PATENTED FEB. 12, 1907.

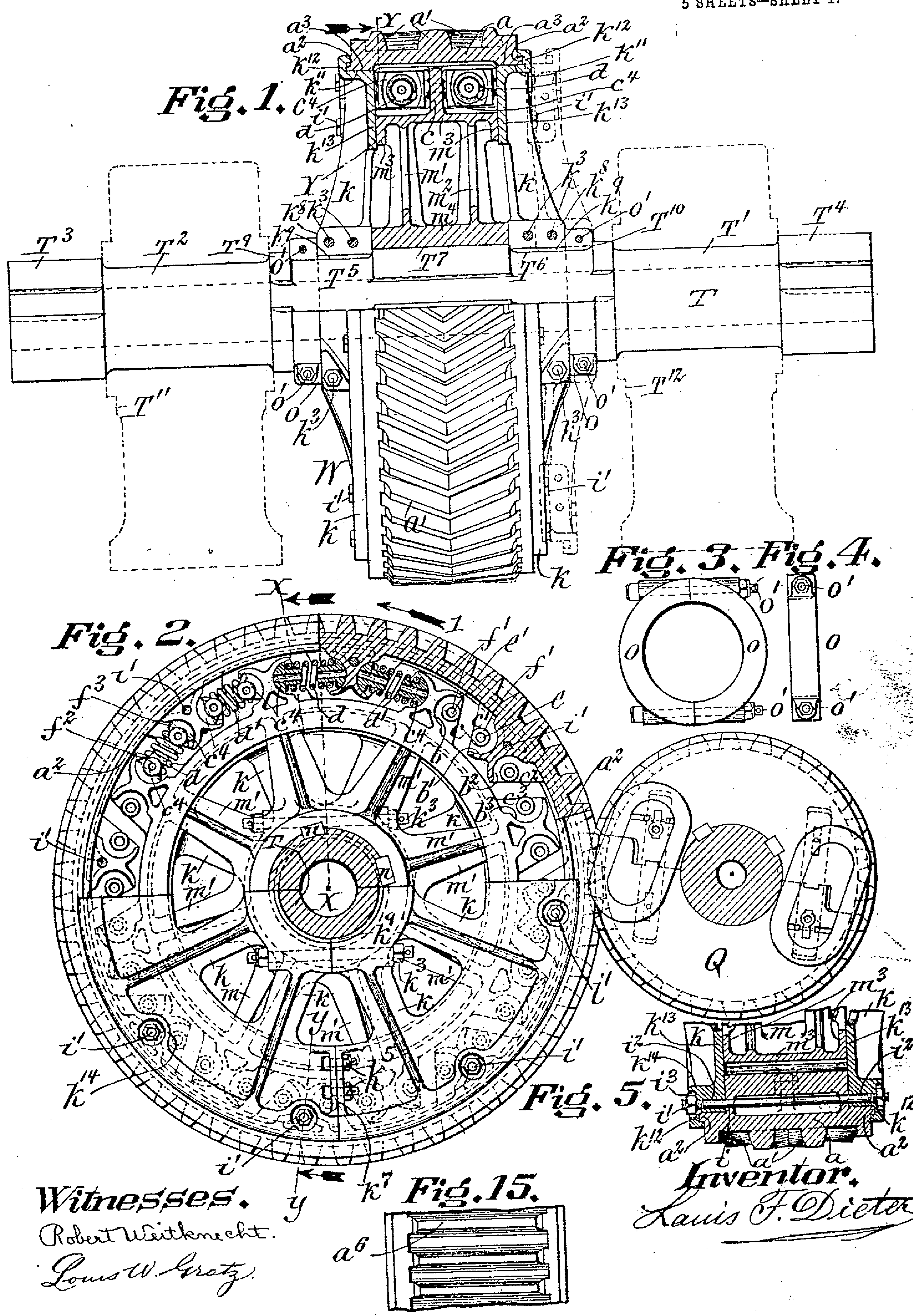
No. 844,261.

L. F. DIETER.

ELASTIC GEARING.

APPLICATION FILED SEPT. 28, 1903.

5 SHEETS—SHEET 1.



Witnesses.
Robert Weitknecht.
Louis W. Gratz.

Inventor.
Louis F. Dieter

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5 SHEETS—SHEET 2.

Fig. 6.

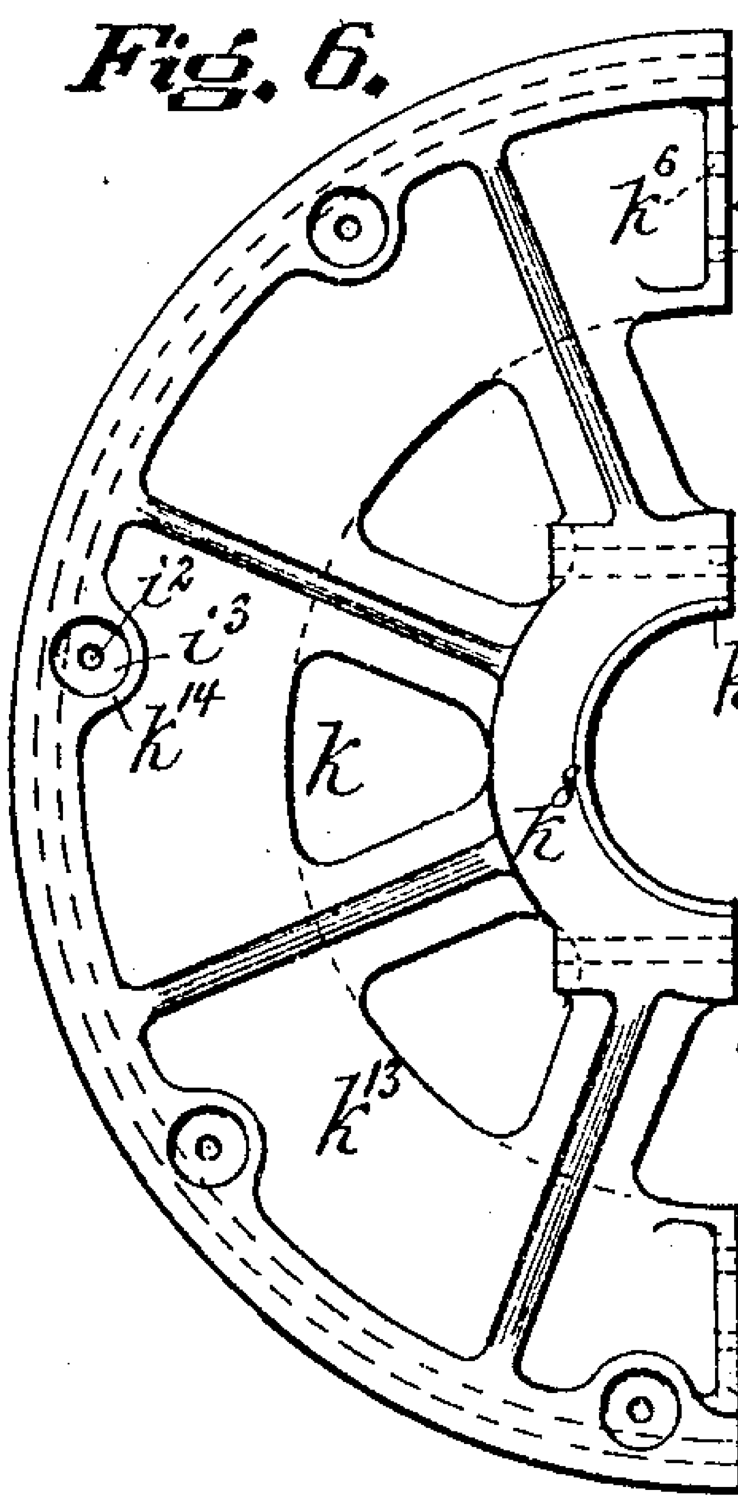
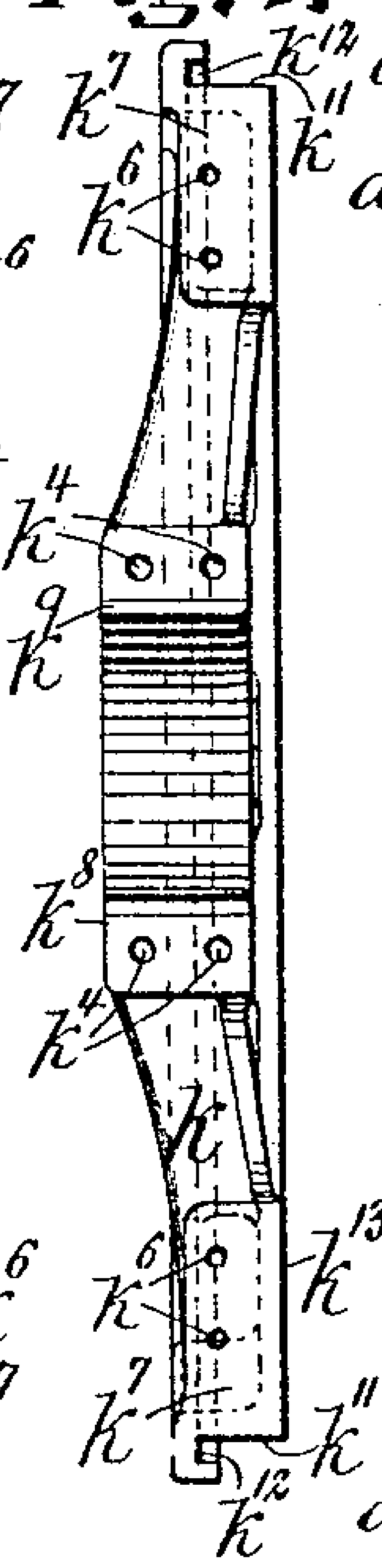


Fig. 7.



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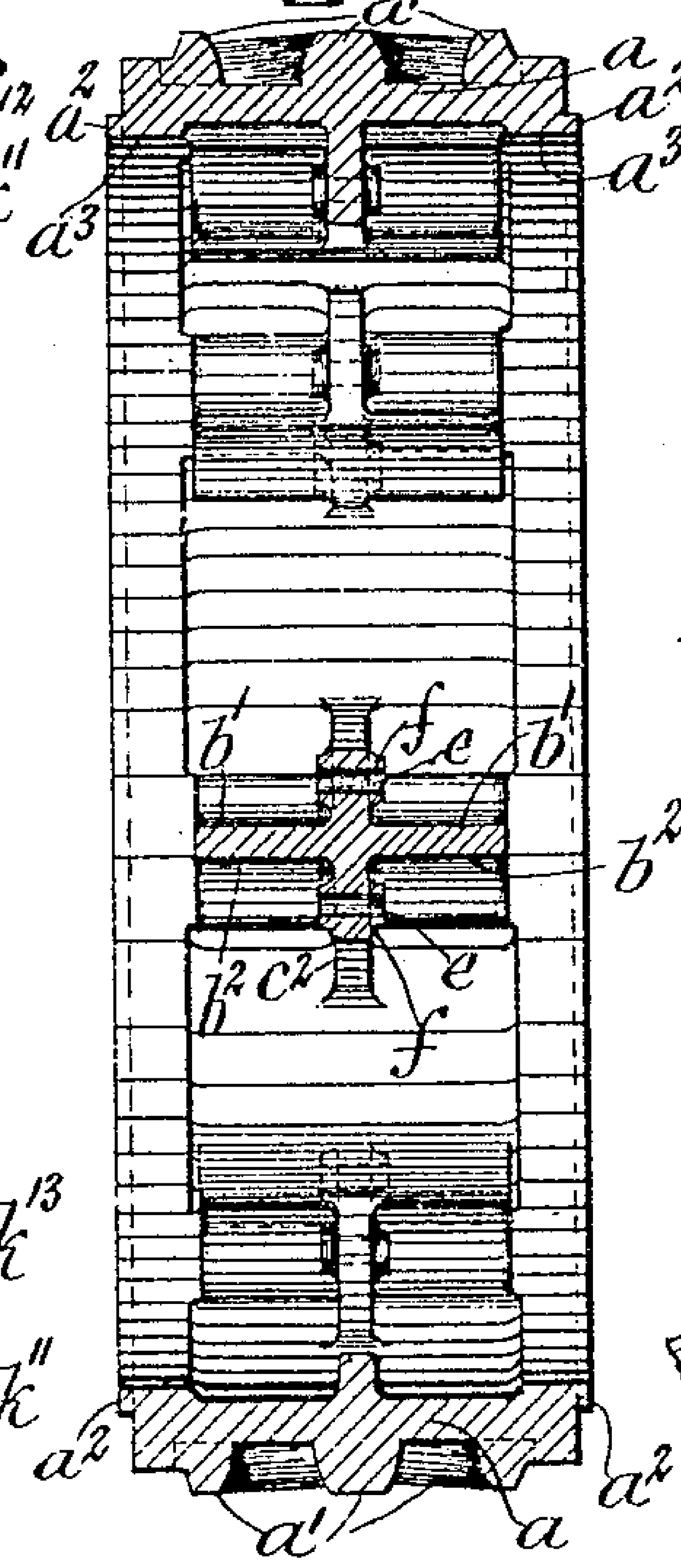


Fig. 9.

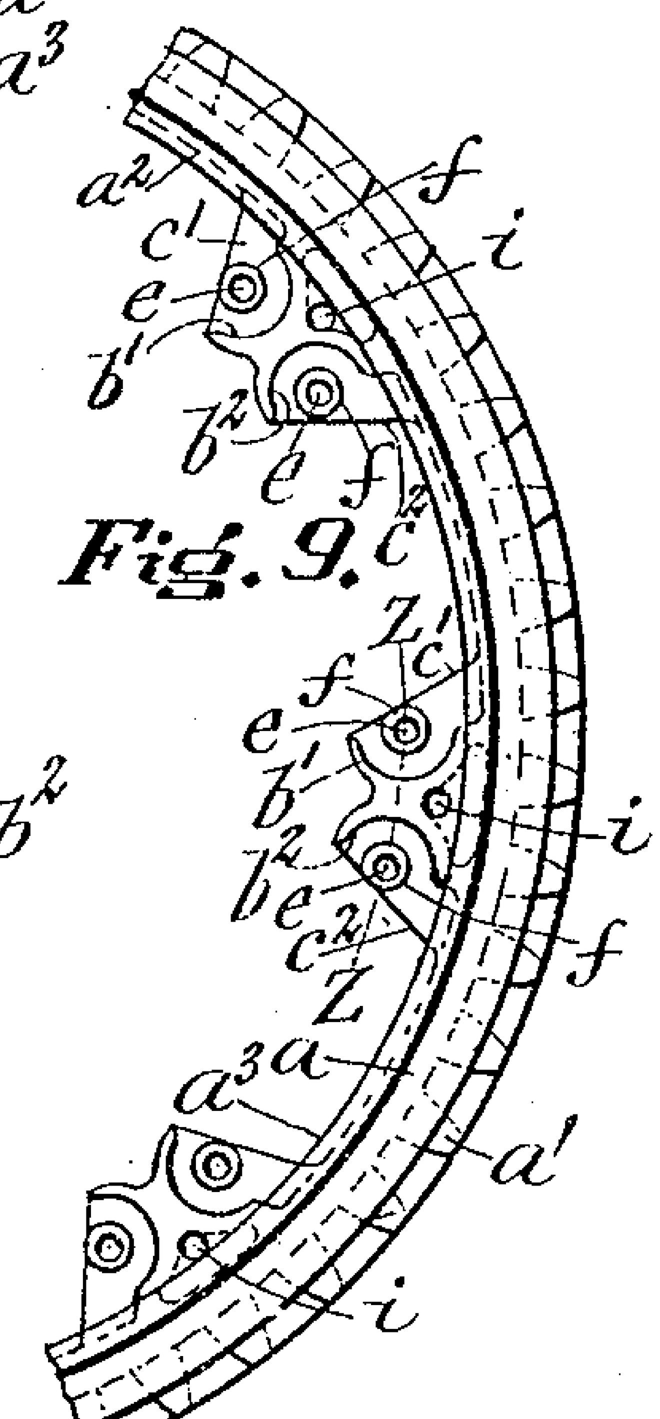
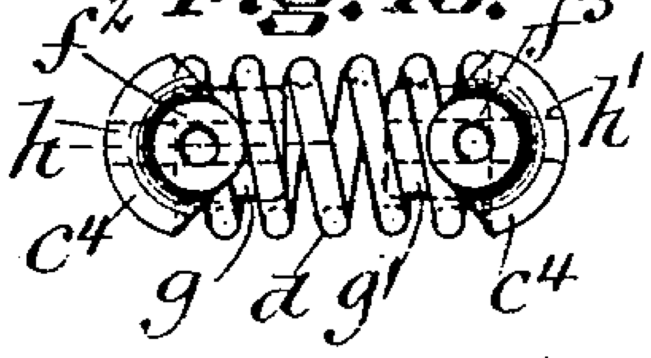


Fig. 10.



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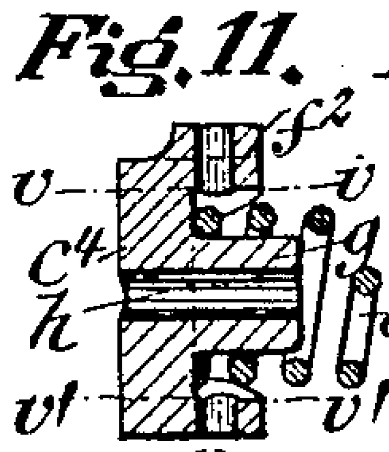

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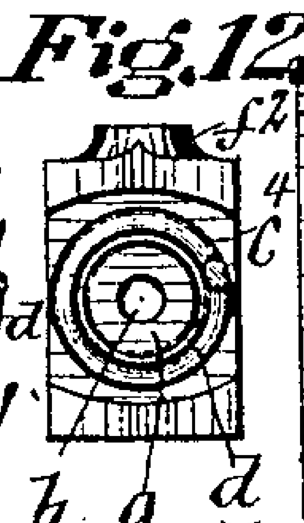

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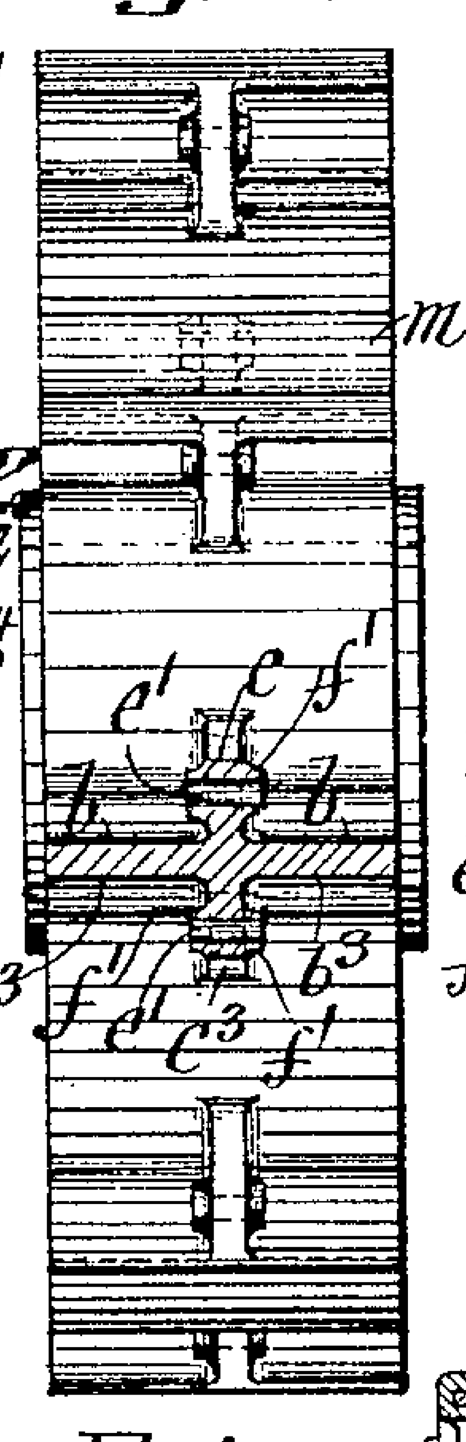
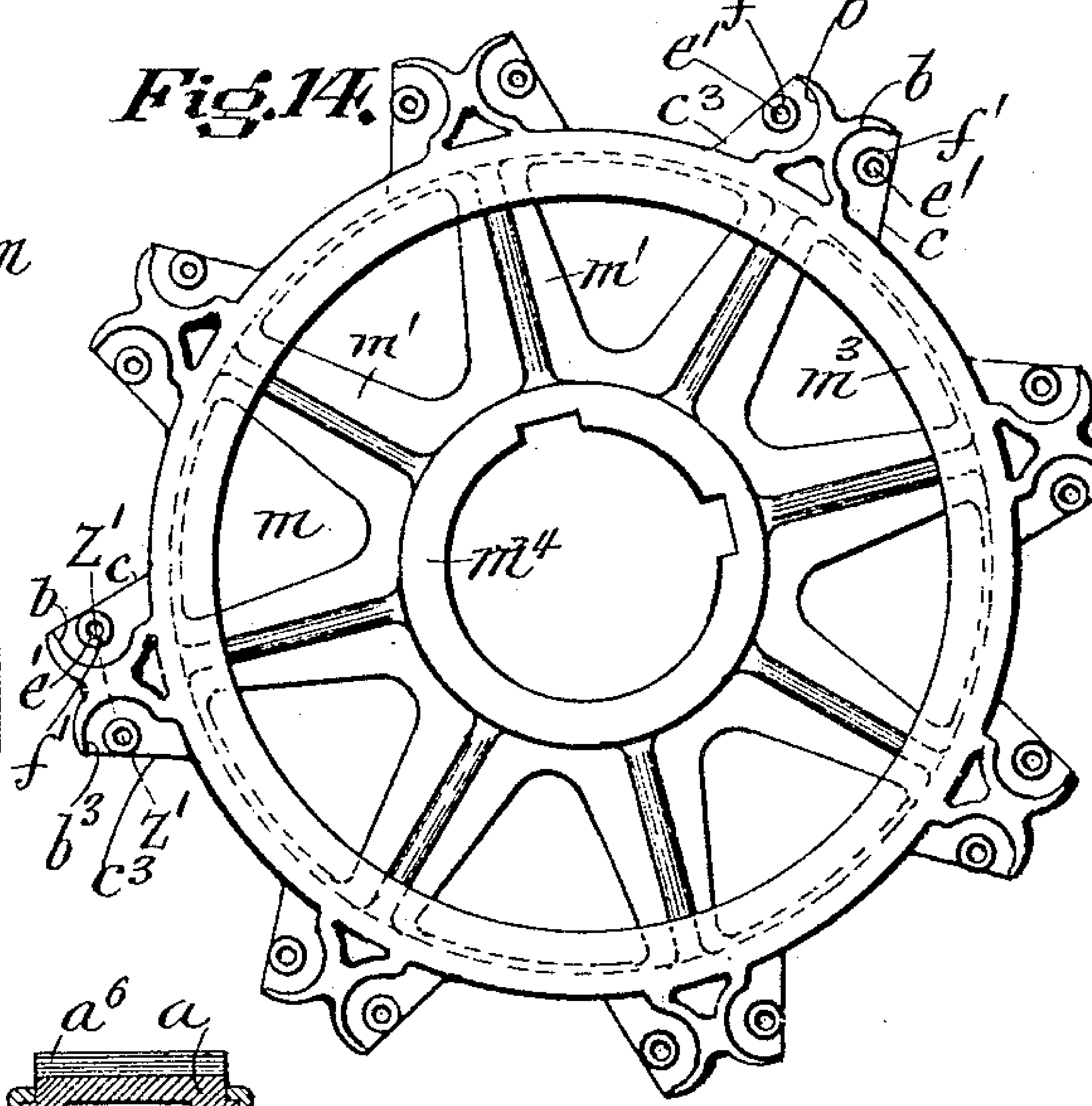


Fig. 14.



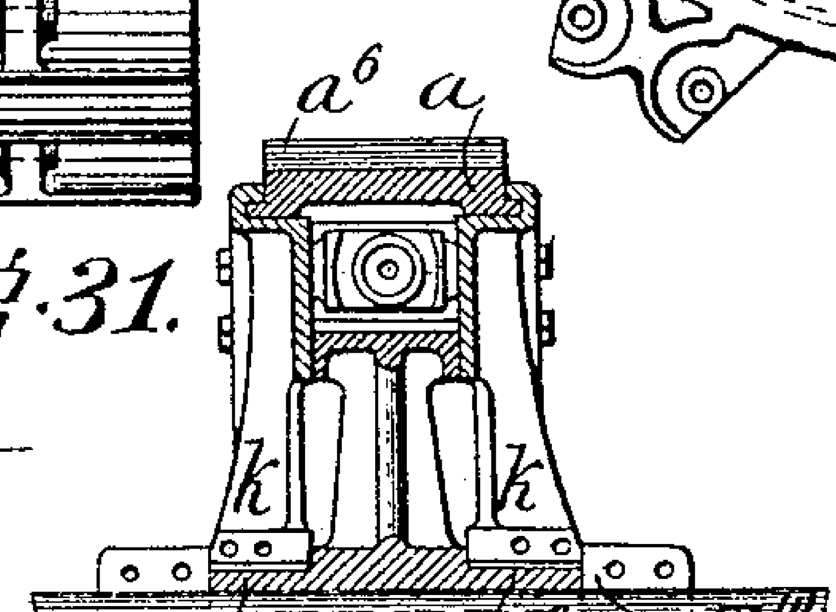


Fig. 31.

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No. 844,261. PATENTED FEB. 12, 1907.

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5 SHEETS—SHEET 3.

Fig. 16.

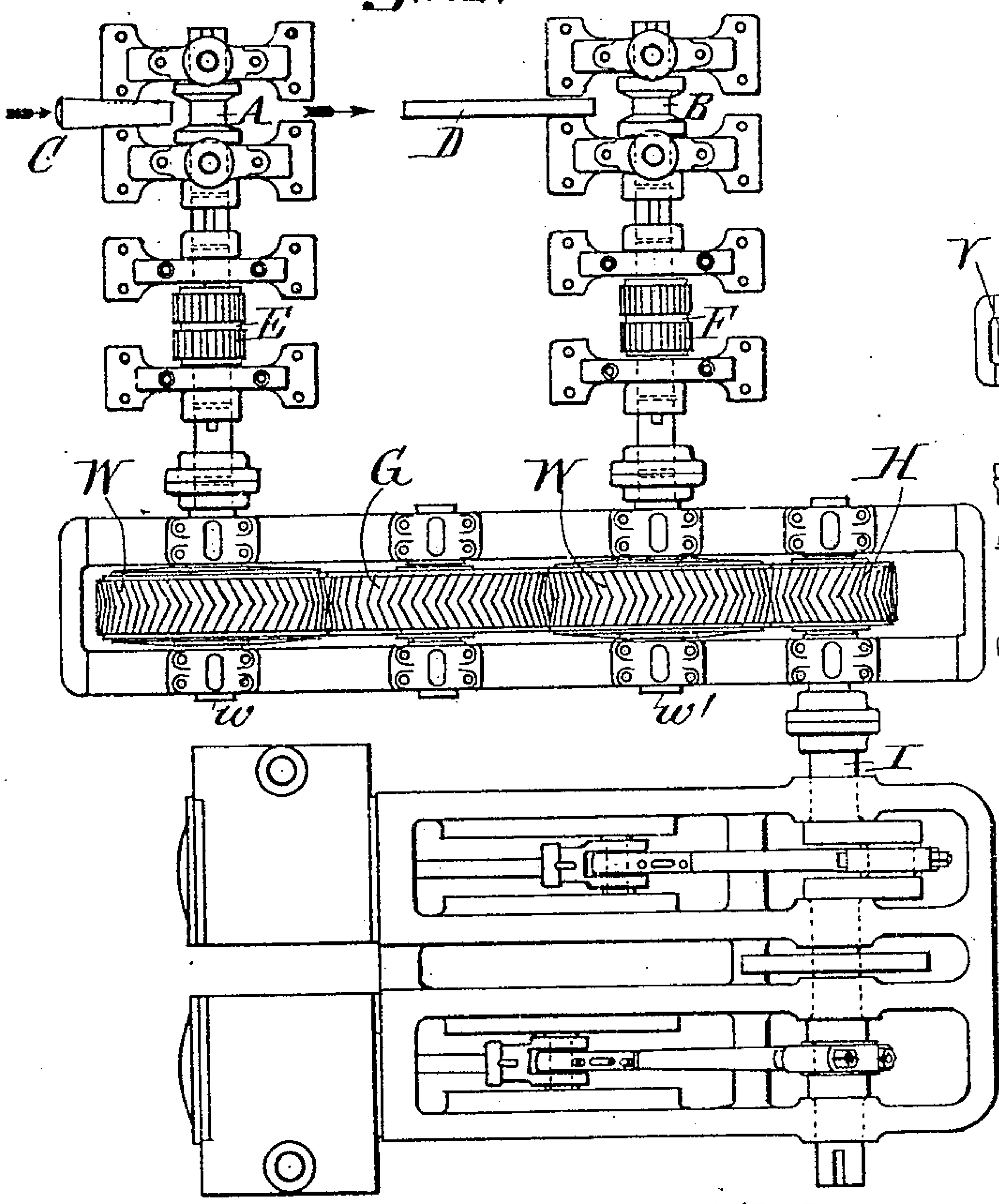


Fig. 18.

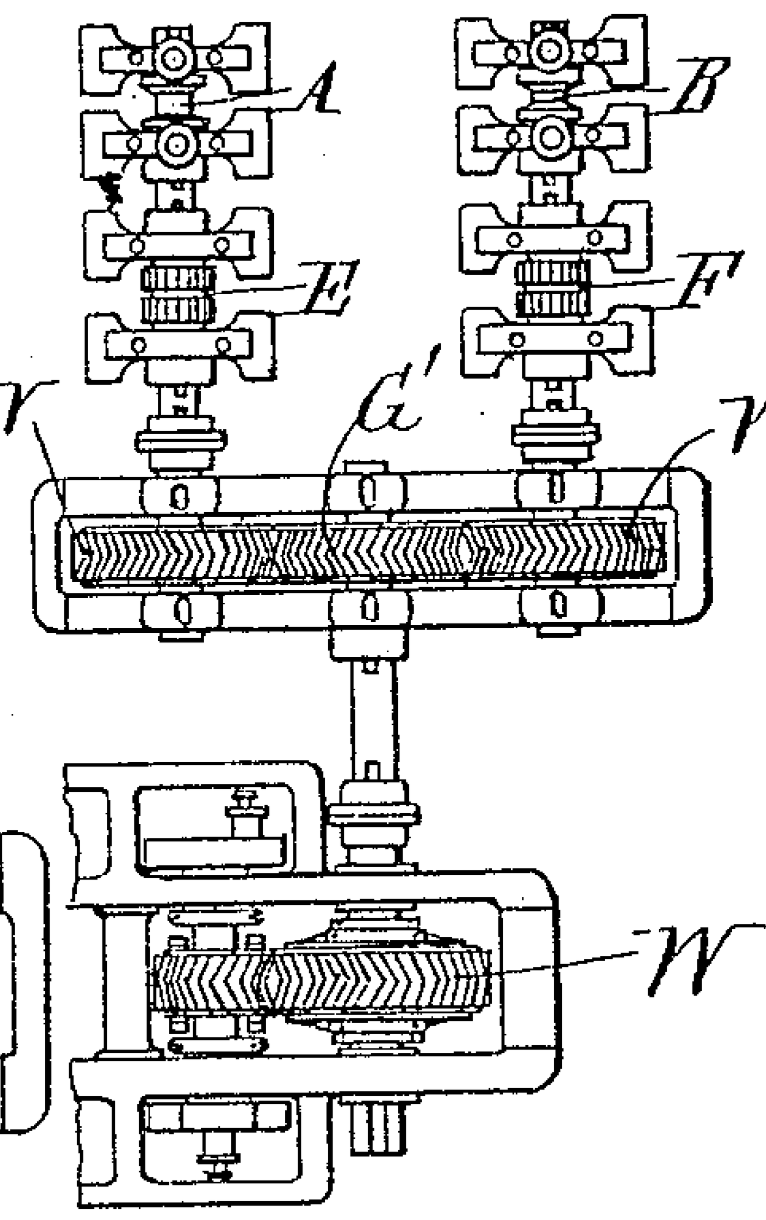


Fig. 20.

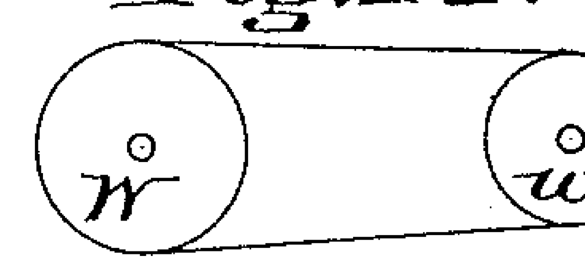


Fig. 21.

Fig. 17.

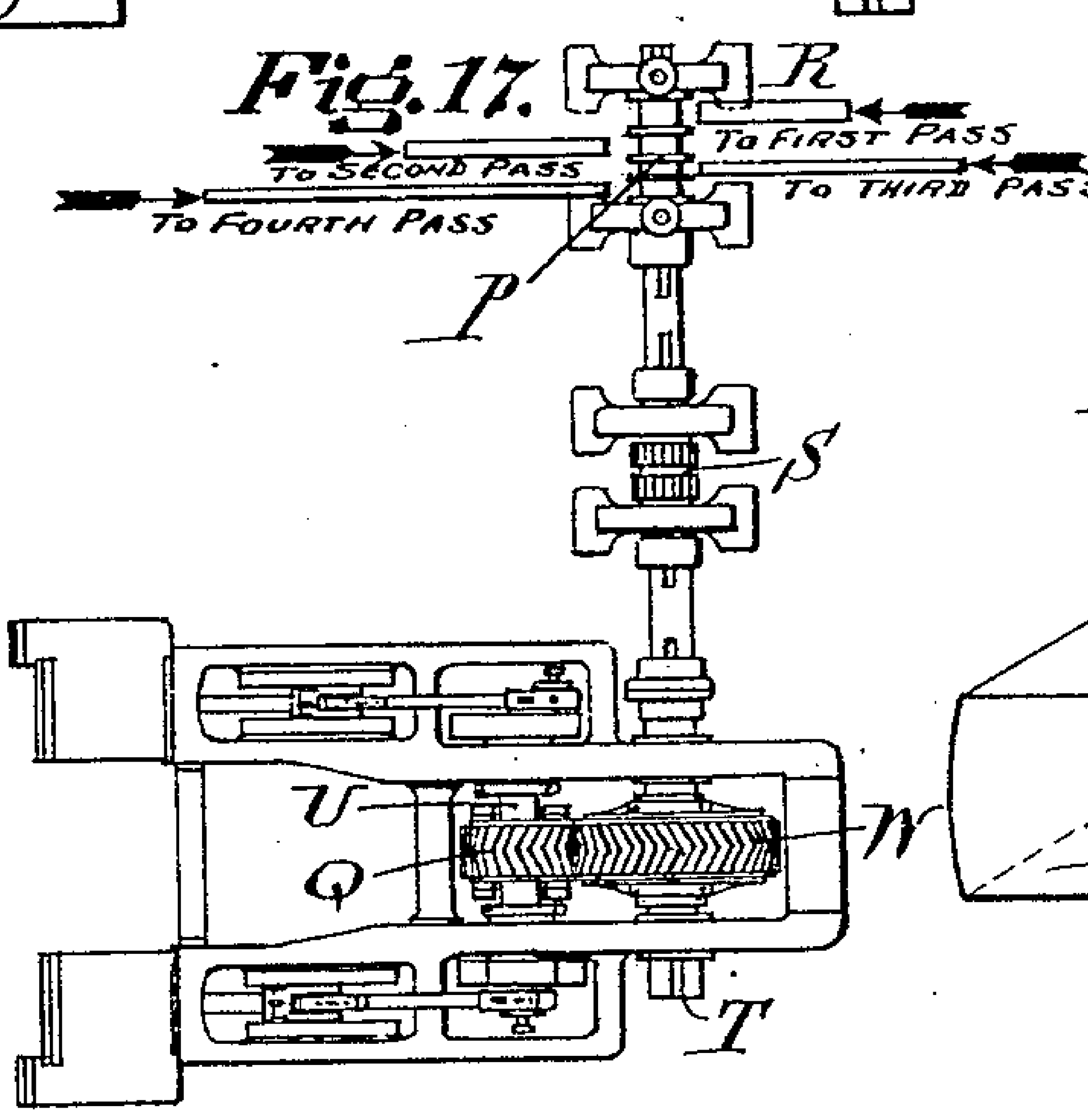
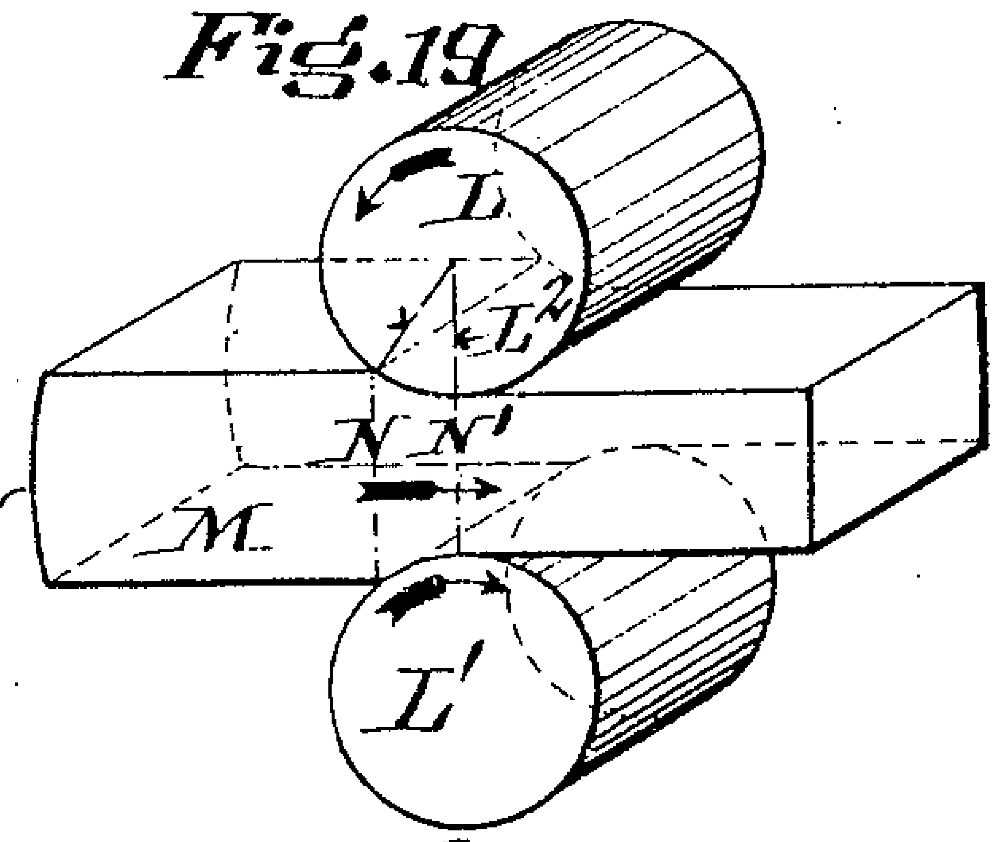


Fig. 19



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5 SHEETS—SHEET 4.

Fig. 22.

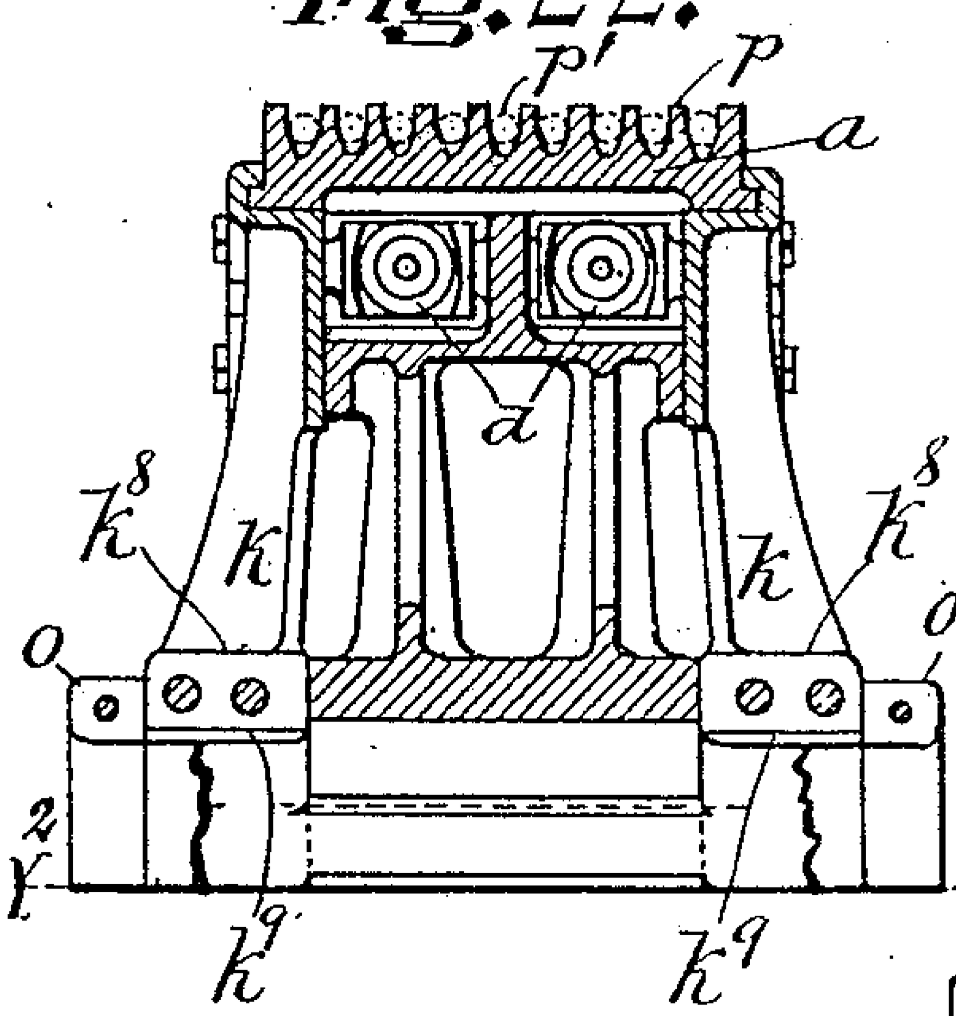


Fig. 23.

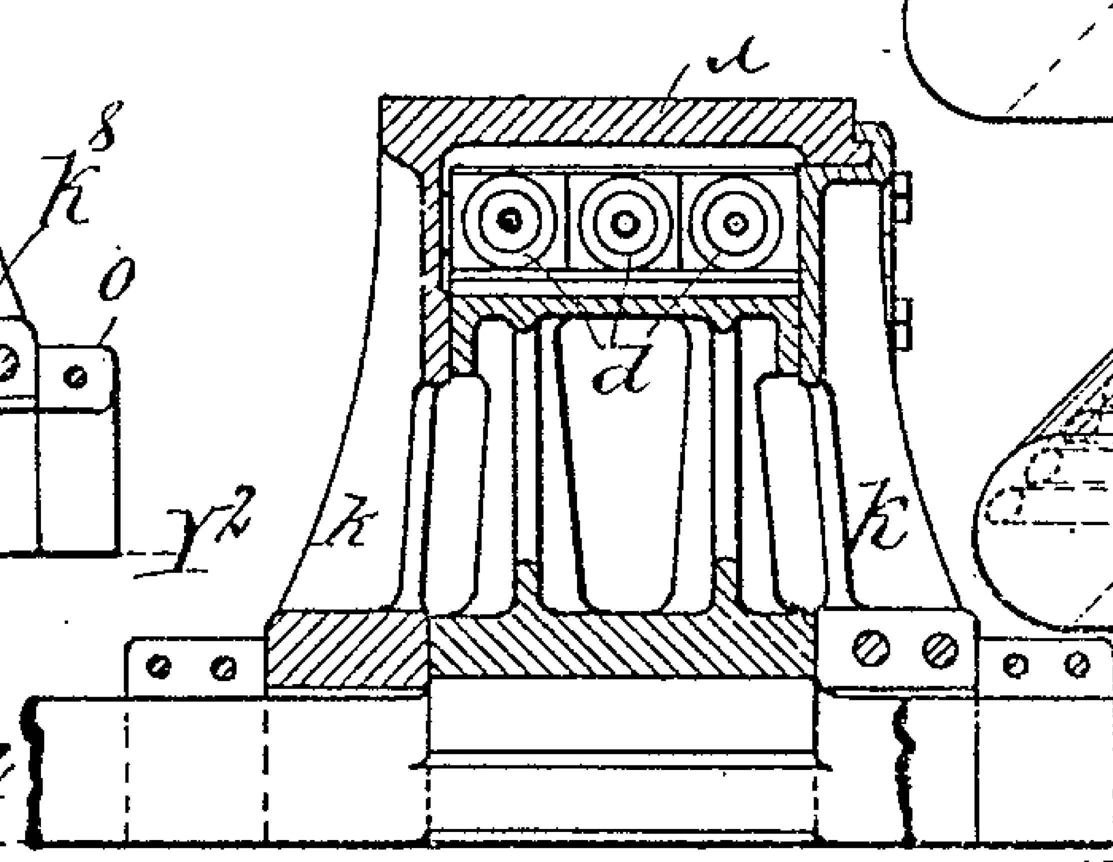


Fig. 27.

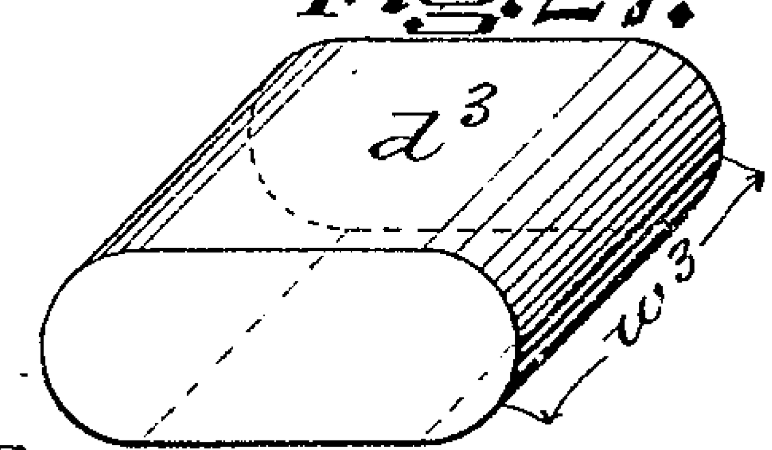


Fig. 28.

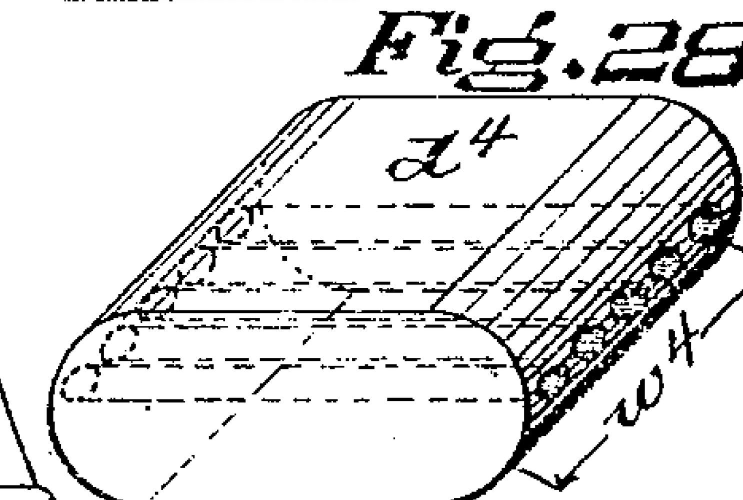


Fig. 29.

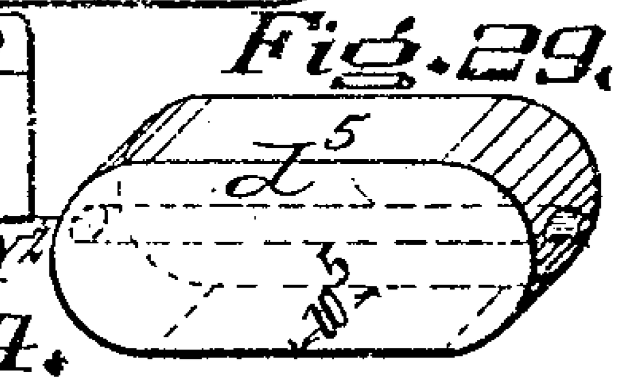


Fig. 25.

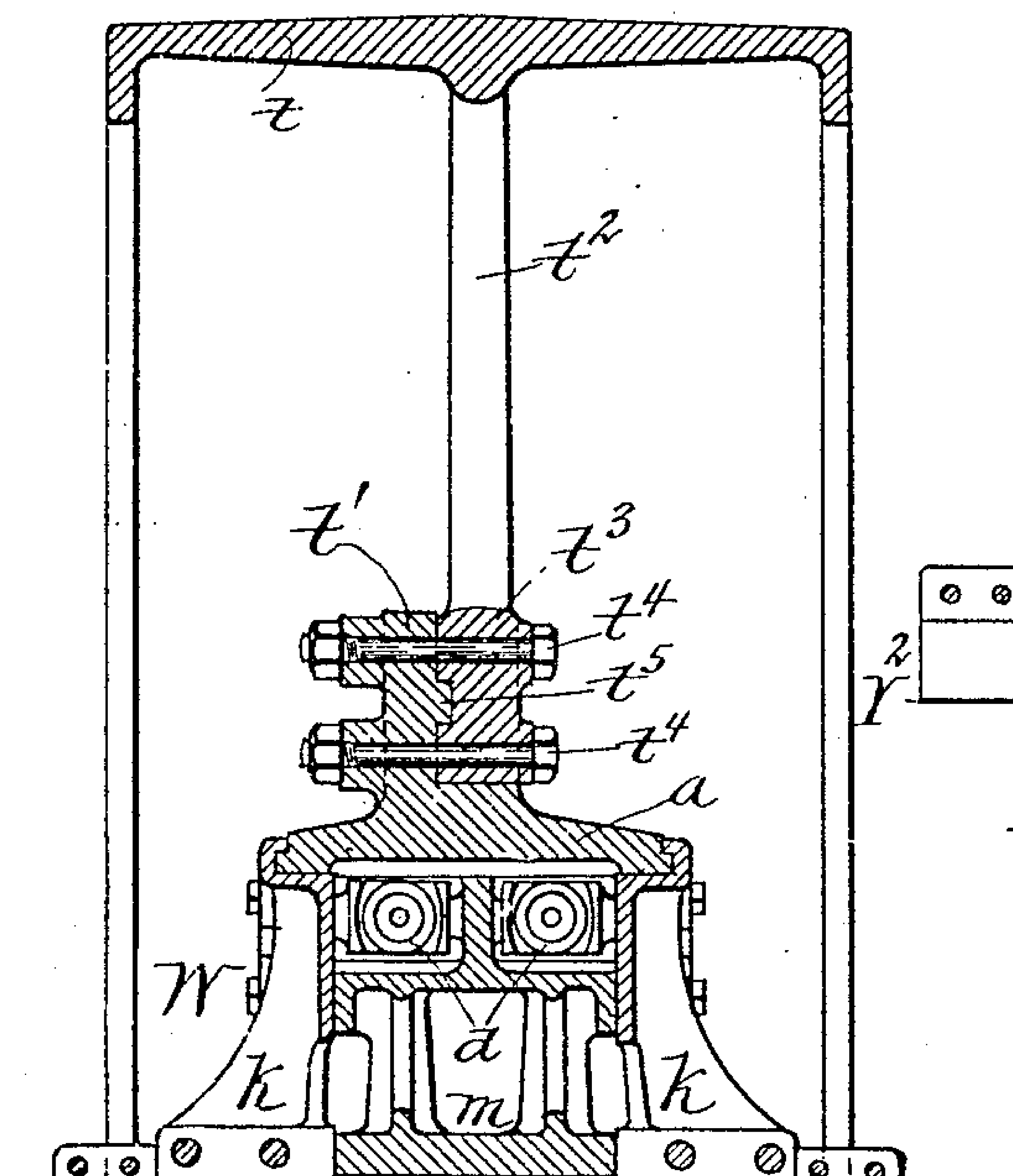


Fig. 24.

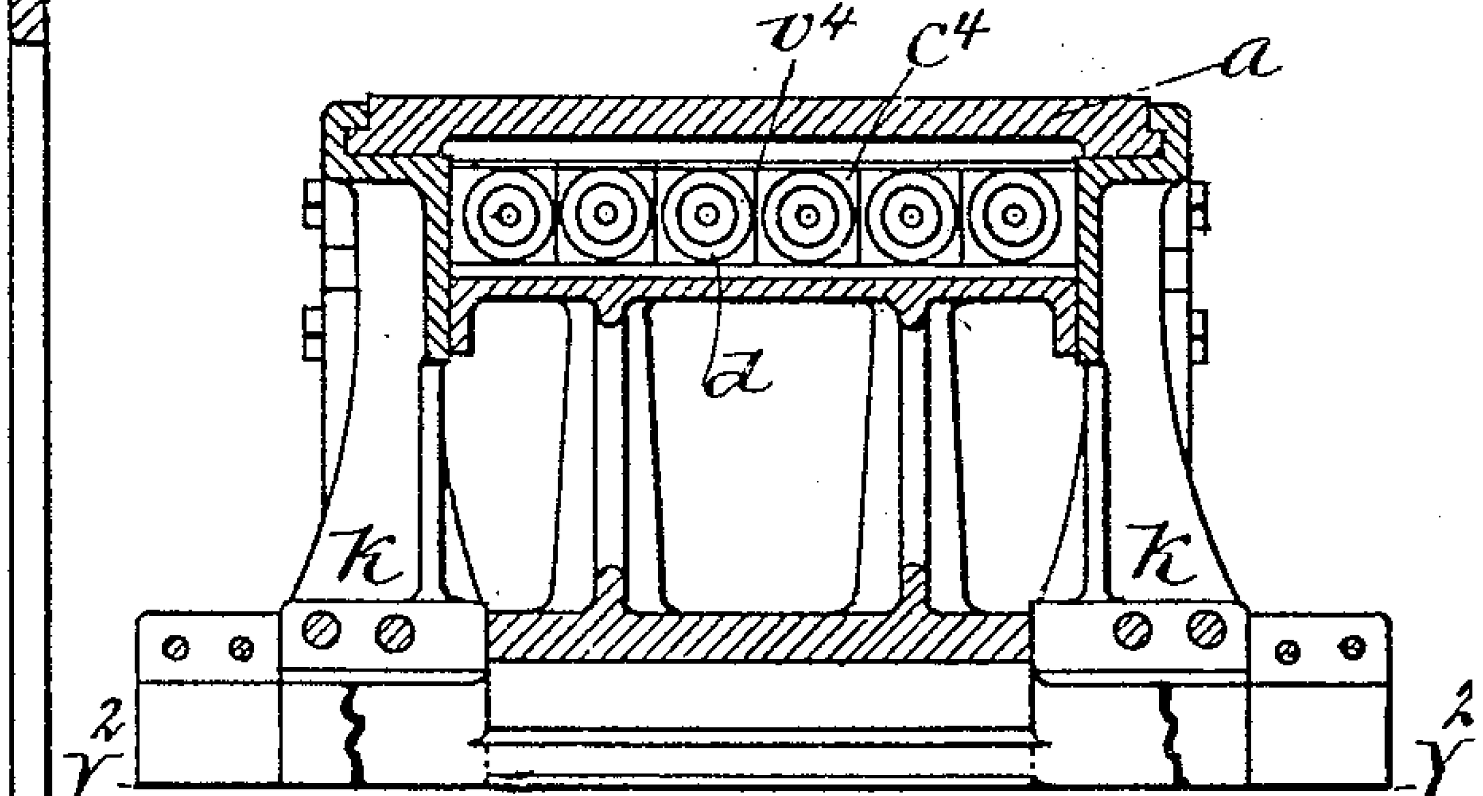
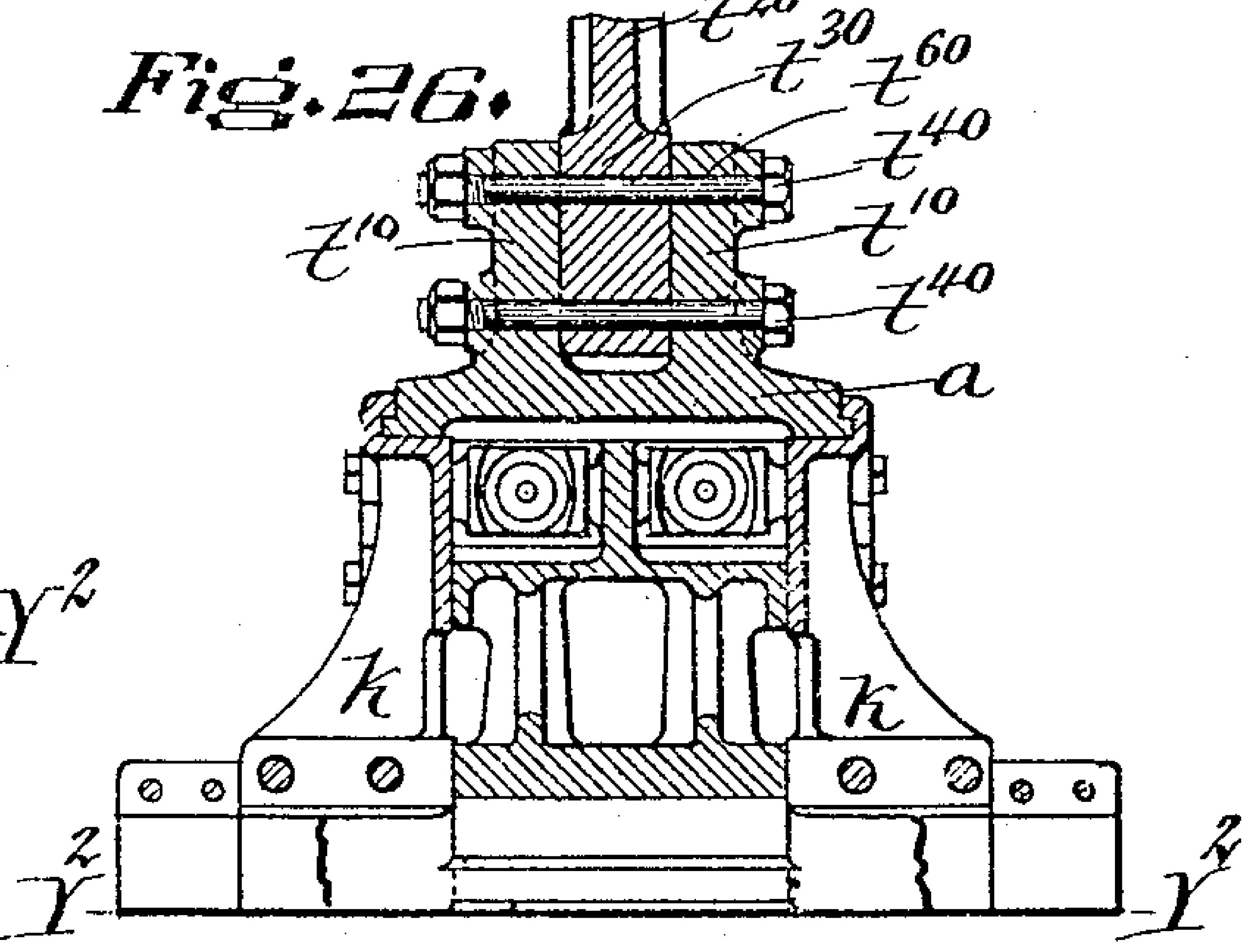


Fig. 26.

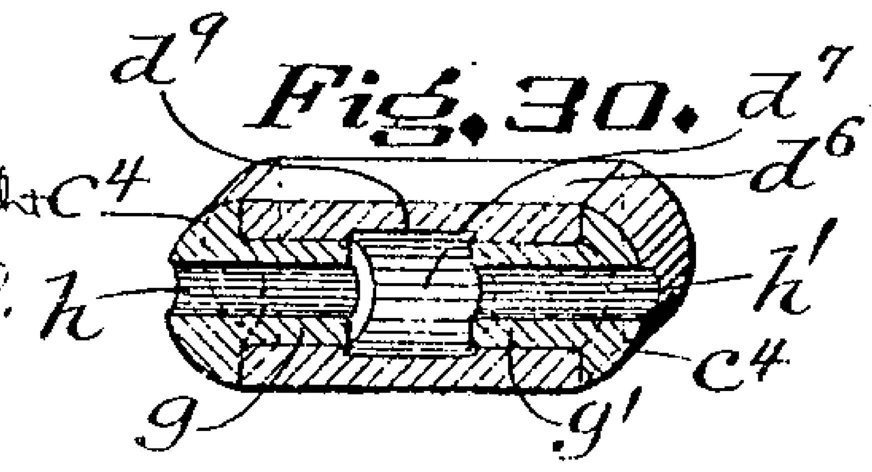


Witnesses.

Robert Weitknecht

Louis W. Gratz.

Fig. 30.



Inventor.

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ELASTIC GEARING.

APPLICATION FILED SEPT. 28, 1903.

5 SHEETS—SHEET 5.

Fig. 32.

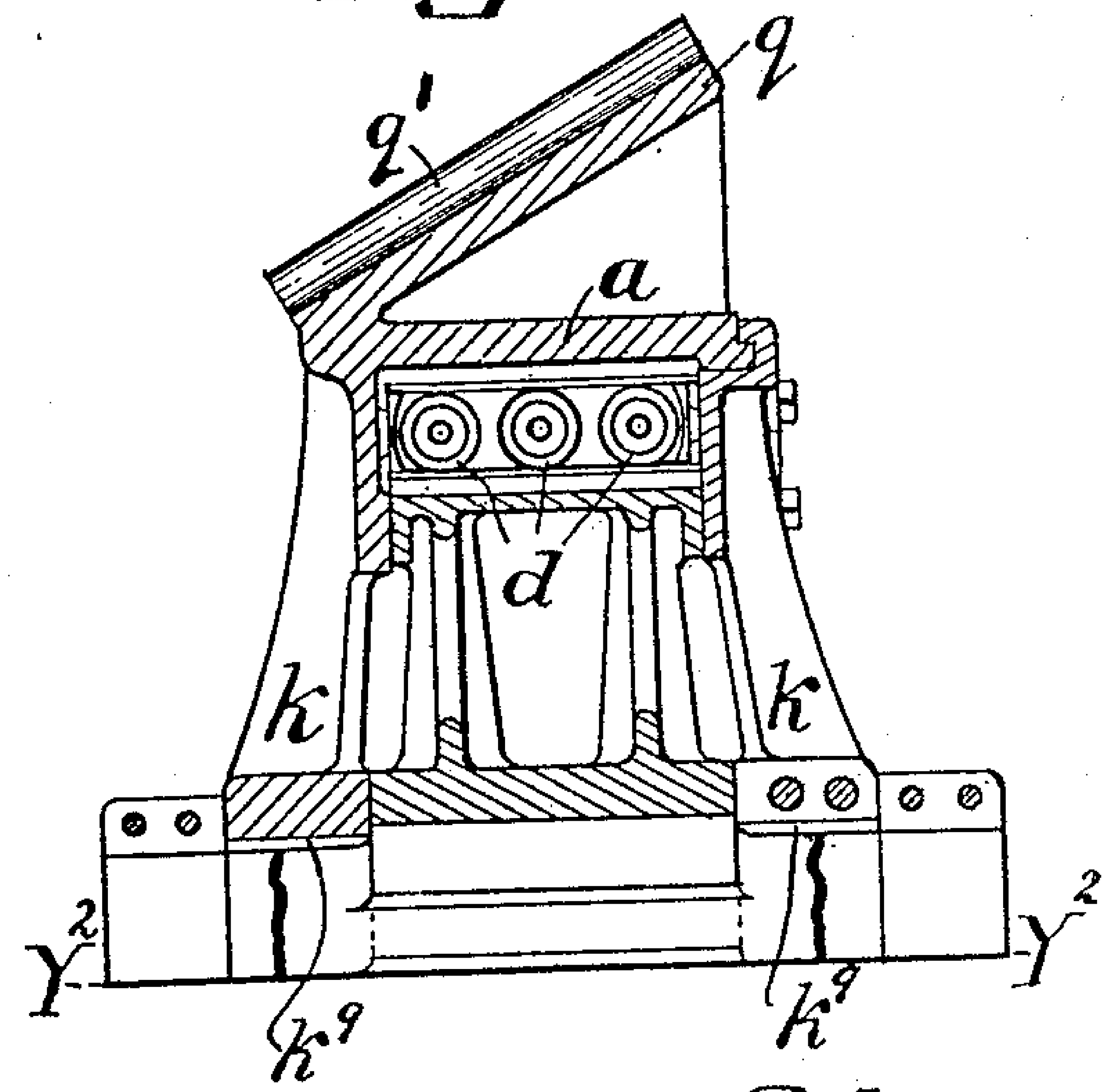


Fig. 33.

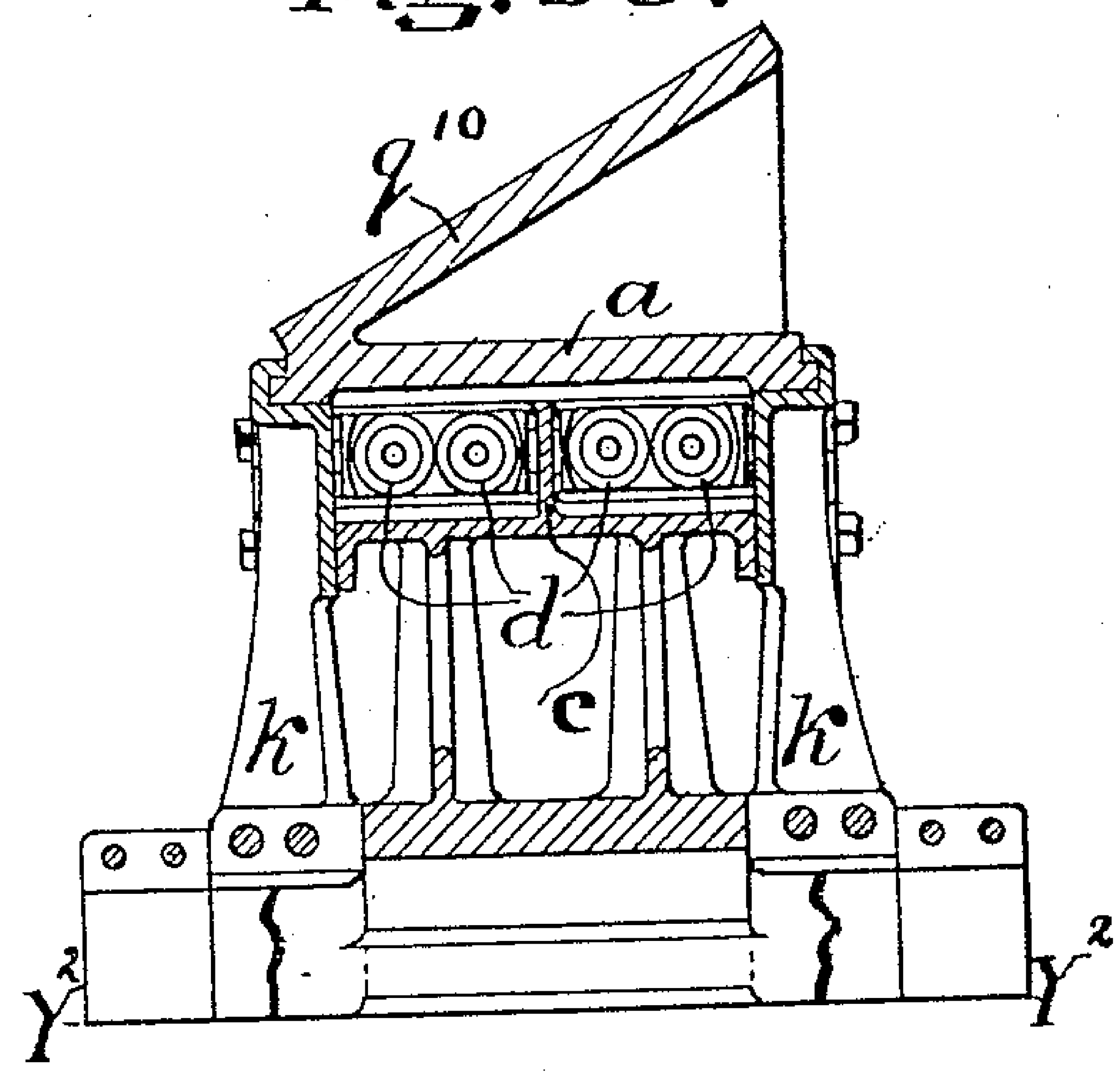


Fig. 34.

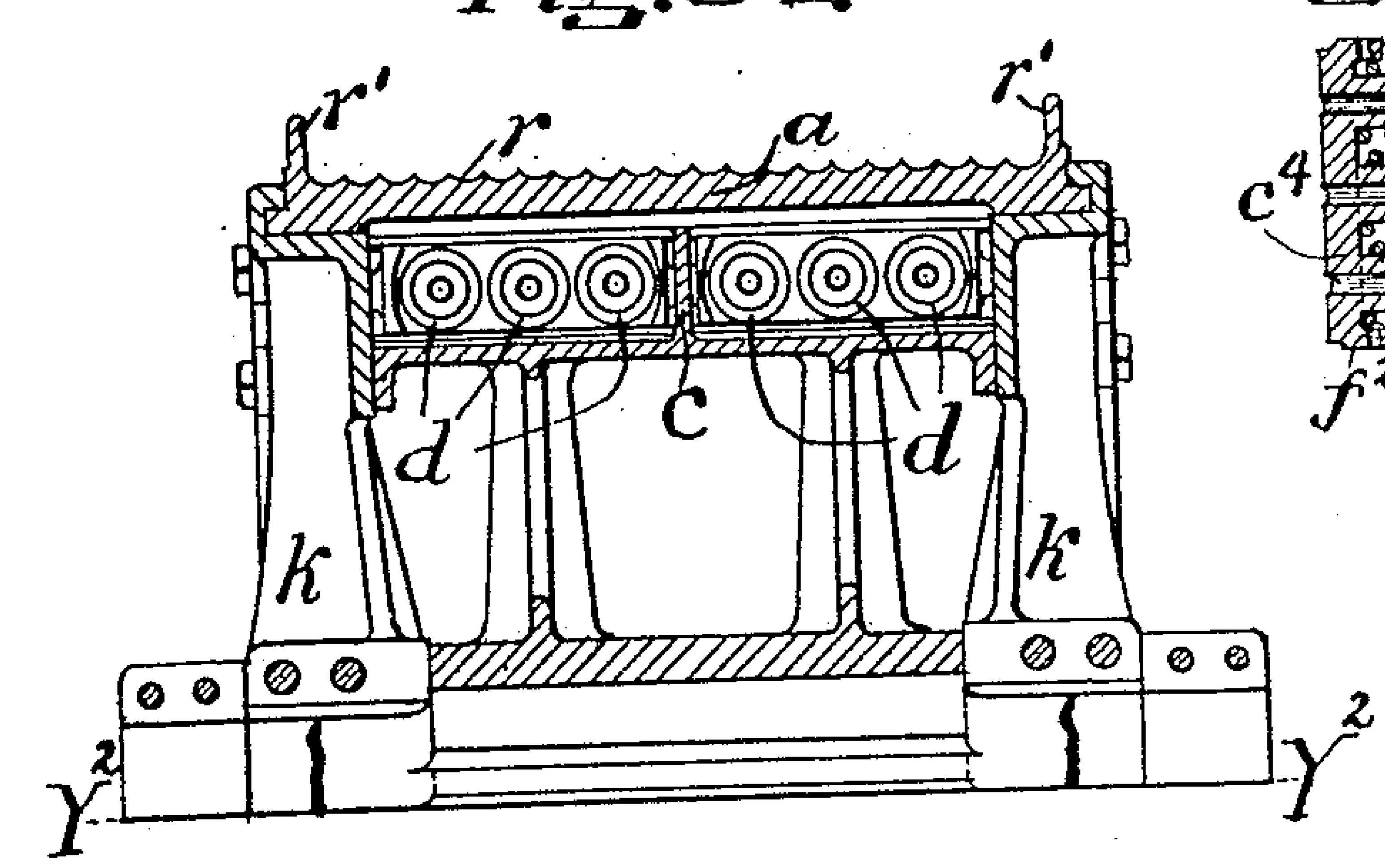
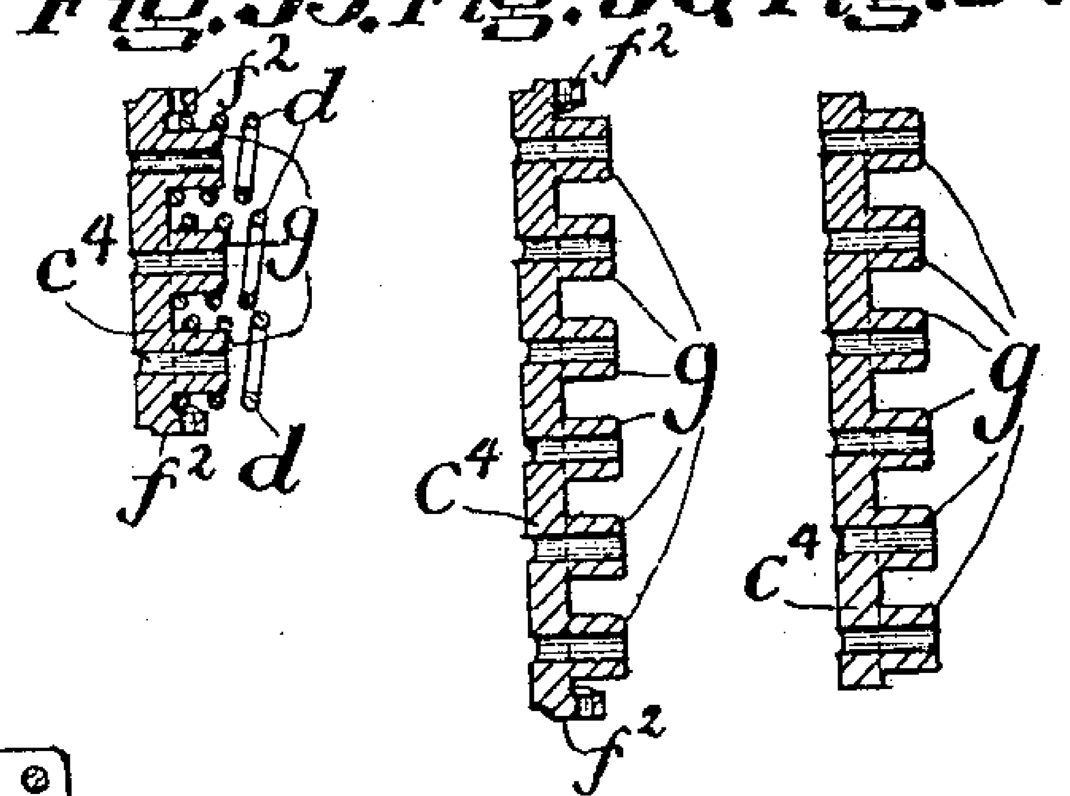


Fig. 35. Fig. 36. Fig. 37.



Witnesses.

Louis W. Gratz.

Robert Weitknecht.

Inventor.

Louis F. Dieter.

UNITED STATES PATENT OFFICE.

LOUIS F. DIETER, OF BUFFALO, NEW YORK.

ELASTIC GEARING.

No. 844,261. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed September 28, 1903. Serial No. 174,951.

To all whom it may concern:

Be it known that I, LOUIS F. DIETER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Elastic Gearing, of which the following is a specification.

My invention relates to improvements in elastic or yielding gears adapted for use in power transmission for all purposes where elastic gear is desired and which especially is of great benefit in transmitting the power to the rolls of mills for rolling rails, bars, plates, &c.

The objects of my improvements are to provide an elastic gear which, first, will not take up much more space than a common gear; second, is strong but light in weight; third, is very sensitive in action and wherein the friction between relatively movable parts is reduced to a minimum and wherein the parts when worn can be easily renewed; fourth, has the total load on the springs equally divided, so that each spring practically carries as much load as the other; fifth, has a rim and rim-supports combined in such a way that they will practically form and act as one piece; sixth, has a rim wholly and substantially supported by the shaft or the hub of the center portion or anywhere around the axis of the shaft; seventh, from which the springs or the connections between the center portion and rim can be taken out or exchanged without disturbing the rim or the center portion; eighth, that can be profitably manufactured in all sizes for light as well as heavy work; ninth, has a rim that can be formed around its periphery or outer circumference in any shape to suit any kind of toothed-gear drive, belt-drive, or any other kind of drive that may be required; tenth, has the pockets for the springs formed in such a way that metallic as well as non-metallic springs may be used; eleventh, has a rim that can be arranged for lateral oscillating play to enable double helical teeth that are not in perfect alinement to run satisfactorily; twelfth, can be arranged after it is all completed to rotate continuously in either direction or alternately in opposite directions, as the requirements may be in a reversible transmission; thirteenth, can be constructed in such a way that the rim-supports of one side can be cast in one piece with the rim; fourteenth, can take the place of the hub of a band-wheel or a fly-wheel to receive the shock or strain liable to be caused by short-circuiting in electric generators, &c., and that otherwise would come entirely on the rim and arms of the fly-wheel or band-wheel, as the case may be, and cause bursting of the same.

In the accompanying drawings, consisting of five sheets, Figure 1 is a sectional end or face view of a gear-wheel with double helical teeth embodying my invention and mounted on a suitable shaft, the lower half of the wheel being shown in elevation and the upper sectional half being taken in line x x, Fig. 2. Fig. 2 is a sectional side elevation of the wheel in connection with a driving-pinion. Some of the springs with their end pieces are shown in elevation and some in section, the upper portion of the rim-supports being cut away and the rim being shown partly in section through line Y Y, Fig. 1. Figs. 3 and 4 are side and face views, respectively, of one of the retaining-collars of the wheel. Fig. 5 is a section of the wheel in line y y, Fig. 2. Fig. 6 is a side elevation of one-half of one of the rim-supports. Fig. 7 is an elevation of the same viewed from its straight diametrical face. Fig. 8 is a central section of the rim parallel with its axis, one set of spring-pockets being shown in section on the line Z Z, Fig. 9. Fig. 9 is a fragmentary side elevation of the rim. Fig. 10 is an enlarged side elevation of one of the springs and its end pieces. Fig. 11 is a longitudinal section of part of one of said springs and an end piece. Fig. 12 is an end elevation thereof. Fig. 13 is a face view of the center portion of the wheel, one of the pocket-lugs being shown in section in the line z' z', Fig. 14. Fig. 14 is a side elevation of said center portion. Fig. 15 is a fragmentary face view of the rim, showing a modification of the teeth or the transmitting means. Figs. 16, 17, and 18 are top plan views of rolling-mills, showing different applications of my improved gear. Fig. 19 is a perspective vew of a pair of rolls and an ingot, illustrating the resistance to be overcome by the engine and gears. Fig. 20 is a diagram showing my improved elastic gear in connection with a belt or rope gear-drive. Fig. 21 is a similar view showing the same in connection with a friction-gear drive. Figs. 22 to 26, inclusive, are diametrical sections of one-half of the improved gear, showing modified constructions of the rim adapted to different kinds of power transmissions. Figs. 27, 28, and 29 are perspective views of modified constructions of the springs or cushions. Fig. 30 is a sectional perspective view of one of said springs or cushions, showing the same provided with end pieces. Fig. 31 is a diametrical section of one-half of the gear, showing another modification. Figs. 32 to 34, inclusive, are sections of one-half of my improved elastic gear, showing other modifications. Figs. 35 to 37, inclusive, are sections of the spring end piece, showing modifications.

Similar letters of reference indicate corresponding parts throughout the several views.

In the drawings, W represents a complete elastic wheel or gear embodying my invention. Referring to Figs. 1 to 15, a is the rim of the gear, which is formed around its outer circumference with double helical teeth, as shown; but these teeth may be omitted and in place thereof the rim may be formed around its outer circumference to suit any other drive—for instance, as shown in Figs. 20 to 26, inclusive, and in Figs. 31 to 34, inclusive. The rim has around its inner circumference pockets b' b^2 to receive the end pieces or trunnions c^4 of the springs d d'. These pockets are formed in a half-circle to permit the trunnions c^4 to turn therein and in the pockets b b^3 of the center portion. Oscillating bearings are thus formed at both ends of the springs, which construction enables the springs to adjust themselves at different angles to correspond to the different degrees of compression, and thus the springs will always be loaded centrally. These pockets are also semicylindrical, so that the springs in all the rows may all be put in from either one side of the wheel or from both sides, as the case may require. In all the figures of the drawings, excepting Figs. 23, 24, 31 to 34, inclusive, two rows of springs are shown. In Figs. 23 and 32 three rows, in Figs. 24 and 34 six rows, and in Fig. 31 one row of springs are shown. In Fig. 33 four rows of springs are shown. Each of the pockets may have a division-piece, as shown by c, c', c^2, or c^3. These division-pieces are of convenience in the manufacture of my elastic gear, for instance, if it should be desired to machine these pockets. In such cases holes e are formed in the division-pieces to fit a suitable boring-bar. A cutter is then fastened into said bar, the outer end of which is guided in said holes while the pockets are machined. Projections f f' f^2 f^3 may be placed in said division-pieces and on the end pieces of the springs central with said pockets and are for the purpose of filling up the space which is not required for the springs and also for convenience in machining those parts of the spring end pieces which fit into the pockets. In cases where all the space of the total length of the pockets is required for springs these projections, including said division-pieces, may be entirely left off. The parts at the ends of the end pieces for the springs may also be cut off to the dotted lines v v and v' v', Fig. 11, as shown in Figs. 23 and 24, which construction will give only enough space to permit the necessary play of the springs.

The end pieces or trunnions for the springs, as shown in Figs. 10, 11, 12, 35, 36, and 37, have cylindrical projections g g', which fit loosely into the inner ends of the helical springs shown and are for the purpose of keeping said springs central with said end pieces. These projections may also form stops for limiting the compression of the springs. If it is desired that the wheel shall have a limited range of elasticity and be rigid beyond that range, the projections are made of the proper length to come together when the desired compression of the springs is reached. The power will thereupon be transmitted partly through the compressed springs and partly through the abutting projections, and no further yield of the wheel will take place.

The holes h and h' may be used in putting the springs partly into their pockets. Before the springs are put into their pockets they will be longer than the normal distance between their pockets.

The rim a has two annular projections a^2 a^2, one on each side, two annular supporting-surfaces a^3 a^3, each extending from the outer edge to nearly the ends of the spring-pockets, and holes i for bolts i'. These bolt-holes are placed near the inner circumference of the rim between the pockets b' b^2, which will permit the use of sufficiently large bolts to securely fasten the rim a to annular supports k by means of the bolts i' without having these bolts interfere with the free rotary or oscillating movement of the rim over the springs d d' and the center portion m of the gear. This arrangement of the bolts provided a broad supporting-surface on the rim against the supports k near said bolts for the proper fastening of the rim to said supports. The rim a is held against lateral displacement and central to the axis of the shaft by the two annular supports k. Each of these supports consists of similar parts or halves, as shown in Figs. 1, 2, 6, and 7, bolted together at the hub by means of bolts k^3, passing through holes k^4, and near the outer circumference by bolts k^5, passing through holes k^6 in flanges k^7. Each of these supports when so bolted together practically forms one piece. The hubs k^8 are bored centrally to receive linings k^9, which form the bearings for the journals T^5 and T^6, formed on the shaft T, as seen in Fig. 1. The linings k^9 are firmly held by the hubs k^8, thus forming substantial bearings. These hubs k^3 and linings k^9 can easily be made any length suitable for any desired amount of bearing-surface. In case these linings become worn they can easily be replaced with new ones.

Around the outer circumference of the supports k is formed an annular supporting-surface k^{11}, fitted into the annular part a^3 of the rim, and also an annular groove k^{12}, fitted over the annular projection a^2 of the rim, both central and true to the axis of the shaft T. Annular flanges k^{13} on the supports k hold the springs against lateral movement. These supports, each consisting of halves, as before mentioned, are provided near their outer circumference with bosses k^{14}, which have holes i^2 in line with the bolt-holes i of the rim. Said holes i^2 are countersunk at the outer side to receive the nuts of said bolts, as shown at i^3 in Fig. 5. The annular flanges a^2 a^2, one on each side of the rim a, and the annular grooves k^{12} are for the purpose to stiffen the rim a and to strengthen this joint, so that it will resist all possible forces from any kind of drive. The rim and rim-supports, when so bolted together are combined in such a way and for the purpose that they will practically form and act as one piece, and thus form a substantial wheel-frame or frame on which, anywhere on its outside, from the hub of one support to the hub of the other support, can be formed or mounted any kind of transmitting gear or wheel—for instance, such as shown by the Figs. 25, 26, 32, and 33. It will be understood that in case wherein the space required between the central bearings k^9 k^9 will be little in comparison to the required width of the rim a and wherein the sides of such rim a will extend over the one or over both the supports k k such annular flange or flanges, as a^2 a^2, will be provided at the inner surface or inner circumference of such rim, and in case that one of the supports is cast in one piece with the rim only one of the supports will be detachably secured to the rim, and in case where a plain joint will be sufficiently strong the annular grooves k^{12} may be omitted.

The rim-supports k k are laterally spaced—that is, they are arranged on or a suitable distance in the opposite sides of the rim a, as the case may require—for the purpose to bring the journals for the bearings k^9 of said supports k k in proper position to make the elastic gear very sensitive in action and to substantially support said frame with any kind of transmitting gear or wheel that may be formed or mounted thereon anywhere on its outside and to resist all forces in any direction that may be applied to such transmitting gear or wheel, and also for the purpose to provide a clear and sufficient space between the supports of said frame for the proper arrangement of any kind of springs or elastic members. For the sake of simplicity said supports k k are named "rim-supports;" but they also serve to substantially support and resist all loads and forces which may come on said frame from any kind of transmitting gear or wheel.

The center portion m is formed around its outer circumference with the pockets b b^3 and the division-pieces c c^3 for the purpose above specified. The projections f' and the holes e' are for the same purpose as the projections f and holes e in the rim. The parts c c^3 f' e' are used or are entirely left off, as and for the purpose above explained. The center portion m, as will be seen in Figs. 1, 5, and 14, has two rows of arms m' m^2, connecting the outer annular portion m^3 with the hub m^4. In some gears of the construction described it may be required that, for instance, the pockets b b^3 to be formed direct on the outer circumference of the hub m^4, and in such case the center portion will consist only of the pockets b b^3 and the hub m^4, and in this construction such center portion may conveniently be formed in one piece with a solid or hollow shaft which transmits the power or motion from or to said center portion. The center portion m is securely fastened to the shaft on which the elastic gear is placed by means of the keys n or other suitable means. All the pockets b' b^2 of the rim and all the pockets b b^3 of the center portion have the same shape and the same size for the purpose above explained and also for the purpose explained in the following. In the drawings, with the exception of Figs. 27, 28, 29, and 30, helical springs are shown; but in manufacturing my elastic gear in large quantities a gear may be required to give, for instance, a greater elasticity, and a complete gear on hand may in every detail fulfil all the requirements of an order, except the springs, which would, for instance, require more yield. In such a case it may be that springs, each consisting of a block of rubber or other suitable material of greater elasticity, having a solid or a hollow cross-section, would fulfil the required purpose. Such springs will then take the place of the helical springs, and the order for such gear may be filled without delay, as in the manufacture of these gears all kinds of springs may be kept on hand. If a gear of less elasticity is desired, blocks of wood or other material having but very little elasticity may be used instead of such helical or rubber springs. Suitable spring-blocks of this kind are illustrated in Figs. 27, 28, 29, and 30.

Two collars o o are placed against the outer side of the hubs k^8 k^8 of the rim-supports k and are fastened to the shaft whereon my elastic gear is placed for the purpose of preventing any possible lateral movement of the rim a and supports k and also to provide a large bearing-surface between said collars and said hubs. In the drawing, Fig. 1, these collars are each made of halves bolted together by the bolts o' (see Figs. 1, 3, and 4) and are placed on the parts T^5 T^6 of the shaft T and between the hubs k^8 and the shoulders T^9 T^{10} of the shaft T. Fig. 2 shows my elas-

.c gear placed on the counter-shaft T of a geared reversing twin-cylinder engine, in which the power is transmitted from the toothed pinion Q on the crank-shaft of such engine to my elastic gear and from there to the counter-shaft T, and from which shaft connection is made at either end T^3 or T^4 to the rolls, as shown in Figs. 17 and 18. In Fig. 1, T' and T^2 are the journals of said shaft, and the location of the frame parts having the bearings for journals T' T^2 are indicated by dotted lines T^{11} T^{12}. In heavy as well as light transmission of power it is always desirable to make the distance between the journals T' T^2 as short as possible, and for such reason shoulders T^9 and T^{10} are provided on the shaft, which permits the collars *o o* to be made very narrow and will also prevent lateral displacement of said collars *o o* and by which the required tension in the bolts *o'* is brought to a minimum. In the arrangement shown in Fig. 1 said collars *o* need not be any wider than is necessary to remove the rim-supports *k*. To remove one of said rim-supports, it is only necessary to remove one of the collars *o* from the shaft, then remove the bolts k^5 k^3, and then remove the bolts *i'* of half of one rim-support or remove all the bolts *i'* of the whole rim-support, as the requirements may be, then slide the rim-support out of the rim, as shown in Fig. 1, by the dotted lines of one-half of one rim-support. Said support may then be wholly removed. In case that both supports should be removed both collars *o* are to be removed.

Suppose the load acting on the teeth *a'* of the rim rotates the wheel in the direction of the arrow 1, Fig. 2, then the springs *d* will be the driving-springs, and if the load be reversed it will cause the rotation of the wheel in the opposite direction to the arrow 1, and the springs *d'* will be the driving-springs. If greater yield or more elasticity than that indicated on the drawing Fig. 2 should be required, the construction will be such that longer springs, but less in number, can be placed in each row in the space between the center portion *m* and the rim *a* and more rows of springs will be used, making the total number of springs the same or greater, if desired, or more rows of lighter springs will be used, or in case it should be required that the rim shall have a yield or elasticity around the center portion equal to about one-half turn or one turn or even more than one turn then the construction of the parts inside the frame will be such that the elastic member or members arranged between said rim-supports and between the rim and center portion will consist of different kind of spring or springs. It will be understood that the number of springs required will of course depend on the power to be transmitted, and in some cases only one single spring may be used. Supposing that the springs *d* are the driving-springs and are under the maximum load, then said springs will also be under their maximum compression. In this condition it is desirable that the springs *d'*, with their end pieces, should not become loose in their pockets b^2 b^3, and for this purpose the springs should be under an initial compression before any load is applied thereto. Said initial compression should be so great that when the springs *d* are under maximum compression the springs *d'* will not be relieved of their total compression, but will retain just so much compression as will be necessary to resist the force of action produced by the acceleration or retardation of the springs with their end pieces due to their inertia and the forces due to change of direction of motion. It will now be seen that the springs with their end pieces before they are put into their pockets should each have a length equivalent to the maximum compression plus the distance the pockets b^2 b^3 are apart with no load on the springs plus the compression required to resist the action from said acceleration, &c., as above explained. In a noiseless and smooth-running gear the best results are obtained when the springs have the length as above indicated, and when so constructed they will prevent rattling in rotating and also prevent a pounding noise whenever the transmission is reversed. In some transmissions of power it will be required to reverse these gears twenty times a minute or more, and considering that such reversing will be done or attempted under full speed it can readily be seen that such elastic gear or wheel must work satisfactorily in every detail, should be strong but light in weight and sensitive in action, and that the frictional resistance of the parts between the rim and shaft should be reduced to a minimum. The maximum wear in my elastic gear between the rim and the bearings of its supports, which may be considered the only wear for the taking up of which provision should be made, is in the linings k^9, that support the rim, and results from the friction casued by the rotary oscillating movement of the rim over the center portion, which wear comes on the linings k^9, which may be made of softer material than the shaft, and if these linings are worn they can easily be replaced by new ones.

If my elastic wheel-rim *a* is provided with double helical teeth *a'*, as shown in Fig. 1, it may be desired to permit the rim part to have a little lateral play to make double helical teeth which are not in perfect alinement to work satisfactorily. In case such play should be desired a space to permit for such play will be provided between the flanges k^{13} of the supports *k* and the annular side part m^3 of the center portion *m*, and the arms of the supports *k* may be constructed to permit the necessary lateral deflection of these arms for this purpose.

It will now be understood from the above description of my elastic wheel or gear that by bolting together the supports k and the rim a in the manner above explained they practically form one piece, which is wholly supported by the shaft and has no other connections with the center portion m except through the springs d d', and if the center portion and springs were removed the rim could be turned freely around the shaft and be true and central with the axis of the shaft, and if the center portion is in place, but the springs removed, the rim could be freely oscillated the distance between the spring-pockets of the rim and center portion without encountering any other frictional resistance than that between the linings k^9 and the journals T^5 T^6 on the shaft, and owing to the large leverage of the distance between the shaft and the rim and also owing to the fact that the extent of the rotary oscillating movement of and at the rim is many times reduced at the journals T^5 T^6 this frictional resistance and wear is thereby reduced to a minimum.

In the manufacture of my elastic gear I prefer to have the rim so it can be formed around its outer circumference to suit any kind of transmission of power and also so as to take the place of the hubs of band-wheels, fly-wheels, &c., or have the rim itself formed for belt or any other drive or into any shape whatever. Owing to the peculiar construction of my rim and rim-supports bolted together in the manner above explained, and thus forming substantial bearings which resist any force in any direction that may be applied to the rim from any kind of drive, my improved gear will be suitable for all different kinds of transmission, some of which, for instance, as herein shown and described. My elastic gear, especially in small sizes, may have the rim and the entire support of one side cast in one piece and the support on the other side bolted to the rim in the manner above explained.

In Figs. 22 to 26, inclusive, and in the Figs. 31 to 34, inclusive, I have shown a number of different applications of my elastic gear.

In Fig. 22 the rim a of my elastic gear is formed around its outer circumference with grooves p, which grooves may be given the proper shape either for wedge friction-gear drive or rope-gear drive. In the drawings, p' is the rope (shown in dotted lines) for rope-gear drive.

In Fig. 23 the rim a of my elastic gear is formed cylindrical and smooth around its outer circumference and in this form will suit a belt-gear drive or a spur friction-gear drive. This figure also shows the rim a and the support k of one side cast in one piece, and it also shows three rows of springs without division-pieces.

In Fig. 24 the rim a of my elastic gear is formed around its outer circumference with a smooth cylindrical surface, and this form is suitable for a wide belt-gear drive or for a wide spur friction-gear drive. In this drawing all the space of the total length of the pockets is filled with springs. Six rows of springs without division-pieces are shown in this case. The lines v^4 indicate the sides of the spring end pieces cut off to the lines v v and v' v'. (Shown in Fig. 11.) In the Figs. 1 and 22 to 26, inclusive, there is a separate end piece for each spring; but these pieces can be made so that each end piece will be suitable for as many springs as there are rows. Such end pieces are shown by the Figs. 35, 36, and 37.

It will be understood that in case where the division-piece ι is used such end pieces as Figs. 35, 36, and 37 may be made so that each end piece will be suitable for as many springs as there are rows on each side of such division-piece—for instance, as shown in the Figs. 33 and 34.

In Fig. 25 my elastic gear is placed, for instance, in the center of a band-wheel t, and thus takes the place of the hub of the said band-wheel. In this case the rim a is provided around its outer circumference with lugs or flanges t', to which are bolted the arms t^2 of the band-wheel t. In case that such band-wheel or belt-pulley may only be a little larger than the rim a of my elastic gear the arms of such band-wheel may be replaced by a circular flange or lugs cast to said band-wheel t around its inner circumference, which flange or lugs will then be bolted against the lugs or flange t' of the rim. In this figure the results derived from the peculiar construction of my elastic gear can readily be seen, and it can also be seen that if the center portion m and the springs d d' were removed the band-wheel would still be held in a substantial manner in the bearings k^9 and would in this condition resist all forces from the belt or any kind of drive in any direction that may be applied to the band-wheel t or to any other kind of wheel which may be applied to the rim a. Of course the turning moment that produces the rotary driving motion would in this condition of my elastic gear cause the turning of the wheel around the shaft in a perfectly true manner, but could not drive the shaft, or if the gear would have to transmit the power from the shaft to the band-wheel then the turning moment in the shaft that produces the rotary driving motion would not drive said band-wheel in this condition of my elastic gear, but would cause the shaft to rotate in the bearings.

In Fig. 26 my elastic gear takes the place of the hub of a built-up band or fly wheel. Such wheels are usually made in sections with the arms bolted to the rim-sections and to the hub, or they are made of sections having one or more arms cast to each section. The inner ends of the arms are then bolted to the hub in a manner similar to that shown in Fig. 26, in which t^{20} is one arm and T^{30} the end of said arm fitted between the flanges t^{10}. The holes t^{60} are reamed together with the arms in their proper position, and bolts t^{40} are then driven into said holes, thus making a substantial fastening. In Fig. 26 the rim a of my elastic gear is formed around its outer circumference with the flanges t^{10} for the purpose above explained. If in such a case the hub of, for instance, a band-wheel or fly-wheel is required to be to one side of such wheel and supposing that in such case the center of the width of such wheel would have to be about in line with one of the supports k, then the construction may be such that the rim a extends over such support or such band or fly wheel be fastened to one of such supports k of my elastic gear instead of being fastened to the rim a thereof, or in case it should be required that the power to or from the outside of said frame, which consists, as before said, of the rim a and supports k k, be transmitted near the outer side of one of the supports k k in such a case the transmitting part of the gear may be formed or be mounted on the outer side of such support k, as, for instance, shown in the Fig. 32.

In Figs. 23, 24, 25, 26, 31, and 32 to 34, inclusive, the halves of the collars O are fastened together and to the shaft by means of two bolts. The shoulders T^9 and T^{10} in Fig. 1 are not required with collars O of sufficient width. These collars, if desired, can each be made of one piece and fastened to the shaft in some other manner. In some transmission said collars may be omitted.

In the Figs. 22 to 26, inclusive, and in the Figs. 31 to 34, inclusive, the center line of my elastic gear is indicated by the line Y^2 Y^2.

Figs. 27, 28, 29, and 30 show a few forms of blocks of elastic material that may take the place of the helical springs d and d' in Fig. 2. In Fig. 27 the block d^3 is solid and rectangular in shape, with the ends rounded, as shown, to fit the pockets b b' and b^2 b^3, and can be made either of wood, rubber, or any other material, as the case may require. The width w^3 may have the total length of the pocket or may have less. In Fig. 28 the block d^4 is rectangular in shape, and preferably has a greater or less number of holes through it for giving it more or less elasticity without changing the form of the block. Its ends are rounded, as shown, to fit the pockets b b' and b^2 b^3. Fig. 29 shows a block similar to that illustrated in Fig. 28 and constructed of the proper size to take the place of a complete single helical spring. In Fig. 30 the block d^6 is also rectangular in shape, as shown, with square ends and with a hole through it, which hole at each end will fit over the projections g or g' of the end pieces c^4. The central portion d^7 of said hole may be enlarged in diameter, as shown, for the purpose of giving the material of the block d^6 free action during compression. If this block is made, for instance, of rubber, the rubber in the sides d^9 around said hole d^7 becomes thicker during compression, and to prevent the rubber from being forced by the action of compression between the ends of the projections g g', and thus liable to be destroyed, said hole d^7 is made larger in diameter than the end holes which fit over the projections g g'. The projections g g' may have a length to suit a desired yield in the elastic gear, as and for the purpose before specified.

In case it should be desired for some reason to make the hub m^4 of the center portion m longer and let such extensions form the journals for the same purpose as are the journals T^5 T^6 of the shaft T in Fig. 1 such a modification will be convenient in shipping, as the whole gear may be completely assembled and shipped in that condition and then keyed to the shaft and put in operation without taking the gear apart. Fig. 31 shows such gear in which the rim a, with the supports k, is supported on the hub extension of the center portion. This figure is a diametrical section of one-half of my elastic gear with one row of springs and one row of arms. On the rim a around its outer circumference are formed, for example, spur-teeth a^6, as shown in Fig. 15.

In Fig. 32 the rim a is formed around its periphery with a rough cylindrical surface, and at one side this rim a is cast in one piece with one of the supports k k and with the conical rim q, which has formed around its outer conical surface teeth q', and therefore will suit a toothed bevel-gear drive. In this case one of the supports k k is formed around its outer circumference with the toothed bevel-wheel rim q and the rim a. Three rows of springs are shown in this figure, and the end pieces for the springs are such as shown in the Fig. 35.

In the Fig. 33 the rim a is formed around its outer circumference with a rough unfinished cylindrical surface, and at one side this rim a is cast in one piece with a conical rim q^{10}, which is formed around its outer circumference with a smooth conical surface, and therefore will suit a bevel friction-gear drive. This figure shows four rows of springs with the division-piece c between them—that is, two rows of springs on each side of the division-piece c. Each end piece for the springs is shown for two springs.

In Fig. 34 the rim a is formed around its outer circumference with flanges r' r', one on each side, and with helical grooves having the form as shown by the lines r, and therefore is suitable for a drum-rope drive of hoisting apparatus and the like. This figure also shows six rows of springs with the division-piece c between them—that is, three rows of springs on each side of said division-piece c. Each end piece for the springs is shown for three springs and is similar to the one shown in the Fig. 35.

Figs. 35 to 37, inclusive, show springs end pieces for more than one spring each. In Fig. 35 is shown one end piece for three springs, in Fig. 36 is shown one end piece for six springs, and in Fig. 37 is shown one end piece for six springs, with the parts f^2 at the ends of the end pieces left off.

In case that the elastic gear always is to rotate in one direction only one set of springs *d* and *d'* is required for driving. For instance, if the rim *a* is driven in the direction indicated by arrow 1 in Fig. 2 only the springs *d* will be required for driving, and the springs *d'* may all be removed. A few springs *d'*, however, may remain for the purpose of preventing any possible backlash. If it is desired to drive the rim in the opposite direction, only the springs *d'* will be required for driving and a few of the springs *d* to take care of any possible backlash. If the gear is to rotate in both directions, forward and backward, as the case may be, in a reversing transmission, all the springs will of course be required.

The strains that my improved gear will be subjected to and the benefit derived from a wheel embodying my invention—for instance, in a rolling-mill—will be understood by reference to Figs. 16–19, inclusive. In Fig. 16, A indicates one of two rolls arranged one above the other and driven by two double pinions E, also one on top of the other. The upper one of the said pinions E is connected with one of my elastic wheels W on the shaft *w* by means of shaft and couplings, as shown. B are two rolls, also one on top of the other, but having a different size than the rolls A, and are driven by two pinions F, also one on top of the other. The upper one of said pinions F is connected with a similar wheel W on shaft *w'* by means of shaft and coupling, as shown. G is an idle wheel, and H is a pinion connected by means of shaft and coupling with the crank-shaft I of an engine, as shown. The rolls B are driven by pinions F from wheel W on shaft *w'*, which wheel is driven by pinion H on shaft coupled to crank-shaft I of engine, as shown. The power is transmitted to the rolls A from the engine crank-shaft I, through pinion H, wheel W on shaft *w'* and the idle wheel G, wheel W on shaft *w*, and pinions E. Supposing in the following description that A and B are thirty-two-inch rolls and the proper speed for these rolls be about twenty-nine revolutions per minute, and the gears are such that while the roll makes one turn, the crank-shaft T makes two and one-quarter turns. Fig. 19 is a diagram of such rolls with an ingot or bloom half-way through the rolls. L is the upper roll turning in the direction of the arrow thereon. L' is the lower roll turning in the direction of the arrow thereon, and M is the ingot or bloom to be reduced—for instance, in thickness—as shown, and passing the direction of arrow on the same. If we omit any possible sliding of the rolls on the ingot, then L^2 represents the angle which the roll will have to turn in moving the ingot from dotted line N to dotted line N'—that is, from no rolling resistance to maximum rolling resistance, which in this case represents an angle of about thirty-two degrees or about 0.09 part of one revolution of the rolls. This will require about 0.2 part of one revolution of the crank-shaft of the engine. This means that during the time the wheel W makes 0.09 part of one revolution and the crank makes 0.2 of one revolution the resistance to be overcome by the engine and gears will be equivalent from no load to maximum load. Further, suppose an ingot of seventeen thousand six hundred and forty cubic inches volume after passing through the first rolls A is fourteen and three-fourths inches thick by eighteen inches wide and by about sixty-six inches long is reduced to fourteen and one-half inches by fourteen and one-half inches and about eighty-three long. Omitting any possible sliding between rolls and ingot it would require about 1.4 revolution of the rolls and about three revolutions of the crank-shaft of the engine, or the time required to make the second pass would be about three seconds. The engine in Fig. 16 and the rolls A and B are supposed to run continuously in one direction. The rolls A and B in said figures are driven by the pinion H, whose shaft is coupled direct to the crank-shaft of the engine, as shown. Fig. 17 illustrates a blooming or roughing mill with two rolls P, one above the other, and each roll is arranged for four passes. The bloom R will enter the rolls in the directions indicated by the arrows from first pass to fourth pass. The rolls are driven through two pinions S, one above the other, of which the upper or the lower one is driven by the wheel W on shaft T, and wheel W is driven from pinion Q on crank-shaft of the engine. In this case the engine and the transmission with the rolls is to be reversed after each pass through the rolls, making the rolls run forward and backward, as the case may require. Fig. 18 shows the same rolls as Fig. 16; but in this case a geared engine, like that shown in Fig. 17, is coupled to a wheel G', between the wheels V and V'. Considering that a working load of about seventy tons is received by the teeth of these gears W when used in driving the above rolls and that such load is applied suddenly, as above explained, it is necessary in order to render such an elastic transmission effective to reduce the frictional resistance between the rim and the shaft to a minimum, which desirable effect is produced by my elastic gear herein shown and described.

While the springs or elastic members as herein shown and described give best results, I do not desire to limit myself to the use of such springs, as for some purposes an efficient gear can be made in connection with my said frame with the arrangement of different kinds of elastic members of, for instance, springs, such as tension springs, spiral springs flat springs of suitable form, or plain spiral springs having suitable number of coils surrounding the center portion, or the like, between the supports of my frame and still be within the scope of my invention.

The foregoing description and the accompanying drawings set forth in detail elastic gears embodying my invention; but various modifications and changes may be made in the details of the construction and still be within the scope of my invention as defined in the claims.

I claim as my invention—

1. An elastic gear, comprising a center portion adapted to be secured to a shaft, a rim, rim-supports arranged on or in opposite sides of the rim and each having a central hub or bearing surrounding the axis of the shaft, said rim-supports being capable of oscillation independently of said center portion, and yielding or elastic members which compel the rim and said center portion to turn together, substantially as set forth.

2. In an elastic gear, a frame comprising a rim having laterally-spaced supports rigid with the rim, and elastic transmission mechanism arranged between said supports, substantially as set forth.

3. In an elastic gear, a frame comprising a rim having laterally-spaced supports and each of said supports having a hub or bearing coaxial with the gear, and elastic mechanism for transmitting power or motion from said frame to a central transmitting part, or vice versa, said elastic mechanism being arranged between said supports, substantially as set forth.

4. An elastic gear, comprising a center portion adapted to be secured to a shaft, a rim, supports for the rim arranged on or in opposite sides thereof and each provided with a central hub or bearing adapted to turn loosely on the shaft, and yielding or elastic members interposed between the rim and said center portion, substantially as set forth.

5. An elastic gear, comprising a center portion, a rim having laterally-spaced supports and each of said supports provided with a hub or bearing coaxial with the gear or with the shaft on which the gear is mounted; one of said supports being formed integral with the rim and the other detachably secured thereto, and elastic member or members interposed between the rim and said center portion, substantially as set forth.

6. An elastic gear, consisting of a rim having formed or mounted in suitable location anywhere on its outside a suitable transmitting gear or wheel, supports for said rim laterally spaced and rigid therewith and each of said supports having a hub or bearing central or coaxial with the gear, and elastic transmission mechanism arranged in the space between said rim-supports, substantially as set forth.

7. An elastic gear, comprising a rim provided on its inner circumference with pockets or seats, rim-supports arranged on or in opposite sides of the rim and each provided with a central hub or bearing, a center portion arranged between said rim-supports and adapted to be secured to the shaft on which the gear is mounted, said center portion being provided with circumferential pockets or seats, and yielding or elastic members seated in the coöperating pockets of the rim and said center portion, substantially as set forth.

8. An elastic gear, comprising a rim, rim-supports arranged on or in opposite sides of the rim and each having a central hub or bearing, a center portion adapted to be secured to the shaft on which the gear is mounted, yielding or elastic members interposed between the rim and said center portion, and a second rim surrounding the first-named rim and carried by the same, substantially as set forth.

9. In an elastic gear, a frame comprising a suitable rim having laterally-spaced supports rigid with the rim, the rim being provided with suitably-located connecting means and the adjacent rim-support being fitted thereto, substantially as set forth.

10. An elastic gear, comprising a rim provided with marginal flanges, rim-supports arranged on or in opposite sides of the rim and provided at their periphery with annular grooves which receive said rim-flanges, and fastening-bolts passing through the rim and said supports on the inner side of said grooves, substantially as set forth.

11. An elastic gear, comprising a rim provided on its inner circumference with lugs each containing a pair of oppositely-facing spring-pockets, rim-supports arranged on or in opposite sides of the rim, a center portion arranged between said rim-supports and having similar pockets, springs seated in the coöperating pockets of said rim and center portion, and fastening-bolts passing through said rim-lugs between the pockets thereof, substantially as set forth.

12. An elastic gear, comprising a rim provided on its inner surface with a seat or seats, laterally-spaced supports rigid with the rim, a center portion having at its periphery a seat or seats of the same size and form as the seat or seats of the rim, and a spring or springs arranged between the rim and the center portion and seated in the coöperating seats of the rim and said center portion, substantially as set forth.

13. An elastic gear, comprising a rim provided on its inner surface with a pocket or pockets, a center portion adapted to be secured to a shaft or to a central transmitting part and having a similar pocket or pockets on its periphery, and a spring or springs seated in the coöperating pockets of said members; the pocket or pockets of both said rim and said center portion being open at both their sides, whereby the spring or springs can from both sides be inserted and removed laterally, substantially as set forth.

14. An elastic gear, comprising a rim provided at its inner surface with a seat or seats, a center portion provided at its periphery with a similar seat or seats, an elastic member or members arranged between the rim and the center portion and seated in the coöperating seats of the rim and said center portion, and division-pieces arranged in said seats, substantially as set forth.

15. An elastic gear, comprising a rim provided on its inner circumference with pockets, a center portion adapted to be secured to a shaft and provided at its periphery with similar pockets, yielding or elastic members seated in the coöperating pockets of the rim and said center portion, and division-pieces arranged in said pockets and provided with lateral spacing projections, substantially as set forth.

16. An elastic gear, comprising a rim having laterally-spaced supports rigid therewith, a center portion adapted to be secured to a shaft or to a central transmitting part, and elastic members arranged between the rim and center portion and connecting said members; one or more of said elastic members being arranged for driving in one direction and the other elastic member or members being arranged for driving in the opposite direction, the elastic members being partly under strain in their normal or unloaded condition, whereby when the elastic member or members for driving in the one direction are under maximum strain or maximum load, the elastic member or members which are arranged for driving in the opposite direction are relieved of part of their strain and the retained strain being sufficient to prevent backlash and also to prevent rattling, substantially as set forth.

17. An elastic gear, comprising a rim having laterally-spaced supports rigid therewith, a center portion, and two sets of elastic members arranged between the rim and the center portion and connecting the rim and center portion, one set of elastic members being arranged for driving continuously in one direction and the other set being arranged and sufficient in number to prevent backlash, substantially as set forth.

18. An elastic gear, comprising a rim, rim-supports arranged on or in opposite sides of the rim and composed of separable halves or sections, a center portion arranged between said rim-supports, and elastic connections between said center portion and said rim, substantially as set forth.

19. The combination with an elastic gear comprising a rim having supports on or in opposite sides thereof and each of said supports having a central hub or bearing, a center portion between said supports, and elastic connection or connections between said rim and center portion, of a shaft provided on the outer sides of said rim-supports with shoulders, and retaining collars or washers applied to said shaft between said rim-supports and said shoulders for securely holding said rim-supports against lateral displacement, substantially as set forth.

20. An elastic gear, comprising a rim provided with a seat or seats, laterally-spaced supports rigid with said rim, a center portion provided with a similar seat or seats, and an elastic member or members seated in the coöperating seats of the rim and center portion and provided with suitable means to limit the yield or elasticity of said member or members, substantially as set forth.

21. An elastic gear, comprising a rim provided with a pocket or pockets, laterally-spaced supports rigid with said rim, a center portion provided with a similar pocket or pockets, and an elastic member or members seated in the coöperating pockets of the rim and center portion, substantially as set forth.

22. In an elastic gear, a frame comprising a rim provided with laterally-spaced supports rigid with the rim and each of said supports having a hub or bearing coaxial with the shaft on which the gear is mounted, said frame being provided with suitably-located means on its outside for fastening thereto suitable driving or transmitting means, and elastic transmission mechanism arranged in the inside of said frame and connected therewith, substantially as set forth.

23. An elastic gear, comprising a frame consisting of a rim provided with laterally-spaced supports and each of said supports having a hub or bearing central or coaxial with the gear, said frame having formed or mounted in suitable location anywhere on its outside suitable driving or transmitting means, and elastic transmission mechanism arranged in the inside of said frame and connected therewith, substantially as set forth.

24. An elastic gear, comprising a center portion, a frame consisting of a rim having laterally-spaced supports and each of said supports having a hub or bearing central or coaxial with the gear, and elastic members arranged between the rim and center portion for transmitting power or motion from said frame to said center portion, or vice versa, one or more of said elastic members being arranged for driving in one direction and the other elastic member or members being ar-

ranged for driving in the opposite direction, substantially as set forth.

25. An elastic gear, wherein power or motion is transmitted to a frame and from said frame to an elastic transmission mechanism arranged inside of said frame, or vice versa; said frame comprising a rim having laterally-spaced supports and each of said supports having a hub or bearing central or coaxial with the gear, substantially as set forth.

26. An elastic gear, comprising an elastic member or members, a central transmitting part, a frame surrounding said elastic member or members and said central transmitting part, laterally-spaced bearings coaxial with the gear supporting said frame and arranged at opposite sides of said elastic member or members and on which bearings said frame being capable of oscillation independently of said central transmitting part, said elastic member or members connecting said frame with said central transmitting part, substantially as set forth.

27. An elastic gear, wherein power or motion is transmitted by an elastic transmission mechanism from a central transmitting part to a frame, or vice versa; said frame surrounding said elastic transmission mechanism and being provided with laterally-spaced bearings coaxial with the gear or with the shaft on which the gear is mounted and which bearings are arranged at opposite sides of said elastic transmission mechanism and on which bearings said frame being supported and being capable of oscillation independently of said central transmitting part, substantially as set forth.

28. An elastic gear, comprising an elastic transmission mechanism, a central transmitting part, a frame having formed or mounted in suitable location on its outside a suitable transmitting gear or wheel and in the inside being provided with suitable means for connecting with said elastic transmission mechanism and having laterally-spaced bearings central or coaxial with the gear and said frame being supported on said bearings and being capable of oscillation thereon independently of said central transmitting part, said elastic transmission mechanism connecting said frame with said central transmitting part, substantially as set forth.

29. An elastic gear, comprising a center portion, a frame consisting of a rim having laterally-spaced supports and each of said supports being provided with a hub or bearing adapted to turn loosely on a journal coaxial with the shaft on which the gear is mounted, and elastic member or members interposed between the rim and said center portion; said frame being supported on said journals and being capable of oscillation thereon independently of said center portion, substantially as set forth.

30. An elastic gear, comprising a center portion provided with means to connect with a spring or springs, a frame surrounding said center portion and comprising a rim provided with laterally-separated supports and each of said supports having a hub or bearing central or coaxial with the gear or with the shaft on which the gear is mounted and said frame having formed or mounted in suitable location on its outside suitable driving or transmitting means and being provided on its inside with suitable means for connecting with a spring or springs, and a spring or springs arranged between said supports and engaging the said connecting means of the frame and said center portion, substantially as set forth.

31. An elastic gear, comprising a rim having laterally-spaced supports and each of said supports having a hub or bearing central or coaxial with the shaft on which the gear is mounted, an elastic transmission mechanism comprising an elastic member or members and a center portion and being surrounded by said rim and arranged between said supports, one of said supports having formed or mounted in suitable location on its outside a suitable transmitting gear or wheel, substantially as set forth.

32. An elastic gear, comprising a center portion surrounded by a frame and provided with a bearing or bearings for an elastic member or members, said frame comprising a rim provided with laterally-spaced supports and each of said supports having a hub or bearing central or coaxial with the gear and a bearing or bearings in the frame for an elastic member or members, suitable transmitting means formed or mounted in suitable location on the outside of said frame, and an elastic member or members arranged between said rim and center portion and connecting said frame with said center portion and engaging the said bearings thereof, substantially as set forth.

33. An elastic gear, comprising a rim provided on its inner surface with a bearing or bearings for an elastic member or members, rim-supports laterally spaced and rigid with the rim and each provided with a central hub or bearing, a center portion arranged between said rim-supports and adapted to be secured to a central transmitting part for transmitting power or motion to said center portion, or vice versa, said center portion being provided with a bearing or bearings for an elastic member or members, and an elastic member or members interposed between said rim and center portion and engaging the said bearings thereof, substantially as set forth.

34. In an elastic gear, a frame comprising a suitable rim provided with laterally-spaced supports rigid with the rim, one of said supports being formed integral with the rim and the other detachably secured thereto, substantially as set forth.

35. In an elastic gear, a central transmitting part, journals central or coaxial with the gear or with the shaft on which the gear is mounted, a frame supporting suitable driving or transmitting means, an elastic mechanism surrounded by said frame for transmitting power or motion from said frame to said central transmitting part, or vice versa; said frame being provided with laterally-spaced bearings adapted to turn loosely on said journals and on which journals said frame is supported and capable of oscillation independently of said central transmitting part, substantially as set forth.

36. In an elastic gear, a frame comprising a rim provided with laterally-spaced supports rigid with the rim and each of said supports having a hub or bearing central or coaxial with the shaft on which the gear is mounted, and elastic transmission mechanism arranged inside of said frame and connected therewith, substantially as set forth.

Witness my hand this 26th day of September, 1903.

LOUIS F. DIETER.

Witnesses:
LOUIS W. GRATZ,
ROBERT WEITKNECHT.