

CLUTCH.

Patented May 6, 1913.

11 SHEETS—SHEET 1.

Fig. 1.

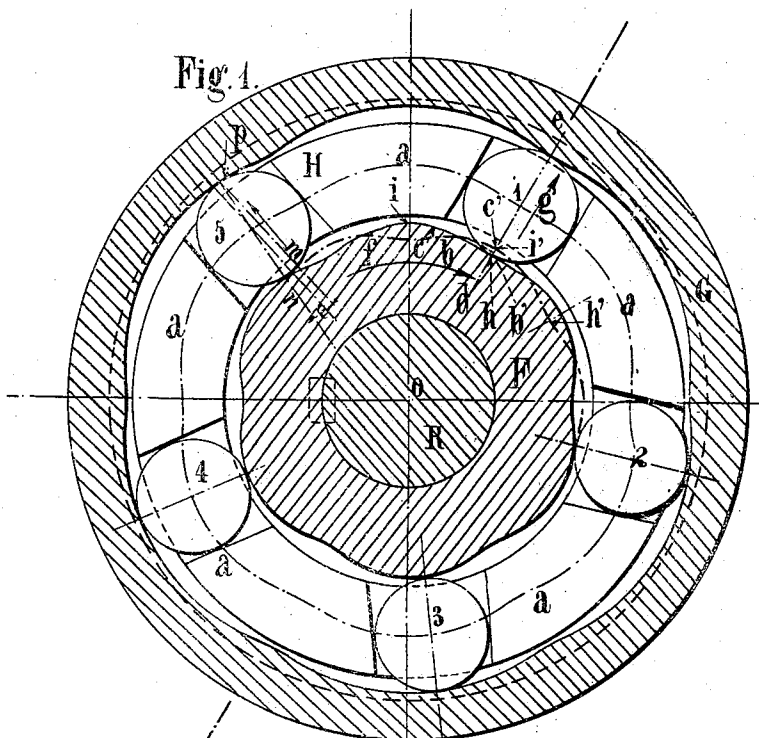
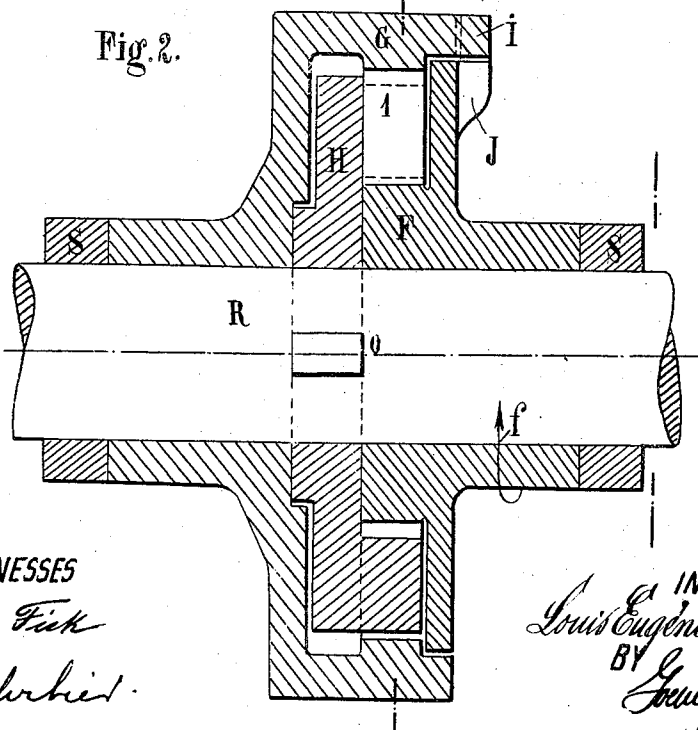


Fig. 2.



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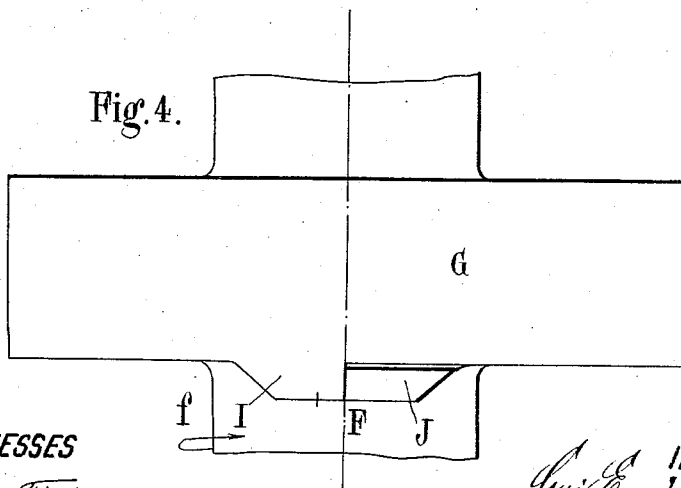
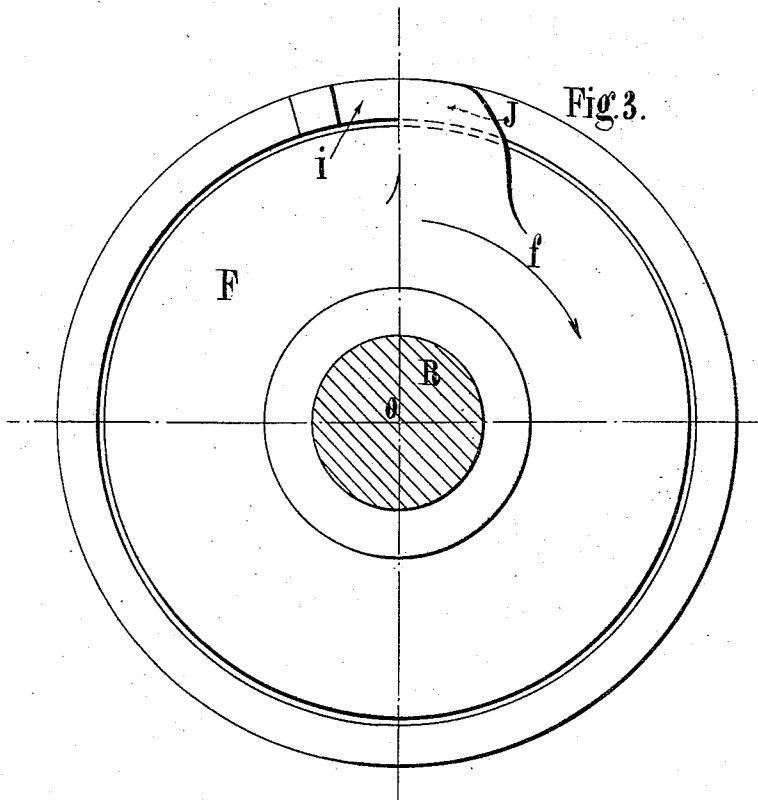
L. E. CLÉMENTCET.
CLUTCH.

APPLICATION FILED FEB. 25, 1908.

1,061,048.

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11 SHEETS—SHEET 2.



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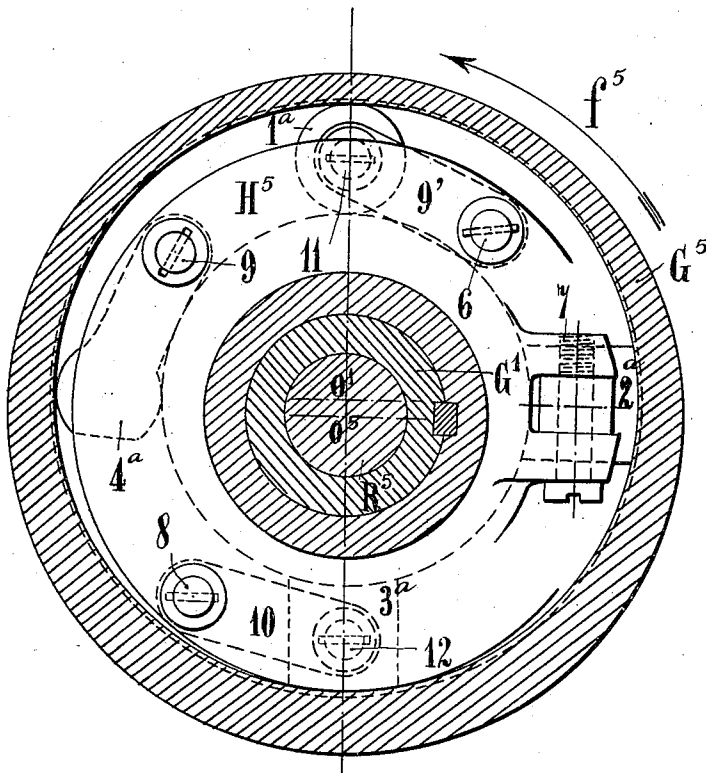
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Fig. 5.



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11 SHEETS—SHEET 4.

Fig. 6.

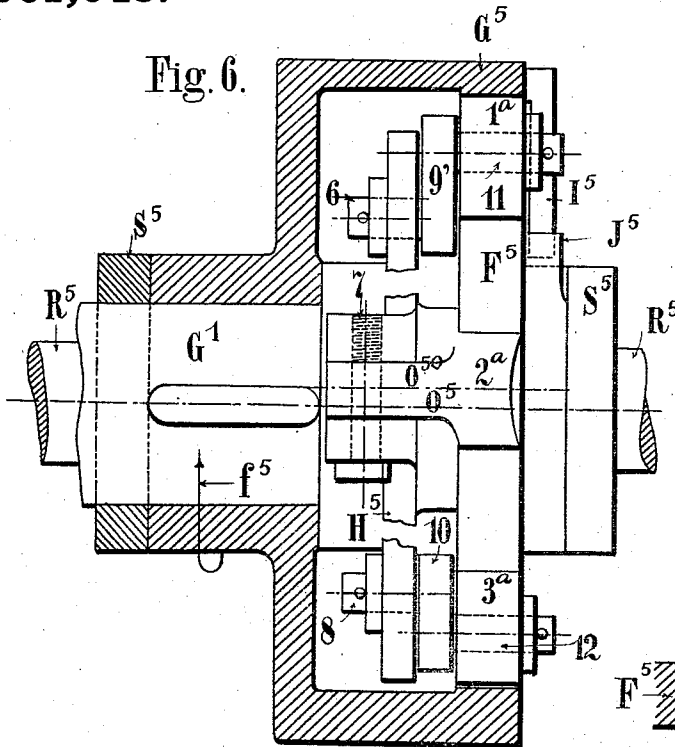


Fig. 7.

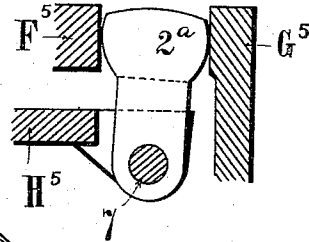
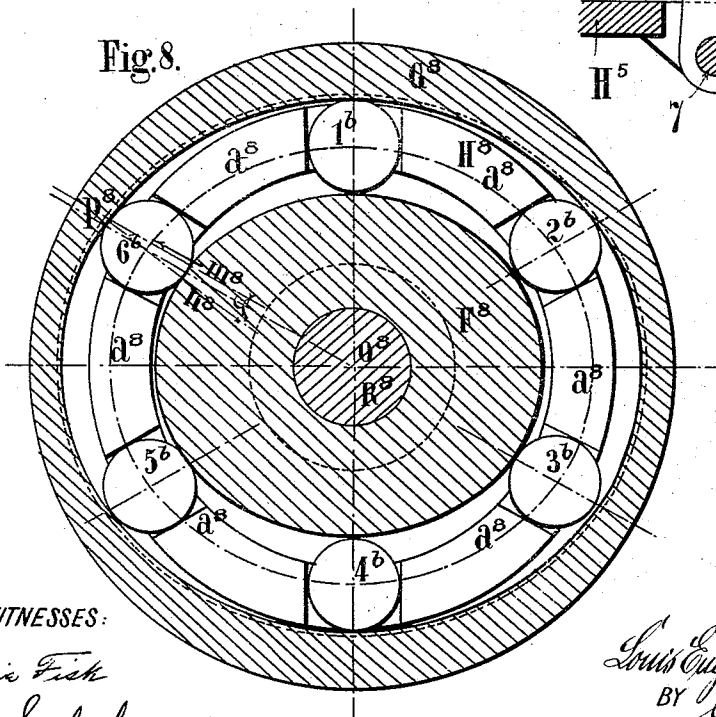


Fig. 8.



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Fig. 9.

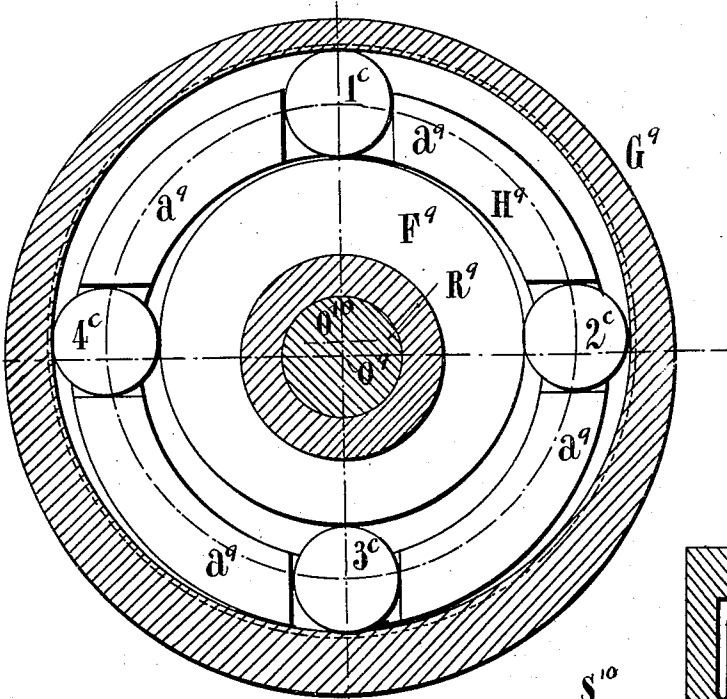


Fig. 10.

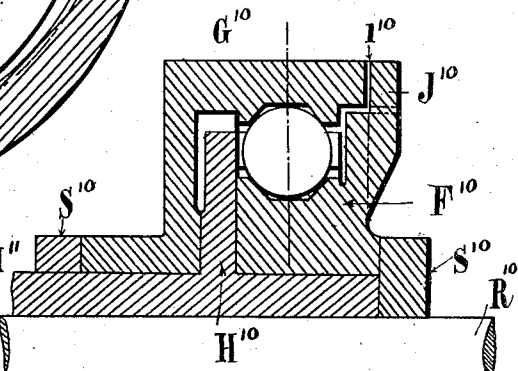
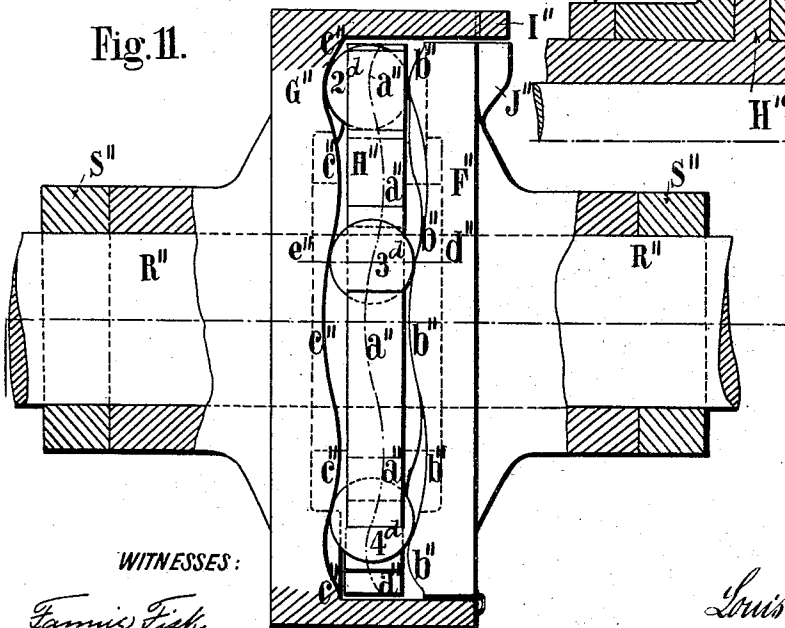


Fig. 11.



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Fig. 13.

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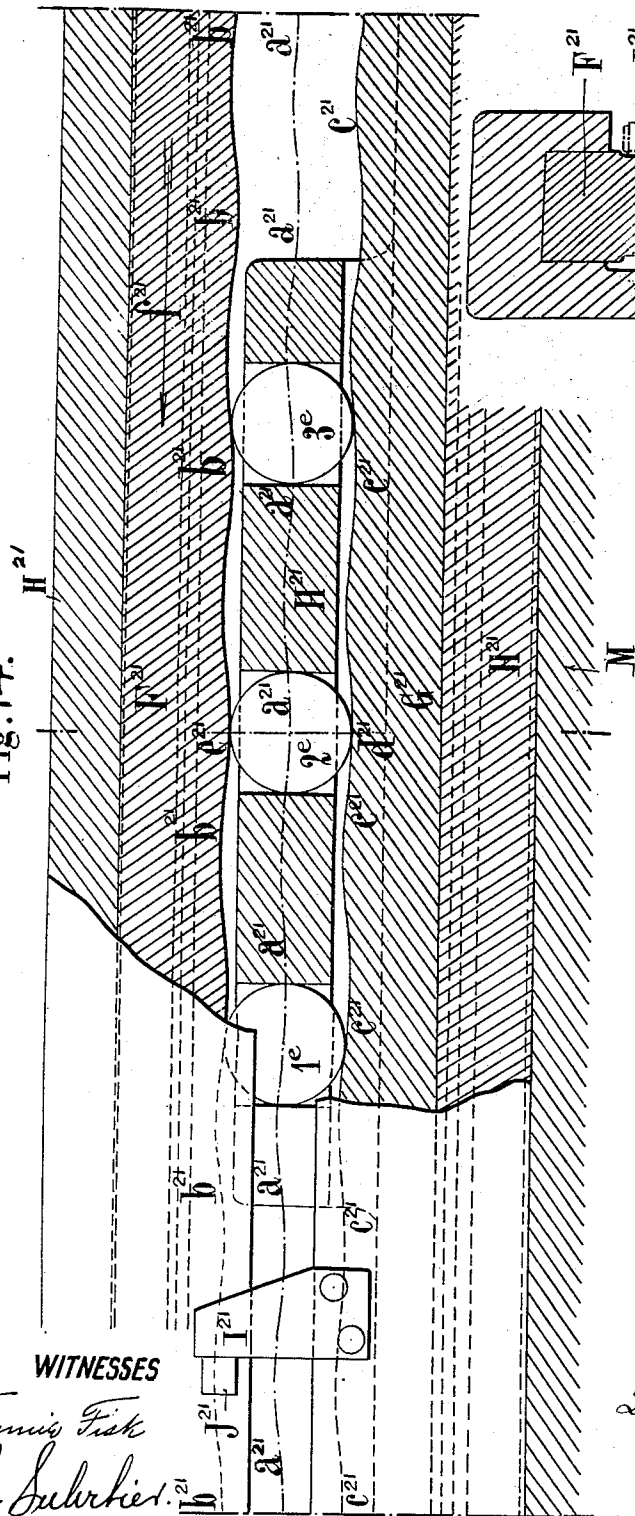
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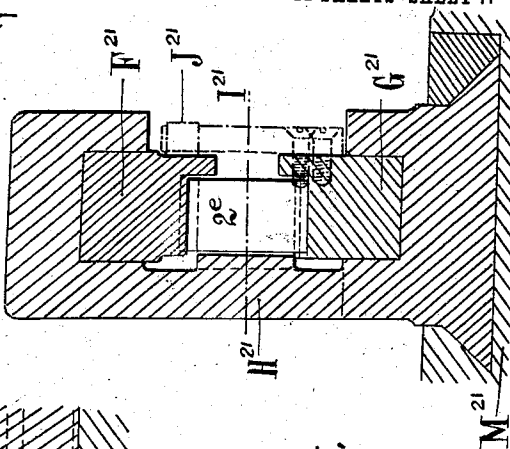
Fig. 14.



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Fig. 15.



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A detailed cross-sectional diagram of a mechanical assembly. The central part consists of a rectangular block with two circular holes, mounted on a base. This assembly is surrounded by multiple layers and structural elements, some indicated by dashed lines. Various parts are labeled with letters (A, B, C, D, E, F, G, H, I, J, K, L, M) and numbers (23, 26). The entire assembly is shown within a frame defined by dashed lines.

Fig. 16.

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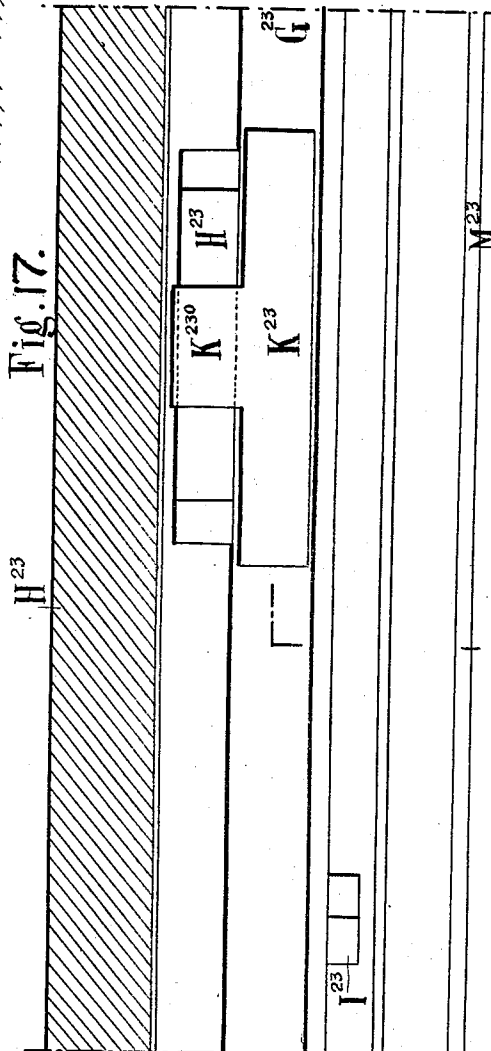


Fig. 21.

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Fig. 20.

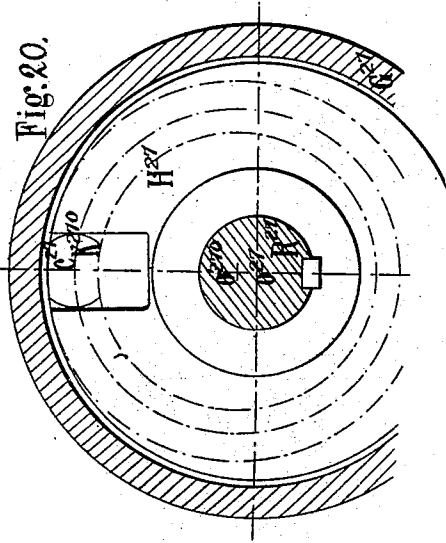


Fig. 18.

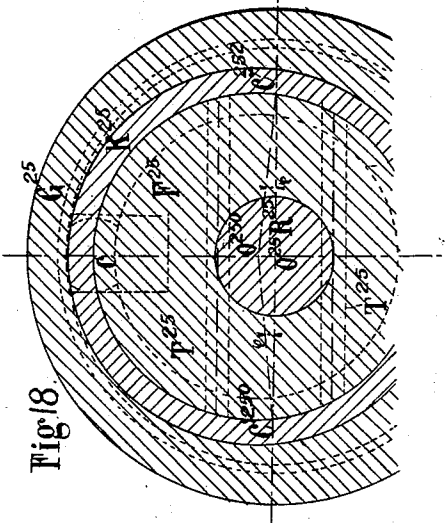
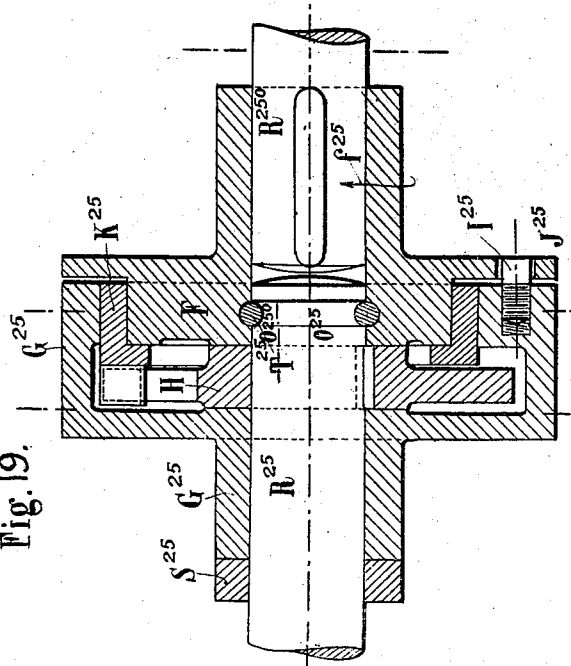


Fig. 19.



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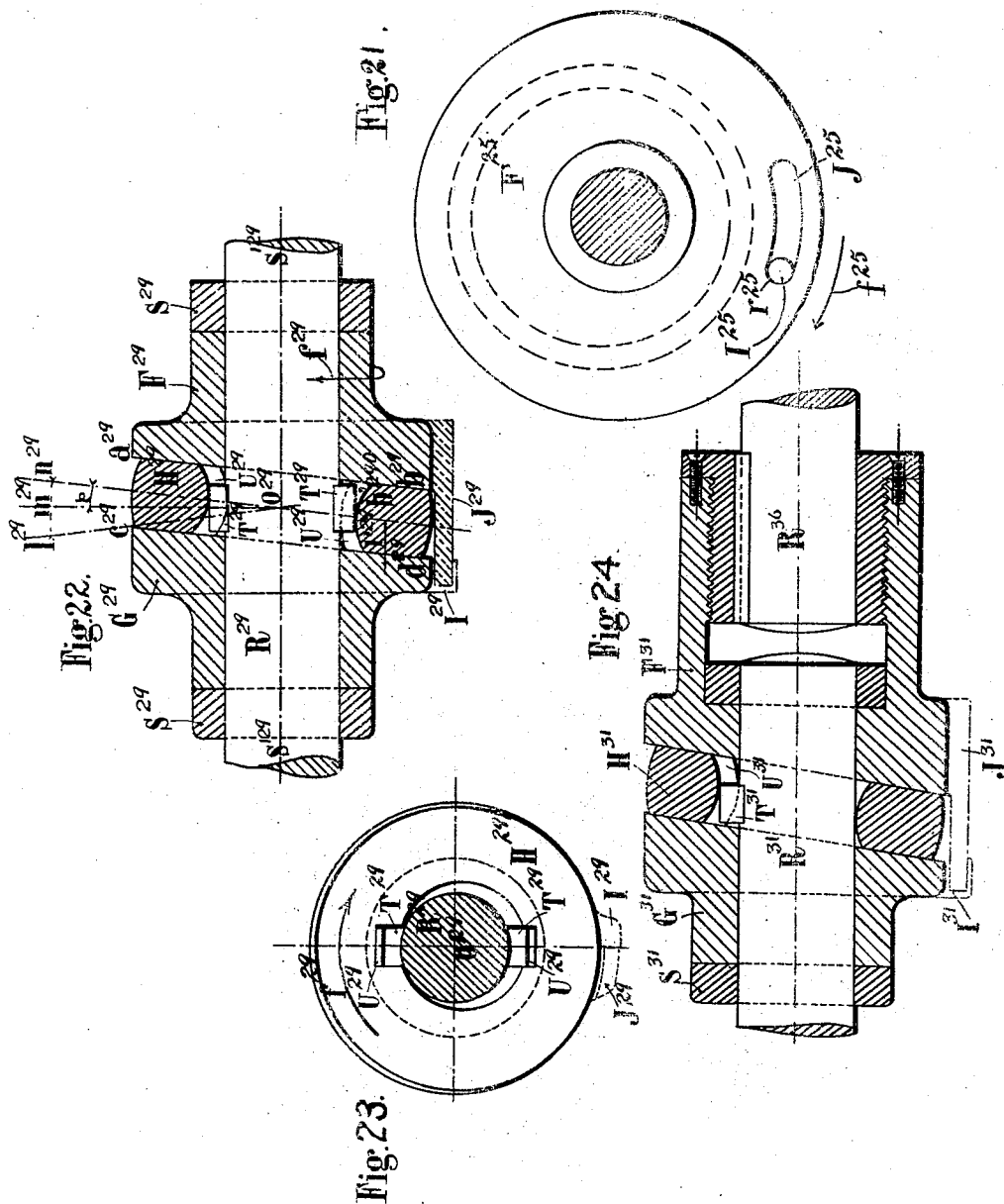
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APPLICATION FILED FEB. 25, 1908.

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11 SHEETS—SHEET 10.

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Fig. 25.

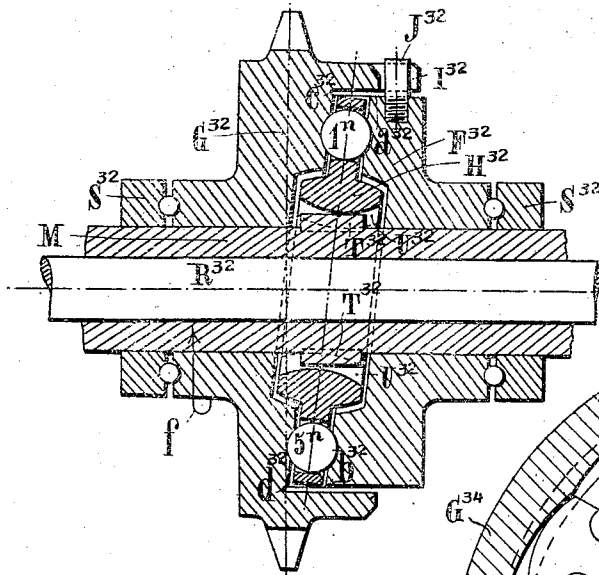


Fig. 27.

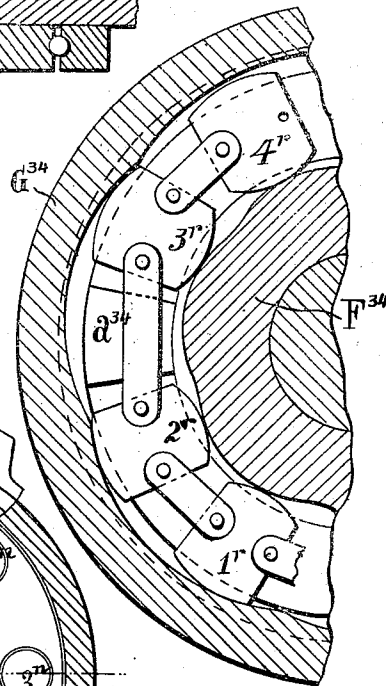
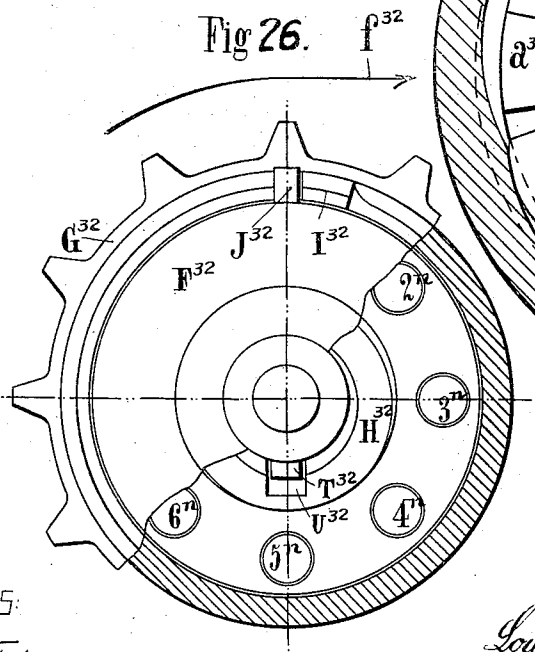


Fig. 26.



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1,061,048.

Specification of Letters Patent.

Patented May 6, 1913.

Application filed February 25, 1908. Serial No. 417,725.

To all whom it may concern:

Be it known that I, LOUIS EUGÈNE CLÉMENCET, a citizen of the Republic of France, and resident of Paris, France, have
5 invented new and useful Improvements in or Relating to Clutches, which improvements are fully set forth in the following specification.

This invention relates to an automatic
10 clutch susceptible of numerous applications.

The accompanying drawings show by way of example various constructions of the automatic clutch.

Figure 1 is a vertical cross-section: Fig.
15 2 a vertical longitudinal section: Fig. 3 a side elevation: Fig. 4 a plan. Fig. 5 is a vertical cross-section, Fig. 6 vertical longitudinal section, and Fig. 7 a partial horizontal section showing different rollers and
20 slide blocks. Fig. 8 is a vertical cross-section of a modified construction with elliptical cams. Fig. 9 is a vertical cross-section of a modified construction in which the cams have the shape of eccentrics. Fig. 10
25 is a vertical longitudinal half-section, showing an arrangement with balls. Fig. 11 is a vertical longitudinal section, and Fig. 12 a vertical cross-section of another arrangement of cams. Fig. 13 is a vertical longitudinal
30 section showing an arrangement of a slide block. Figs. 14 and 15 are respectively vertical longitudinal and cross sections of an arrangement enabling a rectilinear movement to be obtained. Figs. 16
35 and 17 are longitudinal sections of a modified construction of the device shown in Figs. 14 and 15, Fig. 18 is a vertical cross-section, and Fig. 19 a vertical longitudinal
40 section showing special arrangement for eccentric cams; Fig. 20 is a vertical cross section, Fig. 21 is a side elevation, Figs. 22 and 23 longitudinal and cross sections, Fig. 24
45 a longitudinal section, Fig. 25 is a longitudinal section, Fig. 26 a side elevation with parts broken away. All these show special arrangements for cams with inclined planes. Fig. 27 is a vertical transverse section showing
50 the coupling members connected together in a chain.

The said clutch considered as regards its
55 general arrangement, comprises a part F (Fig. 1 vertical cross-section, and Fig. 2 longitudinal vertical section) engaging with a second part G. Owing to the dimensions of the parts F and G, to the inner shape
60 given to the part G and to the outer shape

given to the part F, there is formed between these two parts a cam shaped groove, the axis of which is shown at *a a a . . .* (Fig. 1). In the said groove are arranged balls,
60 rollers or slide blocks, 1, 2, 3, 4, 5, which can roll or slide therein.

The balls, rollers or slide blocks can themselves move in the direction *d e* and *e d*
65 (Fig. 1) in recesses made in the rim of a part H to be driven. The part H must be keyed to the spindle R. Two stop rings S secured to the spindle R, keep the proper distance.

The part G is loose, the part F communicates the movement. In these conditions,
70 by moving the part F about the spindle R in any direction, for instance that shown by the arrow *f*, the counter part G will at first stand still since it is loose on the spindle
75 which is to be driven, and thus there is no action on it.

The rollers, balls or slide blocks 1, 2, 3, 4, 5, held in their recesses made in the rim
80 of the part H cannot advance in the direction of the movement of the part F.

On considering the roller 1, it will be seen that the thickened portion *h i* of the
85 part F which is in front of the said roller and which moves away from the center *o* (Fig. 1) in the direction *h i*, has the tendency to pass under the said roller and to move it in the direction *d e* (arrow *g*)
90 against the part G, the point *b* having the tendency to arrive at *b'*, the point *c* at *c'* etc. On examining Fig. 1, it will be seen that the same applies to the rollers 4 and 5.

The rollers 2 and 3 are not acted upon
95 when the movement takes place in the direction stated and the position is as shown in the drawing. When balls or slide blocks are used, the conditions are the same.

The rollers striking the outside cam G, cannot advance in the direction of the arrow
100 *g*. They are, therefore, forced to follow the movement of the part F, and drive the part H and consequently the spindle R. The part G is also caused to move. In fact, if the rollers did not participate in the movement of the part F, the part G would not
105 participate in the said movement either (the part H would remain stationary), the points situated at *b* would arrive as already stated, at *b'*, those situated at *c-c'*, the thickened portion *h i* would arrive at the
110 same moment into the position *h' i'*, which would be possible only if the rollers or

balls decreased in diameter or if the slide blocks decreased in thickness. The whole of the device, is therefore, properly driven.

Necessary conditions for driving.—If we consider the effect produced on the part G in the present position of the rollers, it will be readily seen that the roller 5, for instance, being pressed against the part G in the direction m at an angle to the line n normal to the surface at the point of contact p , the part G will have the tendency to move in the same direction as the part F, but will not be acted upon as long as the tangent of the angle ϕ formed by the lines m and n will remain less than the coefficient of friction, which can be easily brought about. To that coefficient is then added the effort required for rotating the part G on the spindle R. The tangent of the angle ϕ represents, therefore, in fact the coefficient of friction plus the coefficient representing, in the same terms, the effort which would be required for rotating the part G as hereinbefore described. Where balls or rollers are used, they have the tendency to rotate about their own axis in a direction opposite to that of the part F, and consequently to rotate the part G in the direction opposite to that produced by the pressure. The angle ϕ can then be increased. The rollers, balls or slide blocks, as will be seen later on, can occupy in the groove any desired position; it is sufficient, for obtaining the driving, to design cams which comply at every point with the condition just stated. It goes without saying that by rotating the part F in the opposite direction, the same thing will happen. If the part H is rotated in any desired direction, it will drive by friction the part G: the rollers, balls or slide blocks will be, as before, compressed between the two cams, and the part F will be driven as well as the part G. All possible combinations between the parts F, G and H produce driving. The part F, instead of being mounted on the spindle R, could also be mounted on a second spindle transmitting or receiving movement.

Shape of the cam.—The shape of the cam in the groove is immaterial, provided that the condition for driving hereinbefore specified, be complied with. Nevertheless, in the case of disengagement, which will be considered later on, it is necessary that the groove should be everywhere of the same width.

The shape of and the method of attaching the rollers, balls or slide blocks.—It is not necessary that the rollers, balls or slide blocks should slide or roll in recesses of a rim of the part H. The slide blocks can have any desired shape. The rollers, balls or slide blocks can be secured to the part H in any desired manner, it is necessary and sufficient that they should be capable of slid-

ing or rolling in the groove between the two cams, and of moving farther away from, or coming nearer to, the center of rotation to the necessary extent. This latter condition is indispensable for the disengagement.

Fig. 5—vertical cross-section, Fig. 6—vertical longitudinal section, and Fig. 7 partial horizontal section—show rollers and slide blocks of different shapes and methods of mounting. It will be understood that the several forms of coupling members shown in Fig. 5 are shown in one figure merely for convenience of illustration, and that they are not, in practice, used together in the same clutch.

In the arrangement of eccentric-shaped cams shown in Figs. 5, 6 and 7, it is assumed that the movement is given by the outer cam G^s receiving the movement from its sleeve G' mounted loose on the spindle R^s and rotating in the direction of the arrow f^s . The inner cam F^s is loose on the spindle, and the disk H^s carrying the rollers, keyed to the same spindle R^s , is driven in the direction of the arrow f^s . In the same figures, the pins 6, 7, 8 and 9 connect the parts 1^a , 2^a , 3^a , and 4^a , to the part H^s by means of small connecting rods 9' and 10, or direct by means of the slide blocks (slide blocks 2^a and 4^a). The pins 11 and 12 connect the roller 1^a and the slide block 3^a to the connecting rods 9' and 10. The throwing out of gear or disengagement stop secured to the cam G^s is marked I^s . J^s is the disengagement stop secured to the cam F^s . The rollers, balls or slide blocks can be replaced by a flexible but not compressible part (ring or portion of a ring) or by a chain constituted by any desired number of slide blocks (Fig. 27). The ring or portion of a ring is compressible with slide blocks multiplied to such an extent as to form one single part. The parts, ring or chains, are connected to the part H, so as to be capable of oscillating and of moving to a suitable extent.

Number of rollers, balls or slide blocks.—The number of rollers, balls or slide blocks is also immaterial. It has been seen, however, that the parts 2 and 3, did not participate in the working. In a cam with equal and repeated curves, such as that shown in Figs. 1 and 2, the position of the rim, and consequently of the parts 1, 2, 3, 4, 5, relatively to the curve, determines which of the latter will come into engagement. If, however, the parts 1, 2, 3, 4, 5, were arranged so as to enable them to be in special position of the rim, all tangent to the portion which is the farthest away from the center of the inner cam F, no driving would take place (assuming always that the movement is communicated by the cam F). In order to avoid this dead center, it is sufficient, in a groove with equal and repeated curves, to

place on the rim at equal intervals a number of rollers, balls or slide blocks, either greater than the number of curves, or different from one of its under-multiples. It is also sufficient to arrange on the rim the parts 1, 2, 3, 4, 5, not at equal distances, in which case their number is immaterial. It will still be sufficient to arrange the parts 1, 2, 3, 4, 5, at distances equal to each other, but not equal to the length of the repeated curves of the cam, or to one of the multiples of the said length. If the groove consists of repeated curves, but of unequal length, it will be sufficient to place the rollers, balls or slide blocks in such manner that at a given moment they should not all come to lie at once at the upper points of the curves of the driving part.

Disengagement in one direction.—If we consider a groove of uniform width throughout and forming a closed curve, that is to say, that formed by the two parts F and G, one of which has in relief what the other has in recess and vice-versa, and if the part G is provided with a stop I engaging with the stop J of the part F, the said stops arranged in such manner that the two parts G and F when in engagement leave between them a closed groove of uniform width throughout (Figs. 1-4) by rotating the part F in the direction of the arrow *f*, the stop J of the part F will have the tendency to move away from the stop I, and the whole will be driven. If, on the other hand, the rim H has the tendency to rotate in the same direction and faster than the part F, it will drive the part G, since the rollers, balls or slide blocks are in engagement and compressed. The stop I will strike the stop J, at that moment the groove will again become of uniform width throughout and will remain there. The rollers, balls or slide blocks will be able freely to roll or slide in the groove and will be driven in the direction of the arrow *f* by the part H which will, therefore, be free to continue its movement, the parts 1, 2, 3, 4, 5, simply moving in their respective recesses along the lines *d e* and *e d*, that is to say, alternately moving away from, and coming nearer to, the center of rotation. They will follow the path *a, a...* The parts F and G, not being driven by the part H in that direction, can even stand still. They can also rotate in the direction opposite to that of the part H. The same state of things will obtain if the part G or the part H is given a movement in the direction opposite to that indicated by the arrow *f*.

The direction and the combination of movement depend on the direction in which the stops I and J are arranged. The rollers, balls or slide blocks can stop in this case, at any desired position on the cams. What has been said in the paragraph relating to the

number of the rollers, balls or slide blocks, is therefore, also applicable to this arrangement.

It has been seen that the shape of the groove was any desired; for the disengagement, it is necessary that it should be of uniform width throughout, I and J being in engagement. For a continuous movement, whether circular or any other, it is necessary that the said groove should form a closed curve (in fact, it is impossible to imagine a continuous rectilinear movement). The cams can, therefore, be elliptical (similar ellipses for the disengagement), two inflections such as shown in the arrangement illustrated in Fig. 8—vertical cross-section—where three equidistant rollers are sufficient for driving, or in eccentrics one inflection such as in the construction shown in Fig. 9—vertical cross-section—where two rollers are sufficient for driving. In the latter construction, the cams are constituted by two cylindrical parts having the same eccentricity $o^9 o^{10}$, the centers of rotation of which coincide at o^9 . In this case, disengagement is possible.

Fig. 10 shows a ball construction, the balls rolling in the grooves of the parts F^{10} and G^{10} .

Optional engagement and disengagement.—As already stated, the direction of the disengagement depends on the direction in which the stops are arranged. It is obvious that one of the said stops, or even both, can be removable and could be withdrawn or put in again at will, by means of any desired device. It will thus be possible to obtain:—

1. The engagement in both directions, one of the stops I or J, or both, being withdrawn, so that they should not come into engagement.

2. The engagement in one direction, and the disengagement in the other, the stops I or J being in place.

3. By providing one of the parts, for instance F, with a second, also removable stop, which is arranged at the other side of the stop I (I resting already against J), it will be possible to obtain engagement in both directions, the stop I, or the stop J and the second stop being withdrawn so that they should not enter into engagement. The disengagement in both directions will be obtained with these stops in place.

4. By moving the stops J and second stop together or separately, it will be possible to obtain all the possible combinations of engagement and disengagement.

It is obvious that, instead of providing the part F with a second stop, the part G could be provided with a second stop.

The stops J and its second stop, or I and its second stop, could form one single part having the shape of a fork.

Another arrangement of cams.—It is not necessary that the curves forming the cam groove, should come more or less nearer to the center of rotation. The said groove could be arranged as shown in Fig. 11 in vertical longitudinal section and in Fig. 12 in vertical cross-section.

The part F'' loose on the spindle R'' , presents any surface $b'' b''$. . . The part G'' loose on the spindle R'' , shows in recess what the part F'' shows in projection, and vice-versa (surfaces $e'' e''$). These two parts, held by stop rings S'' so as to leave between them a space forming a cam groove in which the balls, rollers or slide blocks can oscillate along the lines $d'' e''$ and $e'' d''$.

In Figs. 11 and 12, H'' is the part secured to the spindle R'' to be driven. $1^a, 2^a, 3^a, 4^a, 5^a$, are the balls, rollers or slide blocks, and I'' and J'' the stops for the disengagement.

What has been said with reference to the general arrangement and to the disengagement in one direction, is applicable to this arrangement, the rollers, balls or slide blocks not being acted upon when moving away from, or nearer to, the center of rotation, but in the directions $d'' e''$, and $e'' d''$ and following, in the case of the disengagement, the path $a'' a''$. . . This arrangement offers, therefore all combinations of movement previously indicated. The shape of the slide blocks and their system of attachment are always immaterial as long as they can move in order to follow the path $a'' a''$. . .

Figs. 11 and 12 show balls, but it goes without saying that they can be replaced by rollers or slide blocks of any kind. The rollers, balls or slide blocks can be replaced by any desired parts placed in the groove and secured to the spindle to be driven or transmitting the movement, so that they can oscillate or move along $e'' d''$ and $d'' e''$ following the path $a'' a''$. . .

Fig. 13 shows in vertical longitudinal section a slide block K^{13} which has a hub D^{13} keyed to the spindle R^{13} and fitting loosely thereon so that the block is capable of sliding slightly along the lines $d^{13} e^{13}$ or of rocking along the lines $d^{130} e^{130}$ and $e^{130} d^{130}$. The cam surfaces in this construction are formed in the faces of the members F^{13} and G^{13} and their variable contours are obtained by inclining them to the axis of the clutch, so that they tend, when differentially rotated, to pinch the slide-block K^{13} between them. The two arrangements can even be combined, so as to obtain from the blocks a movement along the lines $d'' e''$ and $e'' d''$ (Figs. 11 and 12), while moving away from, and coming nearer to, the center of rotation (Figs. 1 and 2).

As has been explained in the part of this specification relating to the shape and the method of attachment of the rollers, balls

or slide blocks, they can be replaced by a ring, portion of a ring or a flexible part or by a chain formed by slide blocks.

As before, the shape of the groove can be any desired, provided as already explained that the condition necessary to the driving and mentioned in the beginning of this specification, is complied with, and provided that for the automatic disengagement, the groove constituted should be of uniform width throughout, the stops I and J being in engagement, that is to say, one of the cams must have in recess what the other one has in projection, and vice-versa.

One of the simplest constructions consists in obtaining the groove by means of the two parts F and G having, facing each other, planes at an equal angle to the axis of the shaft and consequently parallel when the stops I and J are in engagement.

By rotating one of the parts, their parallel position is destroyed, and the rollers, balls or slide blocks are acted upon. The stops I and J reestablish parallel position.

Rectilinear or any other desired movement.—This system can be arranged for rectilinear or any other desired movement. Fig. 14 (longitudinal section) and Fig. 15 (cross-section) show a construction by means of which rectilinear movement can be obtained. In the said figures, F^{21} indicates the part giving the movement, sliding in the part H^{21} to be driven and provided with a face $b^{21} b^{21}$ the shape of a cam. H^{21} is the part to be driven which slides in the part M^{21} and carries balls, rollers or slide blocks $1^e, 2^e, 3^e$, (which can move in the part H^{21} along the lines $d^{21} e^{21}$ or $e^{21} d^{21}$). G^{21} is the part freely sliding in the part H^{21} and having a cam shaped face $c^{21} c^{21}$. . . M^{21} indicates any stationary part serving as a guide. If the same reasoning as before is followed, it will be obvious that by imparting any desired movement to the part F^{21} , the part H^{21} and also the part G^{21} , will be driven. The movement can also be imparted by any of the parts G^{21}, H^{21} , or F^{21} . By providing the part F^{21} with the stop J^{21} , and the part G^{21} with the stop I^{21} , a disengagement in one direction is obtained. In the position illustrated and in the direction of movement in accordance with the arrow f^{21} , the part F^{21} is driving the part H^{21} but the latter does not drive the part F^{21} . The direction and the combination of movement depend always on the direction in which the stops are arranged. By using removable stops I^{21} and J^{21} , engagement and disengagement in both directions can be obtained. It is obvious moreover that the movement of the part H^{21} as well as F^{21} and G^{21} instead of being rectilinear can follow any desired line. Further, it is not necessary that F^{21} and G^{21} should slide in the part H^{21} . It is sufficient that during their movement, the

parts G^{21} and F^{21} , should be always at the same distance. The rollers, balls or slide blocks can be replaced by a flexible part or by a chain constituted by slide blocks.

5 Finally, the shape of the cam can be any desired, provided that the condition of driving is complied with. For the disengagement, it is necessary that the groove should be of the same width throughout, the stops
10 being in engagement. The two parts F^{23} and G^{23} can, therefore, have flat faces a^{23} a^{230} and b^{23} b^{230} inclined relatively to the direction of their movement, as shown in Fig. 16 in longitudinal section and in Fig. 17 in lon-
15 gitudinal section, the part F^{23} being removed.

Special arrangement for cams of eccentric shape.—When eccentrics are used, the flexible ring or portion of ring, or chain can be
20 replaced by a rigid rim K^{25} (Fig. 18, cross-section, and Fig. 19, longitudinal section) connected at one of its points c^{25} to the part H^{25} , the said ring being moreover capable at the point in question, of moving away from,
25 and of coming nearer to, the center of rotation to a minimum extent of 2ϕ o^{250} and at the same time of oscillating to a minimum extent of 2ϕ about the point c^{25} .

Fig. 20 (cross section) shows one of the
30 numerous constructions which enable the preceding to be carried out. The coupling ring is provided with a nipple K^{270} engaging with the fork of the part H^{27} .

In Figs. 22 and 23 F^{29} indicates the part
35 having an inclined plane a^{29} b^{29} and mounted loose on the spindle R^{29} . G^{29} is a similar part provided with an also inclined plane c^{29} d^{29} (this part is also loose on the spindle R^{29}). H^{29} is a flat washer with parallel faces, keyed
40 to the spindle R^{29} (for instance, in one or more points by means of one or more grooves U^{29} made in the washer H^{29} and engaging with the keys T^{29} arranged for the purpose and secured to the spindle R^{29}) but capable of
45 oscillating on the latter to the minimum extent of l^{29} n^{29} equal to 2ϕ (m^{29} o^{29} at a right angle to s^{129} s^{129} ; n^{29} o^{29} is the axis of H^{29} .) If F^{29} is rotated in any direction, for instance that indicated by the arrow f^{29} , the
50 faces a^{29} b^{29} and c^{29} d^{29} will have the tendency to come out of the parallel (the point b^{29} having the tendency to come into b^{290} etc.), the washer H^{29} will be pushed in accordance with the effective resultant r^{29}
55 (since the washer H^{29} cannot rotate on the spindle R^{29} .)

As has been explained in the beginning of this specification the engagement will last as long as the tangent of the angle ϕ will remain less than the coefficient of friction with the addition specified. The same thing will
60 happen when the movement is communicated by the part H^{29} or G^{29} . By providing the part F^{29} with the stop J^{29} , and the part
65 G^{29} with the stop I^{29} , the disengagement in

the direction of the arrow will be obtained (the part H^{29} rotating for instance quicker than the part F^{29}). The movement being
transmitted by the part F^{29} , for instance in the direction of the arrow f^{29} , the stop J^{29}
70 of the part F^{29} has the tendency to move away from the stop I^{29} of the part G^{29} , and the engagement will take place. If the part R^{29} , and consequently the washer H^{29} , come to rotate more quickly in the same direction,
75 the part G^{29} will also rotate more quickly. The stop I^{29} will come to rest against the stop J^{29} thus reestablishing parallel position of the faces. The washer H^{29} can continue freely its movement by oscillating about the
80 spindle s^{129} s^{129} to the extent of l^{29} n^{29} . The part F^{29} can, therefore, remain stationary, and even rotate in the opposite direction, because it becomes disengaged from the washer H^{29} in the direction opposite to that
85 of the arrow f^{29} , with the given position of the stops. Obviously the same thing happens if the spindle R^{29} or the part H^{29} are given a movement in the direction opposite to that indicated by the arrow. The direction
90 and the combination of movement depend always on the direction in which the stops are placed. The movement can be imparted by the part G^{29} . The part H^{29} can be fixed in any desired manner to the spindle
95 R^{29} . It is sufficient that it should be able to oscillate to the extent l^{29} n^{29} . It is not necessary that the part F^{31} should be loose on the spindle R^{31} . The said part could be keyed to a second spindle R^{310} (or be in one piece with R^{310}) in line with the spindle R^{31} , the parts F^{31} and G^{31} being held at a fixed distance (Fig. 24, longitudinal
100 section). The spindle R^{310} can be the driving or the driven one. In the cells or recesses of the part H^{32} could be arranged rollers, balls or slide blocks rolling or sliding on the planes a^{32} b^{32} c^{32} d^{32} or in suitable grooves (Fig. 25, longitudinal section, and Fig. 26, half cross-section). The movement
105 is assumed to be communicated by the part G^{32} in the direction of the arrow f^{32} . The spindle R^{32} is stationary and forms the axis, and the sleeve M^{32} loose on the spindle R^{32} , receives the movement. The rollers, balls
110 or slide blocks no longer move relatively to the part H^{32} , but on the contrary it is the latter which moves.

The part H^{29} (Figs. 22 and 23) being subjected only to crushing strains and being
120 placed edgewise for the engagement, can be very thin. A wider hub penetrating into the recesses made in the parts F^{29} and G^{29} , enables the attachment to be effected by keying or in some other way.
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Special arrangement for any cams with flat faces.—Like the eccentric cams and the cams with inclined planes, any cams with flat faces can be used for special arrangements. The rollers, balls, slide blocks, chain
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or flexible part could be replaced in this case by a rigid part sliding between the two planes and secured to the driving or the driven part, so that it can move along the lines $d^{23} e^{23}$ and $e^{23} d^{23}$. Figs. 16 and 17 show a construction of the above kind. The movement of the parts F^{23} and G^{23} is shown rectilinear, but it could be any desired. In this arrangement the part F^{23} can move along the lines $h^{23} h^{230}$ and $h^{230} h^{23}$ and is provided with a face $a^{23} a^{230}$ inclined relatively to $h^{23} h^{230}$. The part G^{23} can move along the lines $i^{23} i^{230}$ and $i^{230} i^{23}$ parallel to $h^{23} h^{230}$ and is also provided with an inclined face $b^{23} b^{230}$ (this latter condition being essential for the disengagement). On the other hand, the slide part K^{23} with parallel faces, connected at K^{230} to the part H^{23} to be driven, can move in the part H^{23} along the lines $d^{23} e^{23}$ and $e^{23} d^{23}$. The same reasoning applies as for the construction with inclined planes previously described. If the part F^{23} is given a movement in the direction of the arrow f^{23} , the point l^{23} having the tendency to arrive at l^{230} , the part K^{23} is pressed in the direction of the effective resultant m^{23} and comes to rest against the part G^{23} , but as the part G^{23} cannot move in that direction, K^{23} will be driven in the direction of the part F^{23} . The part G^{23} will also be driven in that direction. By giving to the part G^{23} a movement in the direction opposite to that of the arrow f^{23} , the whole device will be driven. The parts will be also in gear or in engagement as long as the condition necessary for driving, specified in the beginning of this description, is complied with (tangent of the angle ϕ smaller than the coefficient of friction increased as already stated— n o normal to $b b'$). The position illustrated drives only in one direction. By giving respectively to the parts F^{23} and G^{23} the movement in the opposite direction to those above mentioned, no driving will take place, the distance comprised between the surfaces $a^{23} a^{230}$ and $b^{23} b^{230}$ increasing. By giving to the part K^{23} the movement indicated by the arrow, the part G^{23} will be driven in the same direction. The driving of the part F^{23} takes place in the direction opposite to that of the arrow f^{23} , if the part K^{23} is given a movement in the direction opposite to that of the arrow f^{23} . By providing the part F^{23} with the stop J^{23} , and the part G^{23} with the stop I^{23} , disengagement is obtained in one direction. In the position indicated, the part K^{23} being driven, becomes disengaged from the part K^{23} which is the driving part, in the direction of the arrow f^{23} , in the event of the part K^{23} moving in that direction more quickly than the part F^{23} . The part F^{23} can, therefore, move in the direction opposite to that of the arrow f^{23} without driving the part K^{23} . These arrangements of cams are given merely by

way of example, and it is obvious that they could vary *ad infinitum*.

Free wheel clutches and the like.—The clutch with disengagement in one direction can make an excellent free wheel clutch. If we take again any of the constructions, for instance that shown in Figs. 1, 2, 3 and 4, and assume the part F to be fixed relatively to the space or to any part, all the other arrangements remaining the same, the spindle and consequently the part H will be free to rotate in the direction of the arrow f . The stop I of the part G comes in fact against the stop J of the part F , forming a groove of uniform width in which can move rollers, balls or slide blocks. If the part H has the tendency to go back, the part G will follow the same movement, being driven by the friction on the spindle R and the rollers, balls or slide blocks which enter into engagement, and the part is at once coupled to the part F . But as the part F is stationary, it follows that the part H cannot go back. This construction can, therefore, replace the existing free wheel clutches and the like, with the advantage that it makes possible instantaneous stoppage and in any desired position. The part G can be stationary, and the part F loose (the spindle R cannot move in the direction of the arrow with the stops in the position shown). The part H can be stationary, G loose or to be coupled, F loose or to be coupled. The part F can be in one piece with, or keyed to, the spindle R which rotates in the part H which is stationary, the part G being mounted loose on the part H (for instance on its extended sleeve; the said part H can form the bearing for the spindle). In the position occupied in the drawing by the stops I and J , the part F can then freely rotate in the direction opposite to that of the arrow, but cannot rotate in the direction of the said arrow. In order to obtain this backward rotation it is sufficient to keep, by means of an adjustable tappet, the stop I in engagement with the stop J . As long as the said stops are in engagement, complete disengagement will be obtained. As soon as the tappet is removed, the stops I and J will have the tendency to move apart, and the stopping will take place. It will also be sufficient to give to the part G which is loose, by any desired means, a movement in the direction of the arrow f , so as to bring the part I against the stop J , and the disengagement of the part H from the parts F and G is obtained. By releasing the part G the stopping takes place. In order to obtain backward rotation if desired, without any risk of racing, let it be assumed that the part H is stationary, the part F to be coupled, the part G loose; the part F engages, that is to say, it cannot rotate in the direction of the arrow f . If it is desired to move the part F in that di-

rection, it is sufficient to move the part G in the same direction. The stop I is then brought against the stop J, and disengagement from the part H is obtained without at the same time the part F being able to rotate quicker than the part G or to drive the same, for the stop J would at once have the tendency to move away from the stop I, and there would take place the engagement with the part H. The part F can, therefore, only follow the movement given to the part G without driving it or rotating faster. The same happens if it is desired to engage the part G. All the previously described constructions of clutch can apply to this combination forming a free wheel.

Clutch engaging in one direction and disengaging in both directions.—Let us take again any one of the constructions, for instance that shown in Figs. 1, 2, 3 and 4. It has been seen in the beginning of this description when it was question of disengagement in one direction, that supposing that the movement is given in the direction of the arrow *f* by the part F, the part H, and consequently the spindle R, will be driven in the same direction, but if the spindle R, were to rotate quicker in the same direction, the stop I would strike the stop J and the balls, rollers or slide blocks would be able to move freely between the parts G and F, so that the latter would not be driven. If, for any reason, the part H rotates backward, the part G will rotate back with it. The stops I and J will have the tendency to move apart, so that the part F will thus be brought back. In order to have disengagement also in that direction, it is sufficient to prevent the part G from following the backward movement of the part H (nevertheless, the part G can be left the possibility of moving forward) by means either of a pawl device or of a device fulfilling the same object, or by means of a second clutch forming a free wheel clutch, as described in the paragraph relating to free wheel clutches and the like. The stop J of the part F will then come against the stop I of the part G, and the rollers, balls or slide blocks will also be able to circulate freely in the direction opposite to that of the arrow *f*, between the parts F and G. The part F will then be disengaged also in that direction. The above "return free wheel clutch" can be replaced by a second stop I' arranged at the other side of the stop J, rising when the part G rotates in the direction of the arrow, and descending and consequently striking the stop J, when the part G has the tendency to rotate in the opposite direction. The two stops I and I' can constitute a single fork which becomes disengaged from the stop J in the forward movement. (arrow *f*), and engages with the stop J during the movement backward. It is obvious that this arrangement can be applied to the

stop J instead of the stop I. During the backward movement of the part H, it is possible to brake that movement (direction opposite to that of the arrow *f*) or even to stop it altogether by means of an effort having the tendency to rotate the part F in the direction of the arrow *f*. The parts F or G can be the driving parts, and H the driven part. The latter can be the driving part, and G or F the driven parts. Like the previous constructions, this construction is applicable to any of the clutch constructions described. It is obvious that:—The part F can be mounted loose on the spindle R, and the part H keyed to the same spindle. The parts F and H can be keyed to two separate spindles which have to drive each other, arranged end to end at a fixed distance. The driving part G can be arranged in the same ways as the part F, and conversely. All these combinations are applicable to the construction for rectilinear or any other movement, in which the spindle R hereinbefore mentioned represents the driving or the driven part and can be secured to (or be in one piece with) the parts H, F or G. The disengagement is obtained by suitably arranging the stops. In the same way, two or even more different parts can be coupled.

The construction for optional coupling and uncoupling by means of movable stops mentioned in the beginning of this specification, can be obviously applied to any of the constructions described, including free wheel clutches, locking devices, etc.

The condition necessary for driving, explained in the beginning of this specification, can also be applied to all the constructions described, clutches, free wheel clutches, brakes or locking devices.

Among the numerous applications for which can be used the automatic clutch construction described may be mentioned the following:—1. A clutch for replacing couplings and keys. 2. A clutch automatically disengaging in one direction. 3. A device capable of replacing free wheel clutches and the like and capable of forming at will a safety apparatus for the return. 4. A safety device and automatic stop for hoisting apparatus. 5. An automatic coupling for connecting two engines. 6. An automatic coupling for connecting several engines or making possible by means of one engine to drive one or more parts leaving the latter free to increase temporarily their speed (replacing differential gear). 7. Optional throwing into and out of gear coupling. 8. Free wheels and fixed wheels at will. 9. Crank for starting explosion and other engines, by means of which the turning back is avoided. 10. Driving cranks of any kind for hoisting apparatus, shop front, blinds, etc., making it possible to apply the brake during the descent and thus forming a safety apparatus

during the descent. 11. Locking device for nuts, bolts and other parts, etc.

I claim:

1. In an automatic clutch, two relatively movable clutch-members provided with opposite and equal surfaces, coupling means adapted to be clamped between said members and carried by one of the same, a driving-member engaging said coupling means, and means for moving said clutch-members relatively to each other into and out of clamping connection with said coupling means.

2. In an automatic clutch, the combination of a pair of relatively movable cams together forming, when in one position, a groove of constant width and when in another position of varying width, and engaging means within said groove, said means being of less than said constant width but greater than the smallest varying width of said groove.

3. In an automatic clutch, the combination of a pair of relatively movable cams together forming, when in one position, a groove of constant width and when in another position of varying width, engaging means within said groove, said means being of less than said constant width but greater than the smallest varying width of said groove, and means for limiting the relative movement of said cams.

4. In an automatic clutch, the combination of a pair of relatively movable cams together forming, when in one position, a groove of constant width and when in another position of varying width, engaging means within said groove, said means being of less than said constant width but greater than the smallest varying width of said groove, and means carried by said cams for limiting the relative movement thereof.

5. In an automatic clutch, the combination of a pair of relatively movable cams together forming, when in one relative position,

a groove of constant width, and forming when in another relative position, a groove of varying width, engaging means within said groove, said means being of less than said constant width but greater than the smallest varying width of said groove, an additional moving part, and means for communicating motion between said additional part and said engaging means.

6. In an automatic clutch, the combination of a pair of relatively movable cams together forming, when in one relative position, a groove of constant width, and forming when in another relative position, a groove of varying width, engaging means within said groove, said means being of less than said constant width but greater than the smallest varying width of said groove, an additional moving part, means for communicating motion between said additional part and said engaging means, and means for limiting the relative movement between said cams.

7. In an automatic clutch, two relatively movable cam members provided with opposite and equal pressure surfaces, forming between them a groove of variable width, said groove being of less width in engaging than in disengaging position, a driving-member having recesses, coupling-balls in said recesses and in said groove, said balls being shiftable in the recesses, and of greater diameter than the engaging width of said groove, but of less than the disengaging width thereof, means for moving one of said movable cam-members, and stops for limiting the movement of said cam-members relatively to each other.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

LOUIS EUGÈNE CLÉMENCET.

Witnesses:

EMILE LEDRET,

DEAN B. MASON.