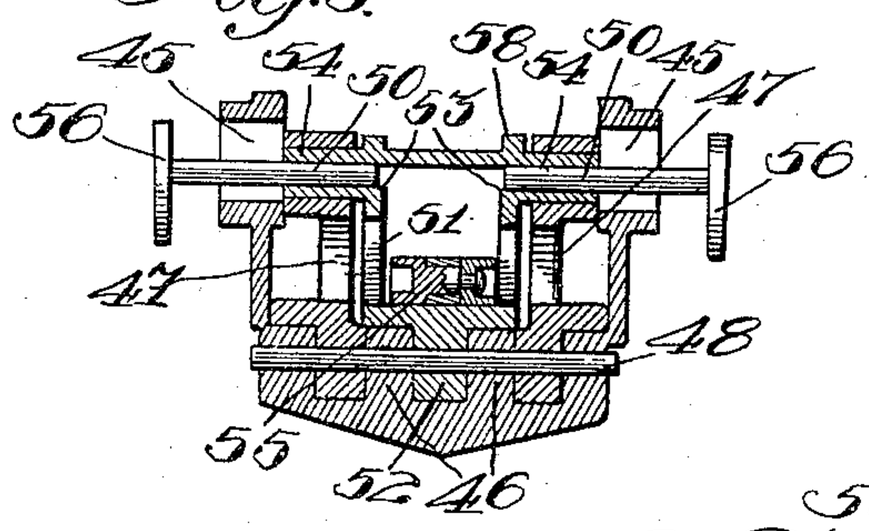
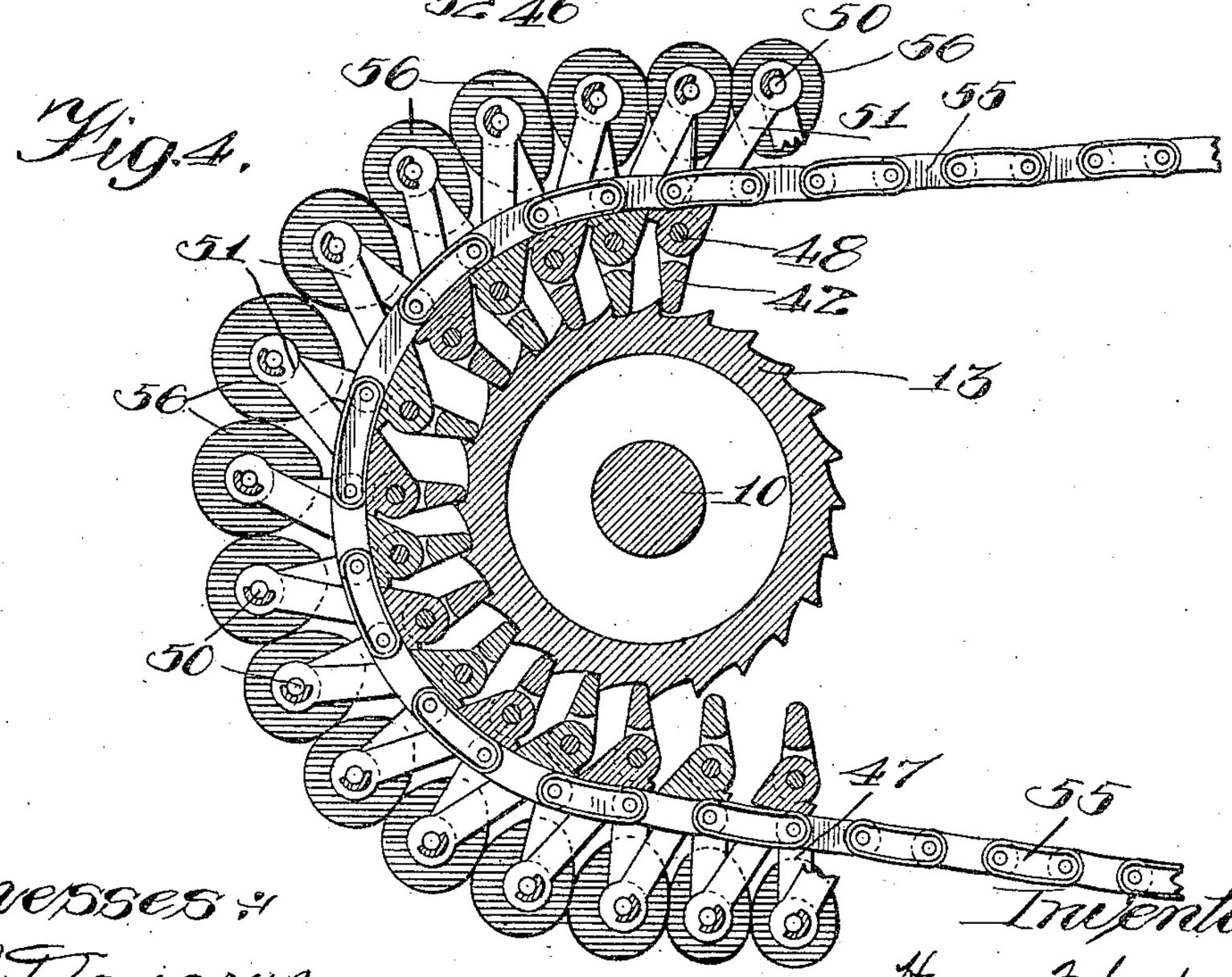


Fig. 4.



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ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HENRY F. WATSON, OF OAK PARK, ILLINOIS.

DRIVING MECHANISM.

944,585. Specification of Letters Patent. **Patented Dec. 28, 1909.**

Application filed February 10, 1905. Serial No. 245,066.

To all whom it may concern:

Be it known that I, HENRY F. WATSON, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Driving Mechanism, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates primarily to driving-mechanism by which, from a prime mover running at a constant speed, variable speed may be produced, for the purpose of driving automobiles, line-shafting, or any other mechanism in which it is desired to produce such variable speed from a prime mover running at a constant speed; and one of its objects is to produce a new and improved mechanism by which this result may be attained.

Another object of my invention is to provide new and improved toothed cones,—one driven by a prime mover and the other by the first-named cone, and capable, by the shifting of a suitable chain thereon, of being driven at different relative speeds, and thereby, by the shifting of the connecting belt or chain in one direction, to produce an increased speed in the shaft to which it is desired to ultimately impart the motion; and by the mere shifting of the driving belt or chain in the other direction to slow down the relative speed of said ultimately-driven shaft, then to stop it, and then to reverse or "back" its rotation,—the revolution of the prime mover and the cone driven thereby being constantly in the same direction, and the speed of the said prime mover remaining constantly the same during the shifting.

A further object of my invention is to improve variable-speed mechanism in sundry respects hereinafter pointed out.

In the accompanying drawings,—Figure 1 is a side elevation of my device; Fig. 2 is a horizontal longitudinal section of the mechanism shown in Fig. 1; Fig. 3 is an enlarged detail, showing the driving-chain in side elevation, partly in section, and the two driving-cones in section; Fig. 4 is an enlarged detail,—being a view of one of the driving-chains and one of the cones in vertical section; Fig. 5 is an enlarged detail,—being a vertical section of one of the chain-members; Fig. 6 is an enlarged detail,—being an isometric view of one of the engaging-members of the chain; Fig. 7 is an enlarged detail,—being a view of one of the truss-links of the chain; Fig. 8 is an enlarged detail,—being an isometric view of one of the central truss-members; and Fig. 9 is an enlarged detail,—being a modification of the construction shown in Fig. 5, and showing the binding-chain suspended by stirrups.

Referring to the drawings,—10 indicates a shaft, which is adapted to be connected by means of a sprocket-wheel 11 to and driven by any suitable prime mover (not shown),—such as a gasolene-engine,—to the connection of which my invention is especially adapted. As this prime mover may be of any well-known kind and description and forms no part of my present invention, I do not deem it necessary to illustrate the same in the drawings.

13 indicates a cone, which is keyed or otherwise secured upon the shaft 10.

14 indicates a shaft, upon which is keyed or otherwise secured a second cone 15.

The cones 13 and 15, as is best shown in Figs. 1 and 2, are in substantial alinement with each other and face in opposite directions, with the smaller end of one opposite the larger end of the other. As is best shown in Fig. 1, the cones are provided upon their peripheries with a series of converging teeth 16. The teeth are farthest apart at the large end of the cone, and gradually approach each other toward the small end thereof.

17 indicates a truss-chain, hereinafter more particularly described, which passes around the cones 13 and 15 and is provided with engaging-members hereinafter described, adapted to engage the converging teeth upon said cones.

18—19 indicate shifting cones, which are feathered, respectively, upon the shafts 10 and 14. The cones 18—19 are hollow, as is best shown in Fig. 2, and are adapted to move longitudinally on the shafts 10 and 14, and to move over the surfaces of the cones 13 and 15. They are provided upon their inner edges with flanges 18^a—19^a, respectively, which are adapted to bear upon the chain as hereinafter described, and which, as best shown in Fig. 2, are beveled slightly, in order to be sure that the chain will not be caught when rotating between them.

As is best shown in Figs. 1 and 2, the shifting cones 18—19 are set apart from each other a distance equal to the width of the parts of the truss driving chain 17,—whereby, by the simultaneous longitudinal movement of the

shifting-cones upon the shafts 10 and 14, the truss-chain 17 is shifted upon the cones 13 and 15. This shifting may be accomplished by any suitable shifting-device,—as the shifting-rod 20, provided at each end with connecting-bars 21 having upon their ends rings 22 which engage a suitable peripheral groove at the smaller outer ends of the shifting-cones 18—19 and permit free rotation of the shifting-cones therein. The rod 20 may be shifted by any suitable means (not shown),—thus simultaneously sliding the shifting-cones to one side or the other. As the means for shifting the rod 20 may be of any well known and approved form and construction, and forms no part of my present invention in themselves, I do not deem it necessary to illustrate the same.

It is obvious that the relative speed at which the cones 13 and 15 and the shafts 10 and 14, upon which they are mounted, revolve, will depend upon the position of the truss-chain 17 on said cones. When the chain is in the position shown in Fig. 2, it is obvious that the cone 15 will be driven slower than the cone 13. As the driving-chain is shifted to the left, the relative speed of the cone 15 will increase with reference to that of the cone 13 until it reaches the same speed, and then a greater speed as the shifting continues.

23 indicates a circular gear-box, which is keyed or otherwise secured to the shaft 10,—the shafts 10 and 14 being shown as broken in Fig. 2 for convenience of illustration.

24 indicates pins—preferably three in number—which are secured upon the gear-box 23 and project inwardly thereinto.

25 indicates beveled gears, which are rotatably mounted upon the pins 24.

26 indicates a gear-wheel, which is rotatably mounted upon the shaft 10 and has upon its periphery gear-teeth 27, and upon its lateral surface a beveled gear which meshes with the teeth upon the beveled gears 25.

29ª indicates a hub which is keyed to the shaft 14.

29 indicates a gear, which is mounted upon the hub 29ª and connected therewith by a suitable pawl and ratchet mechanism 29ᵇ which will cause the gear 29 to be carried around with the shaft 14 when it is rotating in the same direction with the shaft 10 as indicated by the arrow thereon in Fig. 2, but which will permit the gear 29 to move backward over the ratchet in the other direction. As this pawl and ratchet mechanism may be of any approved form and is readily understood, it is shown only conventionally in the drawings, in order not to confuse the illustration. The gear 29 has preferably the same number of teeth as those on the gear 26, though their relative number may be varied if desired.

30 indicates an idler-gear, which meshes with the gear 29 and with the gear-teeth 27 on the gear 26,—whereby when the gear 29 is rotated, the gear 26 will be rotated in the same direction.

31 indicates a shaft, which is adapted to be connected by any suitable gearing—sprocket-chains or otherwise—with the line-shafting, the driving-wheels of an automobile, or any other device to which it is desired to give varying degrees of speed. As the mechanism which it is desired to drive by my invention may be of many different types in which a varying speed is desired, and as the connections of said shaft 31 therewith may be of any well known and approved kind and description, and as these form of themselves no part of my present invention, I have not deemed it necessary to show the same, as the various mechanisms to which my invention may be connected to impart varying speed, and various methods of connecting said shaft 31 therewith, will be obvious to any mechanic skilled in the art.

32 indicates a beveled gear, which is provided with a sleeve-hub 33 keyed or otherwise secured to the shaft 31 and permitting the free rotation within it of the end of the shaft 10, as shown in Fig. 2.

34 indicates a sprocket-wheel, which is secured to a suitable portion 35 of the gear-box 23 which extends over and partially embraces the beveled gear 32, as is best shown in Fig. 2.

36 indicates a sprocket-wheel, which is provided with a sleeve-hub 37 and is rotatably mounted upon the shaft 14 in alinement with the sprocket-wheel 34 and preferably of the same size therewith. The sprocket-wheels 34 and 36 are connected by a sprocket-chain 38,—see Fig. 2.

39 indicates a gear, which is keyed upon the sleeve-hub 37 of the sprocket-wheel 36.

40 indicates a gear-wheel, which is rotatably mounted upon the sleeve-hub 33 of the gear 32 and is adapted to be slid back and forth longitudinally of said hub by any suitable mechanism,—not shown. The gear 40 is provided upon its inner side with engaging-lugs 41, shown in Fig. 2, which are adapted to engage with suitable openings on the outside of the beveled gear 32,—forming a clutch between said gear 32 and said gear 40 when the gear 40 is slid upon the sleeve-hub 33 into the position shown in Fig. 2. The gear 39 is wider than the gear 40, so that when the gear 40 is slid outward to disengage the clutch it is still in mesh with the gear 39.

The operation of the parts of my invention so far described is as follows: Suppose the chain to be in a central position, midway of the cones 13 and 15, thus working on the same diameters. The shaft 10 being driven at a constant speed in the direction of the arrow shown in Fig. 2, the cone 13 and the

gear-box 23 will be rotated with it, and, of course, in the same direction. By means of the truss driving-chain 17 the cone 15 will be rotated in the same direction, and at the same speed,—rotating with it the shaft 14 and the gear 29. Through medium of the intermediate gear 30 the gear 26 will be rotated also in the same direction and at the same speed, and through the medium of the beveled gears 25, which do not then rotate, the rotation will be communicated to the beveled gear 32,—the gear 40 being slid to the left to disengage the clutch-members, and the shaft 31 will be rotated in the same direction at the same speed as the shaft 10. The relative amount of the rotation of the shaft 31, and also the direction of its rotation, will depend upon the position of the truss-chain 17 upon the cones 13 and 15. In order to make this clear let us suppose that the cone 13 were driven and the cone 15 held stationary,—the truss-chain being removed for that purpose. It will be obvious that the gear-box 23 will be rotated in the same direction and at the same speed as the cone 13. The gear 26 would be held stationary, which would cause a rotation of the beveled gears 25 as they were carried around by the rotation of the gear-box, and would impart a much accelerated speed to the gear 32 and thus to the shaft 31. Suppose that the reverse was true, and the cone 13 were held stationary and the cone 15 rotated in the same direction in which the cone 13 had been previously rotated, the gear-box 23 would, of course, be held stationary against rotation,—being keyed to the shaft 10; but the gear 26 would be rotated in the same direction as the cone 13. This would cause a rotation of the beveled gears 26 in the then-stationary gear-box 23, and would cause the gear 32, with its attached shaft 31, to be rotated in the opposite direction from that in which it would be rotated in the case previously supposed. Now, it is obvious that by the changing of the relative degrees of rotation of the two cones, results of the same nature will be produced with reference to the driving of the shaft 31. Suppose, therefore, that the chain is shifted from its central position as first supposed, in which the two cones are driven at the same speed, and suppose that it is shifted to the right in Fig. 2. This will cause the cone 15 to be driven at a slower speed than the cone 13, which will have an effect similar in nature upon the shaft 31 to that described above under the supposition that the cone 15 were stationary; for, the cone 15 being driven at a slower speed than the cone 13, the gear-wheel 26—rotated, it is true, in the same direction—would be rotated at a slower speed than that at which the gear-box 23 is rotated,—hence the beveled gears 25 would be carried around the gear 26 in an amount proportionate to the relative speeds of the gear-box 23 and gear 26, and the shaft 31 would be driven in the same direction as the shaft 10, but at an accelerated speed, the amount of this accelerated speed depending upon the extent of the shifting of the chain.

It will be obvious from this description of the operation so far, without further extended description, that if the truss-chain were shifted in the other direction, so as to make the cone 15 rotate at a greater speed than the cone 13, the gear 26 will be driven forward at a greater speed than that of the gear-box 23,—causing the beveled gears 25 to rotate in the opposite direction, and hence retarding the relative motion of the shaft 31. It will be obvious too that the cones may be so shaped with reference to each other, and the degree of relative motion between them so varied, that as the chain shifts farther and farther to the left a point will be reached at which the rotation of the shaft 31 will be reversed, and the ultimately-driven mechanism—whether line-shafting or automobile—will be driven in the reverse direction or "backed".

The chain by which the toothed cones 13 and 15 are driven, and referred to above, is best illustrated as a whole in Fig. 3, and in its several parts in Figs. 4, 5, 6 and 7. It will be understood that inasmuch as the cones are provided with teeth, as above described, which gradually narrow and converge toward the smaller end of the cones, and as it is necessary that the chain should engage these teeth, it is necessary in the first place to provide a chain the engaging-members of which will automatically adjust themselves to the varying size of the teeth, not only when the chain is shifted upon the cones, but as the various engaging-members of the chain pass from one cone to the other; and I accomplish this result by the chain illustrated in the figures last above referred to. At the same time I am enabled to construct a chain which will operate upon both sides of the driven member,—that is to say, will operate both with a "push" and a "pull." To this end, the chain is constructed with members which are adapted to engage the teeth of the cones, and which, in referring to them hereafter, I shall call "engaging-members." Said engaging-members are linked together by members which I may call "truss-members," as the entire chain when put together forms a truss-chain. Referring then to these figures, and particularly to Fig. 6, in which it is most clearly shown in its details of construction,—42 indicates one of the engaging-members of the chain. This engaging-member is provided with an engaging edge 43, which is adapted to engage the teeth of the cones. I have shown this in Fig. 6 as sloping each way from the center with a slope which cor-

responds with the slope of the surface of the cones, in order that on one side it may engage with one cone and on the other with the other. It will be understood, however, that the shape of this edge will vary with the shape of the driving-members with which the cone is intended to engage, and may be of the shape shown or any other suitable shape to effect such engagement. The engaging-members 42 are provided with two parallel arms 44, each provided with a slot 45 near its outer end; and the base-portion of each engaging-member is provided with a series of perforated lugs 46.

47 indicates truss-links, which are pivoted at their lower ends between the outer pairs of lugs 46 by means of a rod 48 which passes through their lower ends and through suitable openings in the sides of the engaging-member and through the perforated lugs 46. The shape of the truss-link 47 is best shown in Fig. 7. As is best shown in that figure, the upper end of the truss-link 47 is provided with an opening 49 to receive a journal upon the upper end of the other truss-member, hereinafter described, and to journal it therein. These truss-links 47, thus pivotally connected with an engaging-member at its bottom, extend upward and backward (see Fig. 3) to the top of the next engaging-member behind, and are pivotally connected therewith by means of pins 50 which pass through the slot-opening 45 in the arms 44 and through a suitable opening in the second truss-member hereinafter described. 51 indicates a second truss-member, which is best shown in detail in Fig. 8. This truss-member is provided with a downward-depending lug 52, which rests between the inner pair of the lugs 46 and is suitably perforated to receive the pin 48. The truss-member 51 is provided with two upwardly-extending arms 53 having outwardly-projecting journals 54 near the upper ends of said arms. The journals 54 are journaled in the opening 49 in the truss-member 47, so as to rotate freely therein.

As is best shown in Fig. 3, the truss-members 51, pivoted near the bottom of each engaging-member as above described, extend upward and forward with their journals journaled in the opening 49 of the truss-link 47 which extends upward and backward from the second preceding engaging-member. To make this clear, I have designated one of these engaging-members, in addition to its number 42, by the reference-letter A. Referring then to this engaging-member so marked, it will be seen that the truss-member 51 proceeds upward and forward from it to a position near the top of the next engaging-member in front of it, and, journaled in the perforation 49 at the top of the truss-link 47 which extends upward and backward from the second truss-member ahead of it, is pivotally connected with the top of the engaging-member next in front of it by means of the pins 50. The truss-member 47 pivoted near the bottom of the engaging-member 42, marked A in Fig. 3, extends upward and backward to a position near the top of the next engaging-member in the rear, where it receives in its opening 49 the journals of the truss-member 51 which proceeds upward and forward from the engaging-member second in the rear of the one marked A in Fig. 3. This arrangement, without further description, it will be at once understood extends all the way around the chain, and a spreading apart or bringing together of the engaging-edges of any two adjacent members will cause an opposite movement in the edges of the engaging-members at the opposite end of the chain, whereby, when the engaging-members are set closer together upon the left to engage the teeth on the cone 13, as shown in Fig. 3, they will be correspondingly adjusted and spread wider apart to engage the teeth of the cone 15, as shown in said figure; so when the chain is shifted on the cones by the action of the shifting-members 18—19, the engaging-members will be automatically adjusted to the varying width of the teeth. In addition to this it will be obvious that as the chain moves and passes from one cone to the other, the adjustment will be automatically made,—thus insuring the proper adjustment of the engaging-members to meet and engage the teeth upon the cones, no matter in what position upon the cones the chain may be. In order to prevent this truss-chain from spreading,—in other words, in order to keep its engaging-length substantially the same,—I provide a binding-chain 55, which is composed of separate links, as is best shown in Fig. 4, and which, as shown in Fig. 5, rests upon the bottom of the truss-members 51 and is placed under tension therein, so as to prevent the stretching of the truss-chain. In other words, as the engaging-edges of the engaging-members are varied in their distance from one another, in order to effect engagement with the teeth upon the cones the sum of all the distances between said engaging-edges around the interior of the chain will always remain substantially the same. From the above description I believe it will also be clear that this chain, by reason of its truss-character and of the truss-connections between the engaging-members, will operate between the driving and the driven cone not only with a "pull" upon the under side, as seen in Fig. 3, but also with a thrust or "push." For instance, the teeth upon the upper side of the cone 13 in that figure, as the cone 13 revolves will push forward upon the engaging-edges of the engaging-members which are engaged therewith, and this

movement through the truss-members will be communicated through the upper portion of the chain to the engaging-members which are engaged with the teeth upon the cone 15, and will cause a thrust upon those teeth. The chain slightly yielding will press slightly outward at the top, as is best shown in Fig. 3: so also the teeth upon the cone 13 engaging the engaging-members will exert a force upon them to move them in the direction of its rotation, and by means of the truss-members above described this "pull" will be communicated backward upon the under side of the chain, as shown in Fig. 3, and hence through the members which are engaged with the teeth on the cone 13 to the cone 15. In other words, the peculiar construction of this chain causes it to be operative in conveying the rotation of the driving-cone to the driven-cone upon both sides of the chain.

I have used the expressions "upper", "under", "top" and "bottom" in referring to the truss chain and cones in the above, referring, however, to Fig. 3, to show what is meant by such expressions and for convenience of description. As the chain is not always in the same position, I may say that by the word "top" or "upper" side of the truss chain 17 I mean that portion which is moving away from the driving cone 13 toward the driven cone 15, and by the words "under side" I mean that portion of the chain which is moving away from the driven cone 15 toward the driving cone 13. By the expression "upper side", referring to cones 13 and 15, I mean that portion of the cones which is toward the portion of the chain which is moving from the driving cone to the driven cone, and by the words "under side", that portion of the said cones which is toward the portion of the chain that is moving from the driven toward the driving cone.

56 indicates plates, which are rigidly secured upon the ends of the pins 50 and which form a bearing upon which the inner flanged-edges of the shifting-cones 18—19 bear in order to shift the chain from side to side upon the cones.

In Fig. 9, I have shown a modification,—in which the binding-chain 55 is differently supported. Referring to this figure,—57 indicates stirrups, which are pivotally suspended from the pins 50 and which support the binding-chain 55, instead of having said chain bear upon the bottom of the truss-members 53, as shown in Fig. 5.

That which I claim as my invention and desire to secure by Letters Patent is,—

1. In a driving-mechanism, the combination with toothed conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, and truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members to said toothed cone, substantially as described.

2. The combination of conical driving-members each provided on its surface with teeth converging from the large end toward the small end of said conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, and truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members of said toothed cones, substantially as described.

3. The combination of conical driving-members each provided on its surface with teeth converging from the large end toward the small end of said conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members of said toothed cones, and means for shifting said chain longitudinally of said conical driving-members, substantially as described.

4. The combination of conical driving-members each provided on its surface with teeth converging from the large end toward the small end of said conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members of said toothed cones, means adapted to prevent the spreading of said chain, and means for shifting said truss-chain longitudinally of said conical driving-members, substantially as described.

5. The combination of conical driving-members each provided on its surface with teeth converging from the large end toward the small end of said conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members of said toothed cones, a binding-chain adapted to prevent the spreading of said chain, and means for shifting said truss-chain longitudinally of said conical driving-members, substantially as described.

6. The combination of conical driving-members each provided on its surface with teeth converging from the large end toward the small end of said conical driving-members, of a truss-chain composed of engaging-members adapted to engage the teeth of said cones, truss-members connecting said engaging-members and adapted to automatically adjust said engaging-members of said toothed cones, a binding-chain engaging said engaging-members and adapted to prevent the spreading of said chain, and means for

shifting said truss-chain longitudinally of said conical driving-members, substantially as described.

7. In a driving-mechanism, the combination with conical driving-members each having on its surface teeth converging from the larger end toward the smaller, of a truss-chain composed of engaging-members adapted to engage the teeth of said conical driving-members and having upwardly-projecting arms, truss-members pivotally linking the lower part of said engaging-member with the upper ends of the arms on the engaging members upon each side of the same, a binding-chain adapted to prevent the spreading of said truss-chain, and means for shifting said truss-chain longitudinally of said conical driving-members, substantially as described.

8. In a driving mechanism, the combination with toothed conical driving members, of a chain having engaging members adapted to engage the teeth of said cones and automatically adjust themselves thereto as said cones rotate and also to automatically adjust themselves to said toothed cones when said chain is shifted longitudinally of said cones, and mechanism for shifting said chain longitudinally of said cones, substantially as described.

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Witnesses:
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