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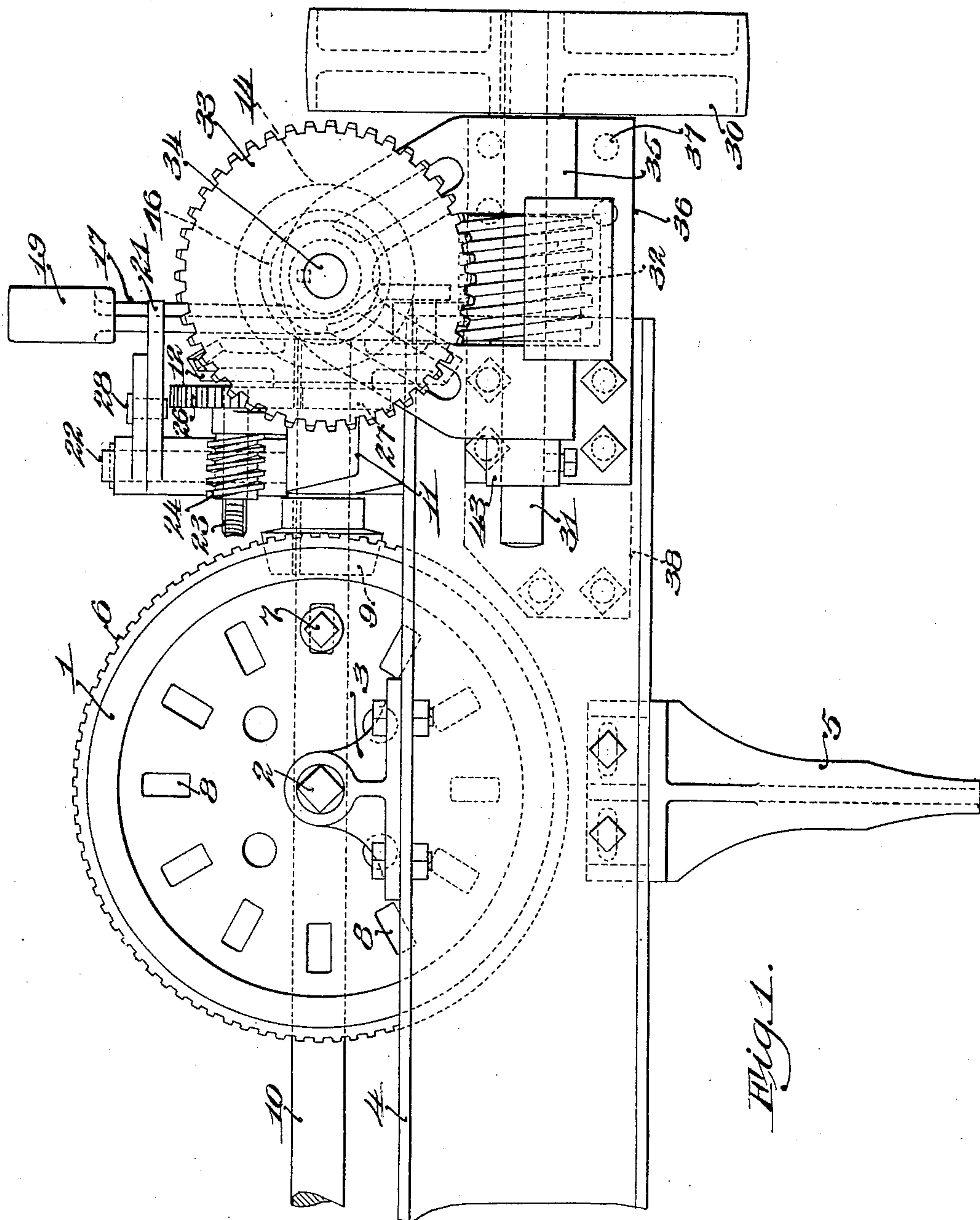
PATENTED NOV. 7, 1905.

E. B. FREEMAN.

TUBE SCRAPER DRIVING MECHANISM FOR FUEL ECONOMIZERS.

APPLICATION FILED DEC. 29, 1904.

5 SHEETS—SHEET 1.



*Witnesses*

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*Inventor*

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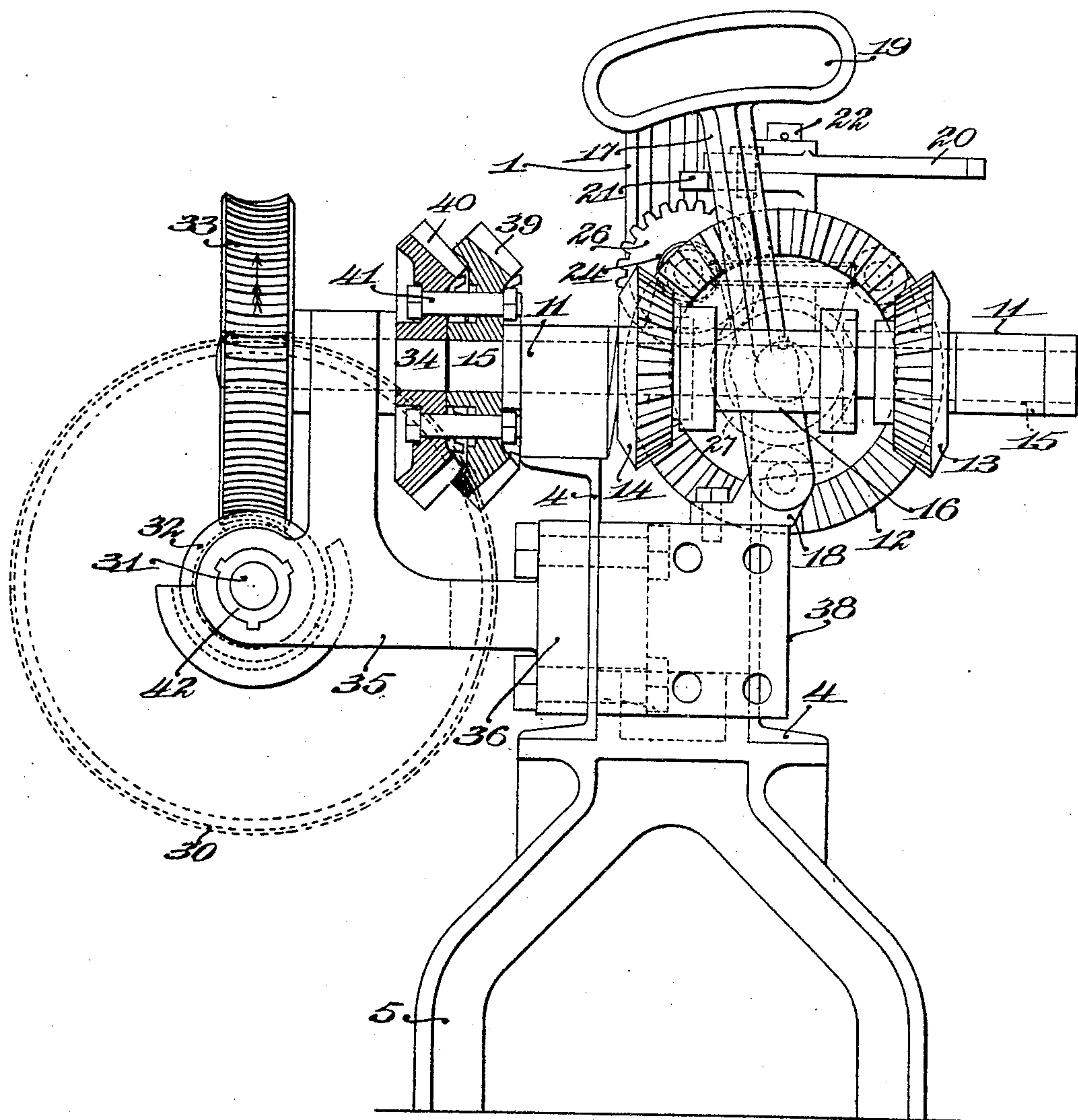
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5 SHEETS—SHEET 2.



*Fig. 2.*

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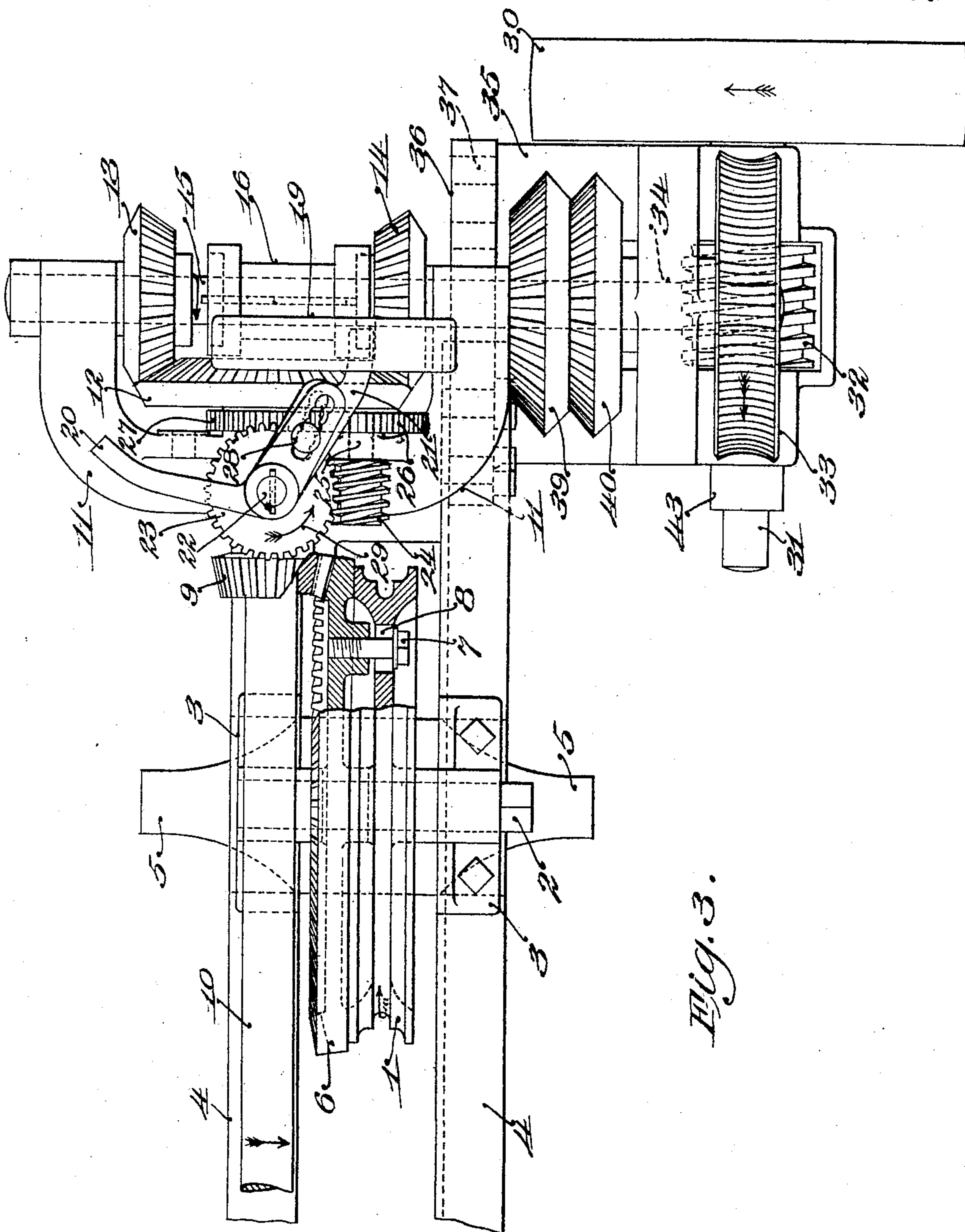


Fig. 3.

Witnesses

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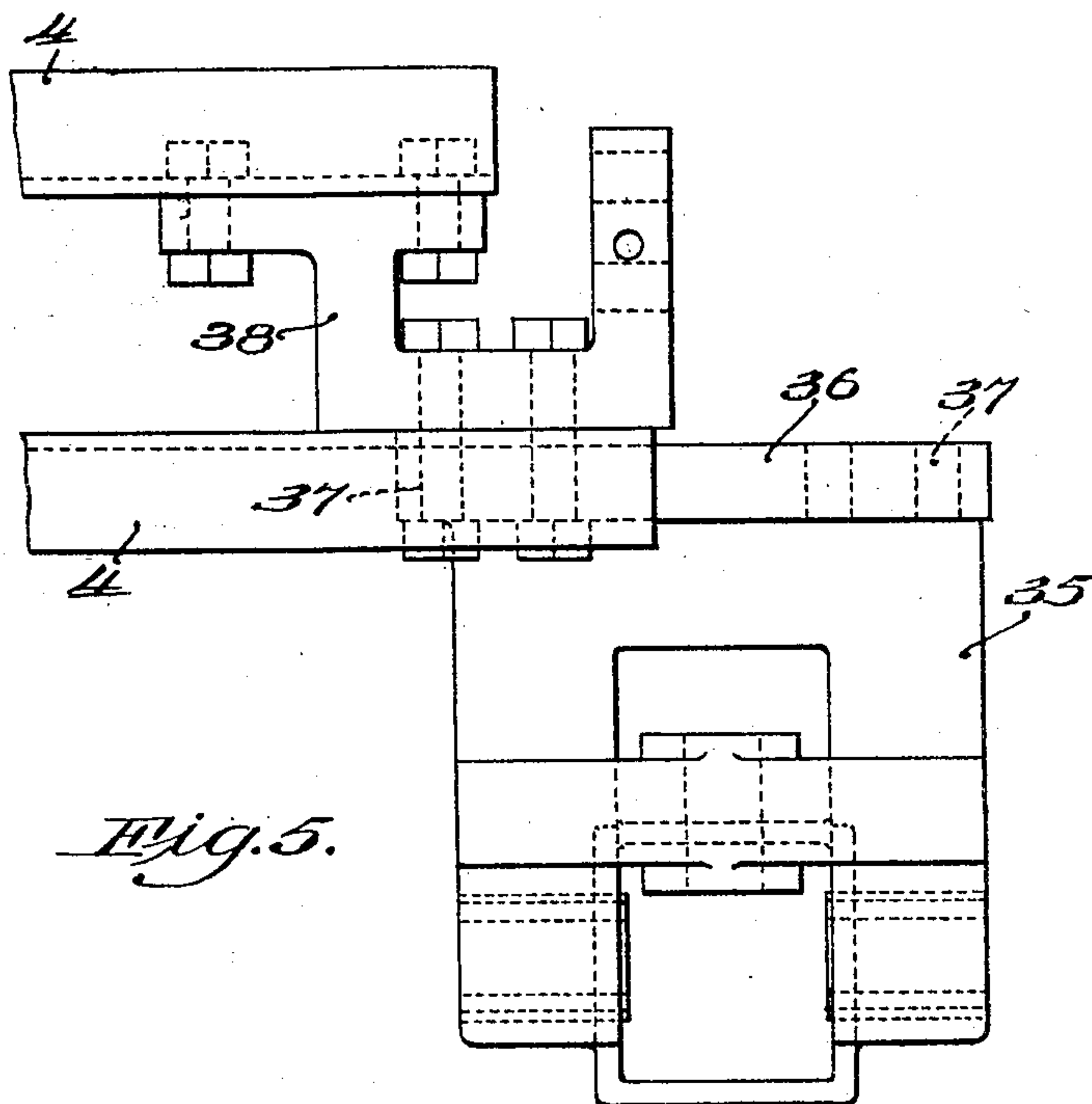
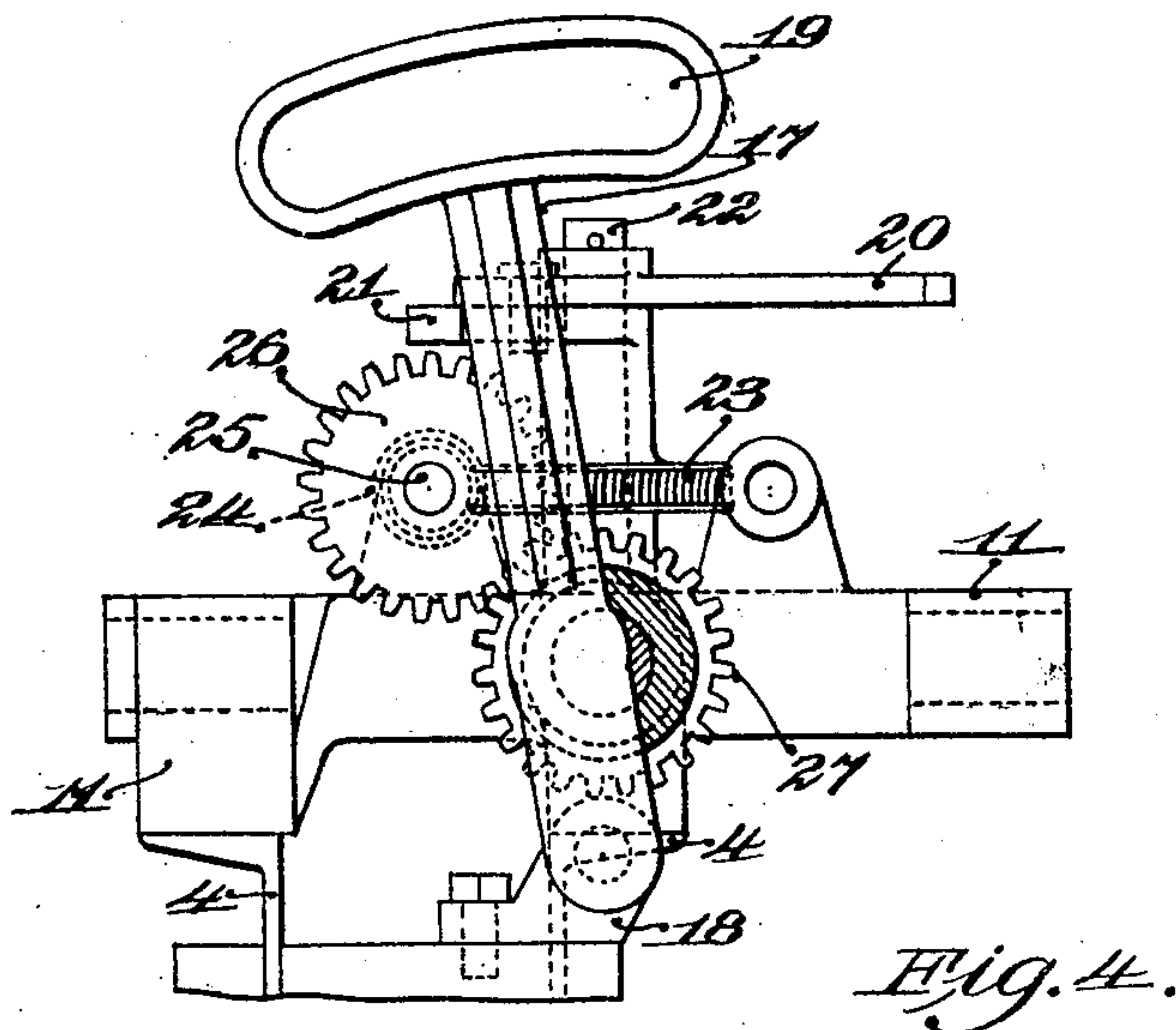
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5 SHEETS—SHEET 4.



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5 SHEETS—SHEET 5.

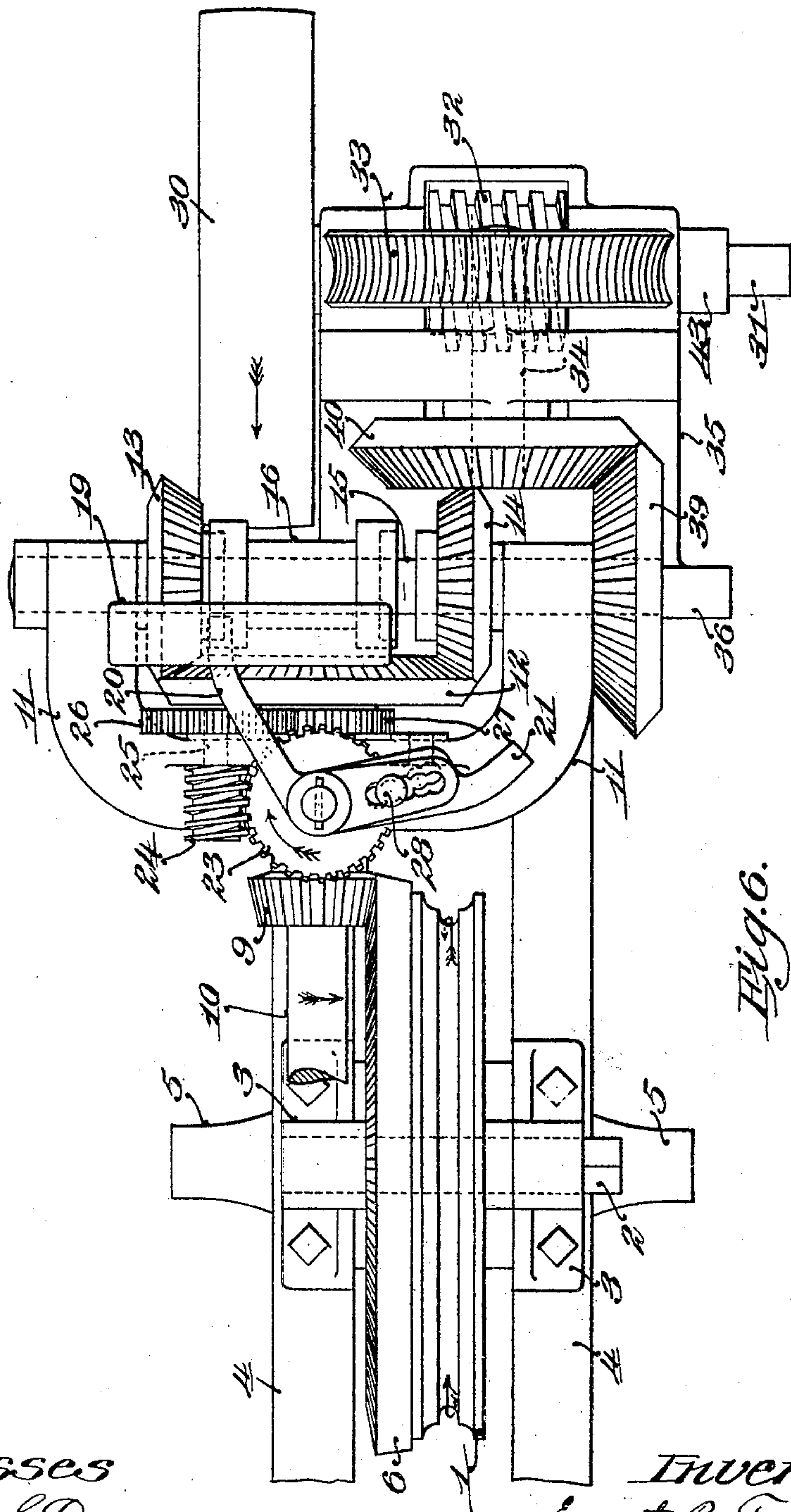


Fig. 6.

Witnesses

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# UNITED STATES PATENT OFFICE.

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TUBE-SCRAPER-DRIVING MECHANISM FOR FUEL-ECONOMIZERS.

No. 803,578.

Specification of Letters Patent.

Patented Nov. 7, 1905.

Application filed December 29, 1904. Serial No. 238,768.

*To all whom it may concern:*

Be it known that I, ERNEST B. FREEMAN, a citizen of the United States, residing at Dedham, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Tube-Scraper-Driving Mechanism for Fuel-Economizers; 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.

The present invention relates to an improved mechanism for driving the tube-scrappers of feed-water heaters or fuel-economizers.

The tube-scraper-driving mechanism of fuel-economizers as usually constructed comprise a series of chain-pulleys over which chains pass which are attached to the scrapers, a shaft extending lengthwise of the economizer and geared to each of the chain-pulleys, a reversing mechanism, usually in the form of reversing-gearing, at one end of the economizer for driving said shaft, and a driving-pulley for driving the reversing-gearing. The driving-pulley is necessarily rotated at a high rate of speed as compared with the rotation of the chain-pulleys, so that reducing-gearing is provided at some point between the driving-pulley and the chain-pulleys. This reducing-gearing has either been placed between the chain-pulleys and the shaft geared thereto or between said shaft and the reversing-gearing. The first-mentioned arrangement is objectionable, as the reducing-gearing is inaccessible and cannot be kept properly lubricated, and both arrangements are objectionable on account of the high speed at which the reversing-gearing is run, which causes the gearing to be subjected to severe shocks and strains at each reversal and renders the proper lubrication of the reversing-gearing difficult if not impossible. An object of the present invention is to overcome these defects in prior mechanisms, and with this object in view a feature of the present invention contemplates the provision of a reducing-gearing between the driving-pulley and the reversing mechanism. The reducing-gearing can thus be placed in an easily-accessible location at one end of the economizer, and the reversing mechanism is run at a comparatively slow rate of speed, so that practi-

cally no lubrication of this mechanism is required and injurious shocks and jars are prevented. In installing the tube-scraper-driving mechanism of fuel-economizers difficulty is often experienced in leading a belt to the driving-pulley, as the space above the economizer is often so cramped as to interfere with the proper arrangement of counter-shafting. A further object of the present invention is to facilitate leading the belt to the driving-pulley, and with this object in view a feature of the invention contemplates the provision of means whereby the driving-pulley can be placed in any one of a number of different positions with relation to the other portions of the mechanism, so that the belt can be led to the pulley from that direction which is most convenient in the particular location in which the mechanism is installed.

It is often desirable to rotate the driving-pulley of a tube-scraper-driving mechanism in the opposite direction to that in which it was designed to run, so as to avoid the use of a cross-belt or a counter-shaft; and an object of the present invention is to provide a tube-scraper-driving mechanism in which the driving-pulley can be rotated in either direction, according to the requirements of the place in which the mechanism is installed. With this object in view the invention contemplates the provision of means whereby the mechanism for controlling the action of the reversing-gearing can be arranged so as to operate properly when the driving-pulley is rotated in either direction.

In addition to the features of invention above referred to the present invention also consists in certain devices, combinations, and arrangements of parts hereinafter described and claimed, tending to simplify and improve the construction and mode of operation of tube-scraper-driving mechanisms.

The various features of the invention will be understood from an inspection of the accompanying drawings, in which—

Figure 1 is a view in side elevation of a mechanism embodying the same in their preferred form. Fig. 2 is a view in end elevation of the mechanism illustrated in Fig. 1. Fig. 3 is a plan view. Fig. 4 is a detail view of a portion of the mechanism illustrated in Fig. 1, showing particularly the mechanism by which the reversing-lever is actuated. Fig.



5 is a detail plan view of a portion of the frame, illustrating particularly the bracket in which the driving-pulley is mounted and the manner in which it is secured in position; and  
5 Fig. 6 is a plan view similar to Fig. 3, but with the bracket in which the driving-pulley is mounted secured in a different position, the axis of the driving-pulley when the bracket is in this position extending at right angles  
10 to that in which the axis of the pulley extends when the bracket is in the position illustrated in Fig. 3.

Referring to the drawings, 1 indicates a chain-pulley over which a chain attached to  
15 the tube-scrappers passes in the usual manner. But one of these pulleys is illustrated in the drawings, it being understood that any desired number of pulleys are provided and that all the pulleys are constructed and actuated  
20 in the same manner. The pulley is secured to a shaft mounted in bearings in brackets 3, secured upon the upper flanges of channel-irons 4, which extend lengthwise of the economizer and are supported above the same by  
25 suitable standards 5. Upon the shaft 2 is loosely mounted a bevel-gear 6, which is secured to the pulley 1 by means of a bolt 7, passing through a slot 8 in the web of the pulley and screwing into the bevel-gear. A series  
30 of these slots 8 is provided, as indicated in Fig. 1, to allow for an adjustment of the pulley with relation to the bevel-gear, such adjustment being sometimes desirable on account of the slipping of the chain on the pulley.  
35 The end of the shaft 2 to which the pulley is secured is squared to afford a means whereby the pulley may be rotated with relation to the bevel-gear after the bolt 7 is withdrawn. The bevel-gear 6 meshes with a bevel-  
40 gear 9 on a shaft 10, extending lengthwise of the economizer and journaled at its forward end in a bracket 11, supported upon the channel-irons 4. The rear end of the shaft is journaled in a bracket (not shown) supported upon  
45 the channel-irons. The shaft 10 is driven alternately in opposite directions and through the bevel-gears 9 and 6 rotates the chain-pulley 1 in opposite directions to alternately raise and lower the tube-scrappers.

50 The reversing mechanism illustrated in the drawings for driving the shaft 10 alternately in opposite directions comprises a reversing-gearing directly connected to the shaft—that is, without the interposition of gearing to effect any substantial reduction in the speed of  
55 the shaft. This reversing-gearing consists of a bevel-gear 12, fast upon the forward end of the shaft 10, bevel-gears 13 and 14, mounted loosely upon a shaft 15 and meshing with  
60 the bevel-gear 12 at diametrically opposite points, and a clutch-sleeve 16, splined upon the shaft 15, so as to rotate therewith, but free to slide longitudinally thereon. The hubs of the bevel-gears 13 and 14 and the adjacent  
65 ends of the clutch-sleeve 16 are pro-

vided with coacting clutch-faces, through which the bevel-gears are driven from the sleeve. The shaft 15 is journaled in bearings in the bracket 11 and is constantly rotated in one direction through mechanism to be here-  
70 inafter described. In order to reverse the direction of rotation of the shaft 10, the clutch-sleeve 16 is moved longitudinally of the shaft 15 out of engagement with one of the bevel-  
75 gears 13 and 14 and into engagement with the other. This movement of the sleeve is produced by a reversing member, (illustrated in the drawings as a lever 17,) pivoted at its lower  
80 end upon a bracket 18 and being enlarged at its upper end to form a weight 19. This lever extends between two flanges formed at the ends of the clutch-sleeve 16 and is arranged  
85 to contact with the flanges and move the sleeve when the lever is oscillated. The reversing-lever 17 is actuated to reverse the direction of rotation of the shaft 10 by mechanism driven from the reversing-gearing.  
90 This mechanism comprises two arms 20 and 21, arranged to extend on opposite sides of the lever and mounted to turn about a vertical pin 22, projecting upwardly from the bracket 11. The arm 21 is formed integral  
95 with a sleeve which is provided at its lower end with a worm-gear 23, and the arm 20 is rigidly secured to the arm 21, so as to turn therewith. The worm-gear 23 meshes with  
100 a worm 24 on a shaft 25, to which is secured a gear 26, which meshes with a gear 27 on the hub of the bevel-gear 12. The arms 20 and 21 are thus driven from the reversing-gearing, so that the movement of the arms is reversed with each reversal in the direction of  
105 rotation of the shaft 10. It will be obvious from an inspection of Figs. 1, 2, 3, and 4 that the gearing for actuating the arms 20 and 21 is so arranged that when the bevel-gear 14 is  
110 clutched to the shaft 15 and the shaft 10 is rotating in the direction indicated by the arrow the arms 20 and 21 are moved in a direction to cause the arm 21 to engage the lever.  
115 This movement is continued until the center of gravity of the lever is moved beyond the vertical line passing through the pivot of the lever when the weighted upper end of the lever falls to the right, as viewed  
120 in Fig. 2, and the clutch-sleeve 16 is shifted into engagement with the bevel-gear 13, thereby reversing the direction of rotation of shaft 10. The movement of arms 20 and 21 is reversed with the reversal in the direction  
125 of rotation of shaft 10, so that the arm 20 is actuated to engage the lever 17 and move it in the opposite direction.

Mechanisms of the same general character as the mechanism so far described have been  
130 heretofore devised. In these mechanisms, however, the mechanism for actuating the reversing member has been driven from the gearing connecting one of the chain-pulleys and the shaft, which extends lengthwise of the



economizer. In such mechanisms a break in the gearing connecting the chain-pulley and the shaft throws the mechanism for actuating the reversing member out of operation, so that the direction of rotation of the shaft is not changed, but the shaft continues to run in the same direction, with the result that many of the parts of the tube-scraper-driving mechanism are broken or injured. Also when the gearing is repaired all of the chain-pulleys must be adjusted with relation to their driving-gearing.

In the mechanism above described the mechanism for actuating the reversing member is separate from the gearing which connects the chain-pulleys and the shaft, so that a break in the gearing connecting this shaft and one of the chain-pulleys does not throw the mechanism for actuating the reversing member out of operation, and injury to the other parts of the tube-scraper-driving mechanism is avoided. Also when the gearing connecting the shaft and one of the chain-pulleys is repaired it is only necessary to adjust this chain-pulley with relation to its driving mechanism.

As will appear from inspection of Fig. 3, the arms 20 and 21 instead of being arranged to project radially from the pivot 22 are curved or bent at their outer ends, so as to bear against the lever 17 in the direction in which the lever is moved. By this arrangement of the arms they act to the best advantage on the lever without tending in any way to cramp the lever on its pivot, so that less power is required to actuate the lever than when straight radial arms are employed, as has heretofore been the practice. This arrangement of the arms is of practical value, as the power required to separate the clutch-sleeve from the bevel-gear with which it is in engagement is often considerable.

Another feature of novelty resides in a construction by which the arms 20 and 21 can be adjusted to vary the extent of movement imparted to the chain-pulleys in each direction. As illustrated in Fig. 3, the arm 20 is extended over the arm 21, and both arms are provided with a series of bolt-holes. By moving the arm 20 toward and from the arm 21 corresponding holes in the two arms are caused to successively register, and the arms can be secured together in any desired position by passing a bolt 28 through the registering holes. By this construction a fine adjustment of the arms is secured, and the arms are locked in adjusted position without any possibility of slipping even if the bolt 28 works loose.

The reversing-gearing is driven from a driving-pulley which acts through mechanism hereinafter described to impart a continuous rotation in one direction to the shaft 15. It is desirable, as has been heretofore explained, to provide means whereby the driving-pulley may be rotated in either direction. In the construction illustrated in Fig. 3 the various

parts of the mechanism are arranged so that the reversing-lever 17 will be properly actuated when the shaft 15 rotates in the direction indicated by the arrow. With the arrangement illustrated in this figure it will be apparent that if the direction of rotation of the shaft 15 is reversed the movement of the arms 20 and 21 will also be reversed, so that the arm 20 will be brought into engagement with the reversing-lever 17 instead of the arm 21, and the reversing-lever will not be actuated to shift the clutch-sleeve 16. For the proper actuation of the reversing-lever 17 the arms 20 and 21 should move in the direction indicated by the arrow 29 when the reversing-lever is in the position indicated in Fig. 3 and the shaft 15 is rotated in either direction. To cause the arms to be so moved, two bearings for the shaft of the worm 24 are provided in the bracket 11, so arranged that when the worm-shaft is placed in one of the bearings the worm meshes with one side of the worm-gear 23 and when the worm-shaft is placed in the other bearing the worm meshes with the opposite side of the worm-gear. With the worm 24 arranged as illustrated in Fig. 3 the arms 20 and 21 are moved to properly actuate the reversing-lever when the shaft 15 rotates in the direction indicated by the arrow applied to the shaft, and when the worm is arranged to mesh with the opposite side of the gear the arms are moved to properly actuate the reversing-lever when the shaft 15 is rotated in the opposite direction. If inclined clutch projections are provided on the clutch-sleeve 16 and the hubs of the bevel-gears 13 and 14, the bevel-gears 13 and 14 are interchanged and the clutch-sleeve 16 is turned end for end when the direction of rotation of the shaft 15 is reversed in order to cause the clutch projections to coöperate with each other.

The driving-pulley by which the reversing-gearing is driven is indicated at 30 and is secured upon a shaft 31, to which is keyed a worm 32, meshing with a worm-gear 33. The worm-gear 33 is secured to a shaft 34, which in the arrangement illustrated in Figs. 1, 2, and 3 is in axial alinement with the shaft 15 and rigidly secured thereto, so that the shaft 15 is driven directly from the shaft 34. The worm 32 and worm-gear 33 constitute a reducing-gearing between the driving-pulley and the reversing-gearing, so that the reversing-gearing is run at a comparatively slow rate of speed, and thereby injurious shocks and jars prevented when the action of the gearing is reversed.

It is desirable in tube-scraper-driving mechanisms that means be provided whereby the driving-pulley can be placed in different positions, as has heretofore been explained. In the construction illustrated in the drawings a means for accomplishing this result is provided, consisting of a bracket 35, in which the



shaft of the driving-pulley is mounted and means for securing the bracket rigidly in either of two positions to cause the axis of the driving-pulley to extend in either of two  
 5 directions at right angles to each other. The bracket is provided with a plate 36, in which are formed two series of bolt-holes 37, through which securing-bolts may be passed to secure the bracket to a block 38, located between the  
 10 channel-irons 4 and securely bolted thereto. The block 38 is located at the forward end of the channel-irons, as is clearly shown in Fig. 5, and is provided with two portions at right angles to each other, to either of which the  
 15 bracket 35 can be bolted, the securing-bolts passing through one series of holes 37 on the plate 36 of the bracket and through the web of one of the channel-irons 4 when the bracket is in one position and passing through the  
 20 other series of holes 37 when the bracket is in the other position. In the construction illustrated in the drawings the reducing-gearing and the shaft 34 are also mounted in the bracket 35, so that the positions of these parts with  
 25 relation to the shaft 15 is changed when a change is made in the position of the bracket 35. The relative arrangement of these parts when the bracket is in one position is illustrated in Fig. 3, and the arrangement when  
 30 the bracket is in the other position is illustrated in Fig. 6. When the bracket is in the position illustrated in Fig. 6, the shafts 34 and 15 are at right angles to each other, and in order to transmit the motion of the shaft 34  
 35 to the shaft 15 bevel-gears 39 and 40 are provided, secured, respectively, to the shafts 15 and 34. These gears are secured to the shafts in such a position that when the bracket 35 is changed from the position illustrated in Fig.  
 40 3 to the position illustrated in Fig. 6 the gears are brought into mesh with each other. These gears are also utilized in securing the shafts 34 and 15 together when the shafts are in actual alinement, registering bolt-holes being  
 45 provided in the webs of the gears, through which securing-bolts 41 are passed. In the arrangement illustrated in Fig. 6 the driving-pulley is rotated in the same direction as in the arrangement illustrated in Fig. 3. On  
 50 account of the bevel-gears 39 and 40, however, the direction of rotation of the shaft 15 is reversed, and consequently the worm 24 is arranged to engage the opposite side of the worm-gear 23. If the driving-pulley is to be  
 55 rotated in the opposite direction, the worm 24 is arranged as in Fig. 3.

While the invention is not limited to any specific form of support for the driving-pulley, the bracket illustrated in the drawings is  
 60 preferably used, as it constitutes the best form of support which has yet been devised. This bracket embodies certain features of construction which are of value, as will be obvious to those skilled in the art and which are believed  
 65 to be novel. The bracket extends horizontally

from the plate 36 and is provided in its outer lower portion with two journal-boxes between which the worm 32 is received, each journal-box being formed integral with the bracket. A horizontal web extends between the jour-  
 70 nal-boxes and forms a trough partially surrounding the worm, so that the worm can be run in an oil-bath, if desired. Between the journal-boxes and the plate 36 the bracket extends upwardly and is provided with a bear-  
 75 ing for the shaft 34. The bushings for the journal-boxes in which the shaft 31 is journaled are in the form of cylinders, as indicated at 42, and are held from rotation by projections engaging grooves in the journal-  
 80 boxes. Each bushing is held from longitudinal movement in one direction by a shoulder near the inner end of the bushing, as indicated in Fig. 5. In assembling the shaft 31, the worm 32, and the bushings 42 the worm  
 85 32 is first placed between the journal-boxes and the shaft 31 is inserted endwise through the boxes. The key which secures the worm to the shaft is then inserted through one of the journal-boxes and then the bushings are  
 90 slipped over the ends of the shaft and moved into final position in the journal-boxes. After the parts are assembled the shaft 31 is held from longitudinal movement by means of the hub of the driving-pulley, which is secured to  
 95 one end of the shaft, and a collar 43, secured to the opposite end of the shaft.

The tube-scraper-driving mechanism illustrated in the drawings and above specifically described embodies the present invention in  
 100 the best form which has at present been devised; but it is to be understood that the various features of the invention are not limited to this specific mechanism, nor except as defined in the claims are they limited to any  
 105 specific construction or arrangement of parts.

The nature and scope of the present invention having been indicated and a preferred form of the invention having been specifically  
 110 described, what is claimed is—

1. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing mechanism directly connected to said shaft for driving said shaft alternately in opposite  
 115 directions, a driving-pulley, and reducing-gearing between the driving-pulley and reversing mechanism acting to substantially reduce the speed of the reversing mechanism.

2. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing directly connected to said shaft for driving said shaft alternately in opposite  
 120 directions comprising clutches controlling the direction of rotation of said shaft, mechanism for actuating said clutches to reverse the direction of rotation of said shaft, a driving-pulley, and reducing-gearing between the driv-  
 125 ing-pulley and the reversing-gearing acting



to substantially reduce the speed of the reversing-gearing.

3. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing directly connected to said shaft for driving said shaft alternately in opposite directions comprising clutches controlling the direction of rotation of said shaft, mechanism for actuating said clutches to reverse the direction of rotation of said shaft, a driving-pulley, a worm driven thereby, a worm-gear driven by the worm, and connections for transmitting the motion of the worm-gear to the reversing-gearing.

4. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a driving-pulley and suitable connections for driving said reversing-gearing, a frame comprising a bracket in which the driving-pulley is mounted, and means for securing the bracket in either of two positions to cause the axis of the pulley to extend in either of two directions at right angles to each other.

5. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a driving-pulley and suitable connections for driving said reversing-gearing, a support for the pulley and means for securing said support in different positions to cause the axis of the pulley to extend in different directions.

6. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a driving-pulley, a frame comprising a bracket in which the driving-pulley is mounted, means for securing said bracket in either of two positions to cause the axis of the pulley to extend in either of two directions at right angles to each other, two intermediate shafts, one of which drives the reversing-gearing and the other of which is driven by the driving-pulley and is mounted in said bracket, bevel-gears secured to said intermediate shafts and arranged to intermesh when said bracket is in one position, and means for connecting said intermediate shafts end to end when the bracket is in the other position.

7. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a reversing member acting upon said gearing to reverse the direction of rotation of said shaft, a driving-pulley and suitable connections for driving said reversing-gearing, and mechanism separate

from the gearing connecting the shaft and chain-pulley and driven from said reversing-gearing for actuating said reversing member.

8. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a reversing member acting upon said gearing to reverse the direction of rotation of said shaft, a driving-pulley and suitable connections for driving said reversing-gearing, mechanism driven from said reversing-gearing for actuating said reversing member, and means permitting an arrangement of said mechanism to properly actuate the reversing member when the driving-pulley is rotated in either direction.

9. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a driving-pulley and suitable connections for driving said reversing-gearing, a reversing member acting upon said gearing to reverse the direction of rotation of said shaft, mechanism driven from said reversing-gearing for actuating said reversing member comprising a worm and worm-gear, and a frame provided with two bearings for said worm arranged to allow the worm to be placed in mesh with either side of said worm-gear whereby said reversing member may be properly actuated when the driving-pulley is rotated in either direction.

10. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a reversing-lever acting upon said gearing to reverse the direction of rotation of said shaft, arms mounted upon a common pivot and extending upon opposite sides of the reversing-lever, and connections between said arms and the reversing-gearing for actuating the arms, each of said arms being provided with a series of bolt-holes arranged to register successively with the corresponding holes in the other arm when the arms are adjusted toward and from each other.

11. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a reversing-lever acting upon said gearing to reverse the direction of rotation of said shaft, arms mounted upon a common pivot and extending upon opposite sides of the reversing-lever, one of said arms being extended over the other and being adjustable about said pivot, means for securing said arms together, and connections between said arms and the reversing-gearing for actuating the arms.

12. A tube-scraper-driving mechanism for fuel-economizers, having, in combination, a



chain-pulley, a shaft geared thereto, reversing-gearing for driving said shaft alternately in opposite directions, a driving-pulley, a worm-shaft driven thereby, a bracket provided with journal-boxes integral therewith in which the worm-shaft is mounted, cylindrical bushings in the journal-boxes, a worm keyed to the worm-shaft between the journal-boxes, a worm-gear meshing with the worm,

and connections for transmitting the motion 10 of the worm-gear to the reversing-gearing.

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

ERNEST B. FREEMAN.

Witnesses:

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