No. 814,133. PATENTED MAR. 6, 1906.

H. S. HELE-SHAW.

STARTING, STOPPING, SPEED CONTROLLING, AND REVERSING GEAR.

APPLICATION FILED DEC. 16, 1903. RENEWED JAN. 9, 1906.

3 SHEETS—SHEET 1.

Fig. I.

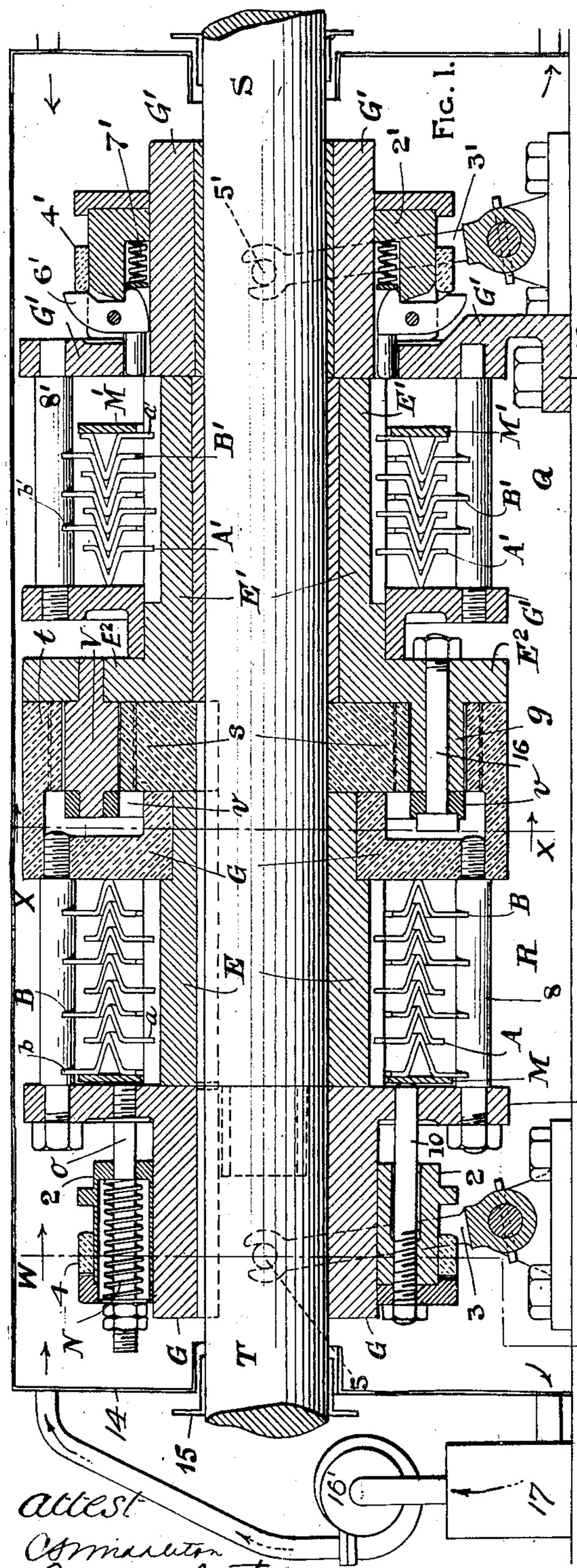


Fig. V.

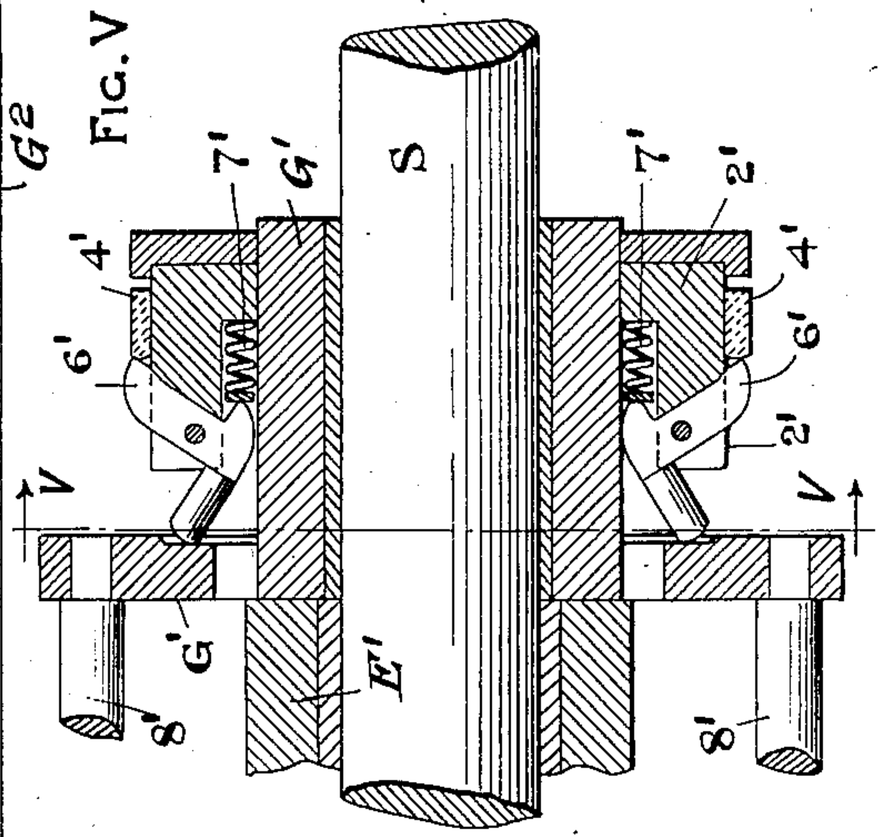
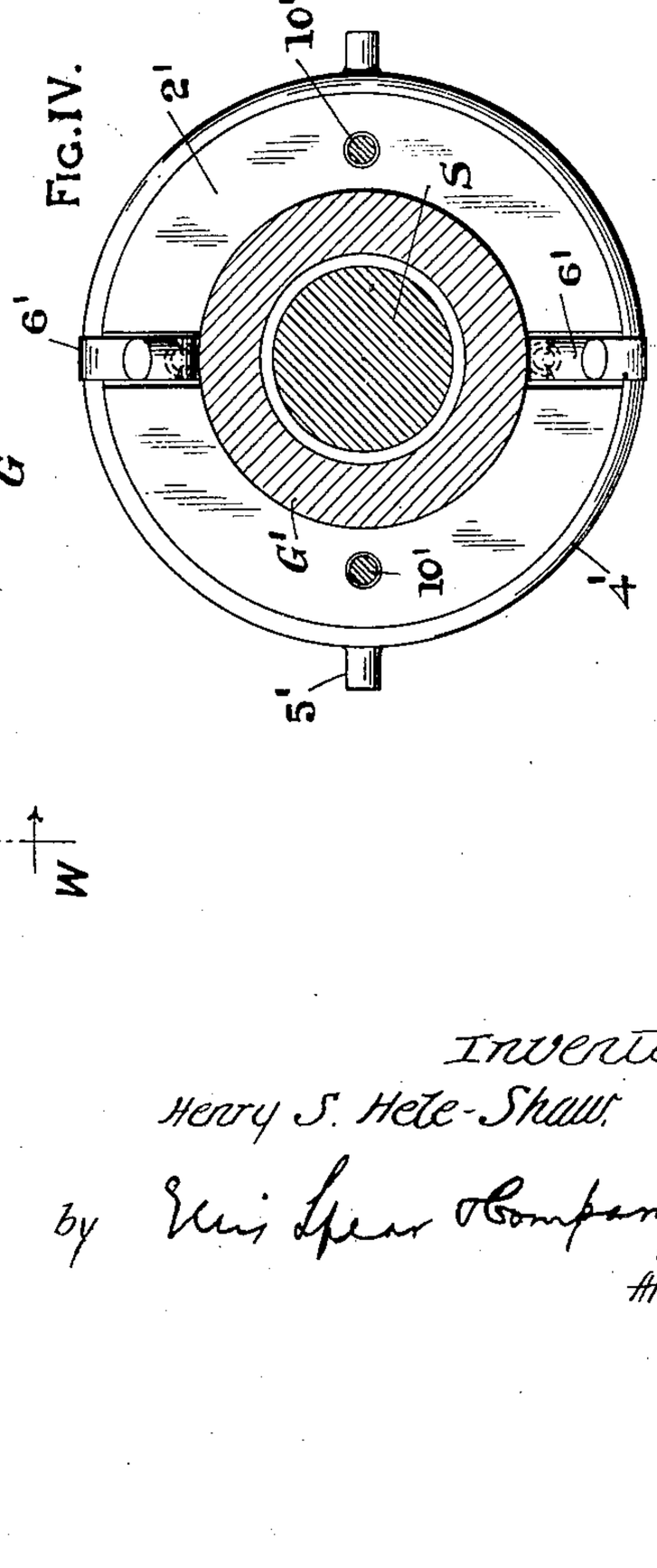


Fig. IV.



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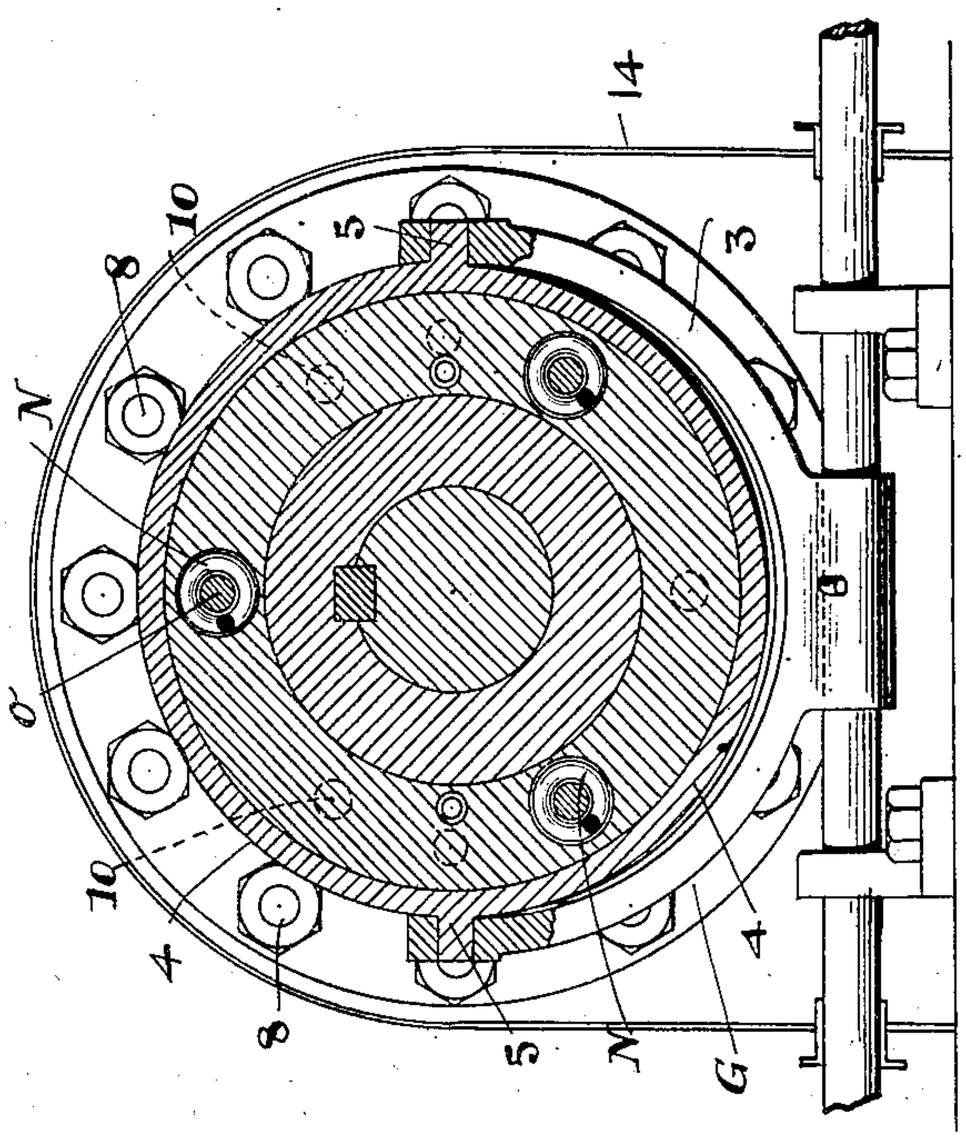
3 SHEETS—SHEET 2.

FIG. III.



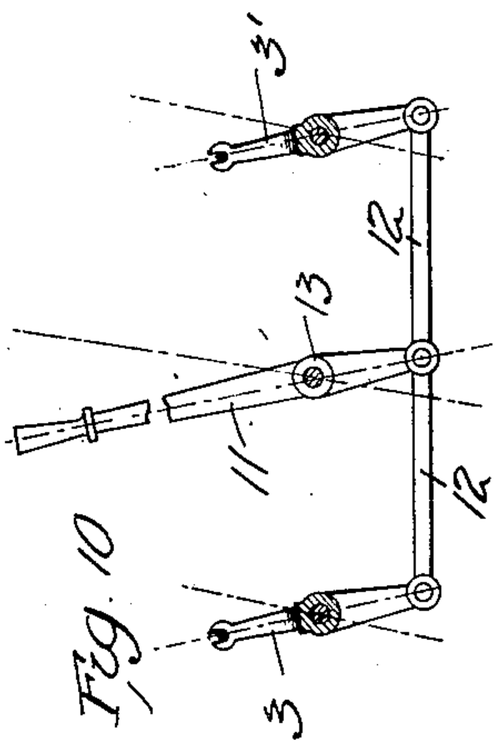


Fig. 10

FIG. II.

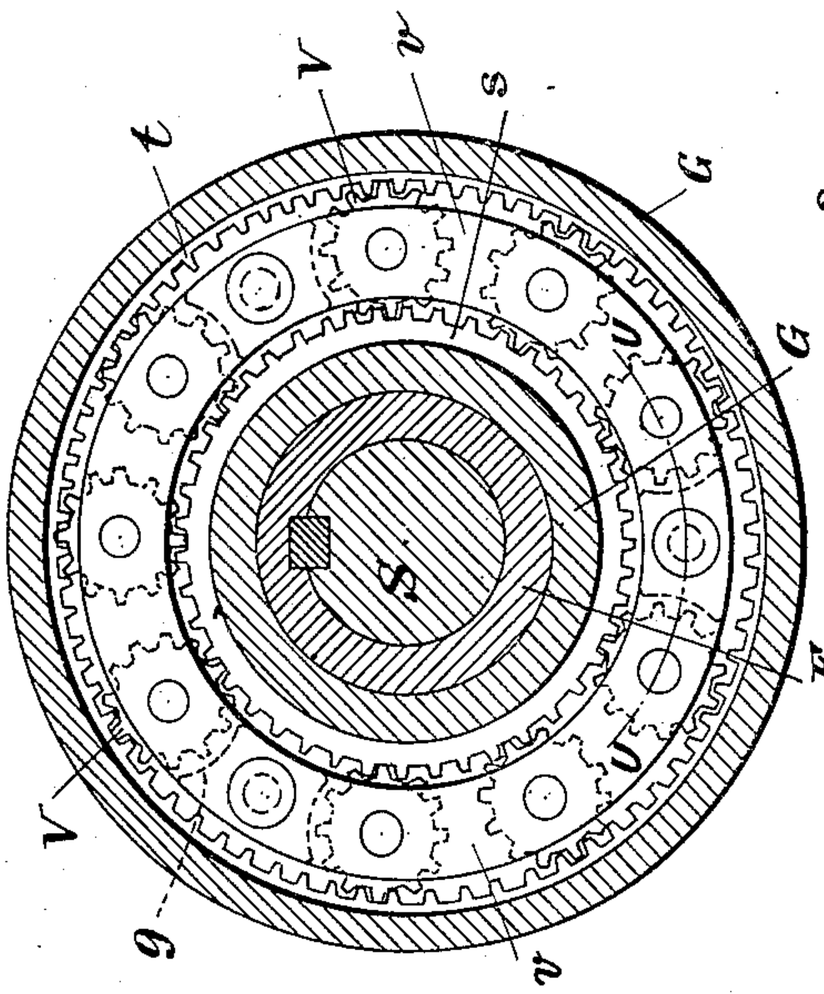
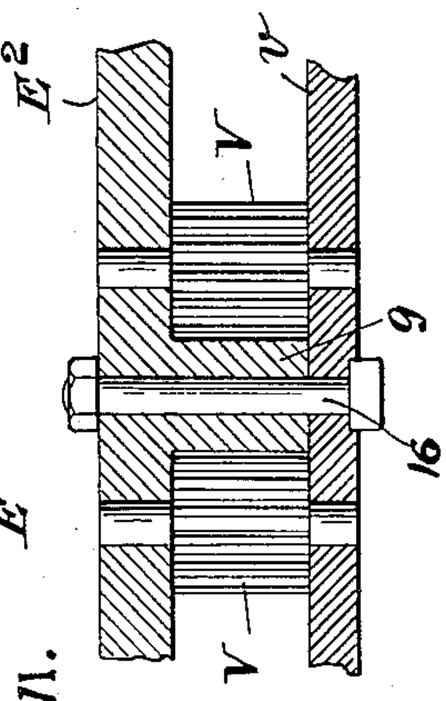


FIG. VI.



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3 SHEETS—SHEET 3.

FIG. IX.

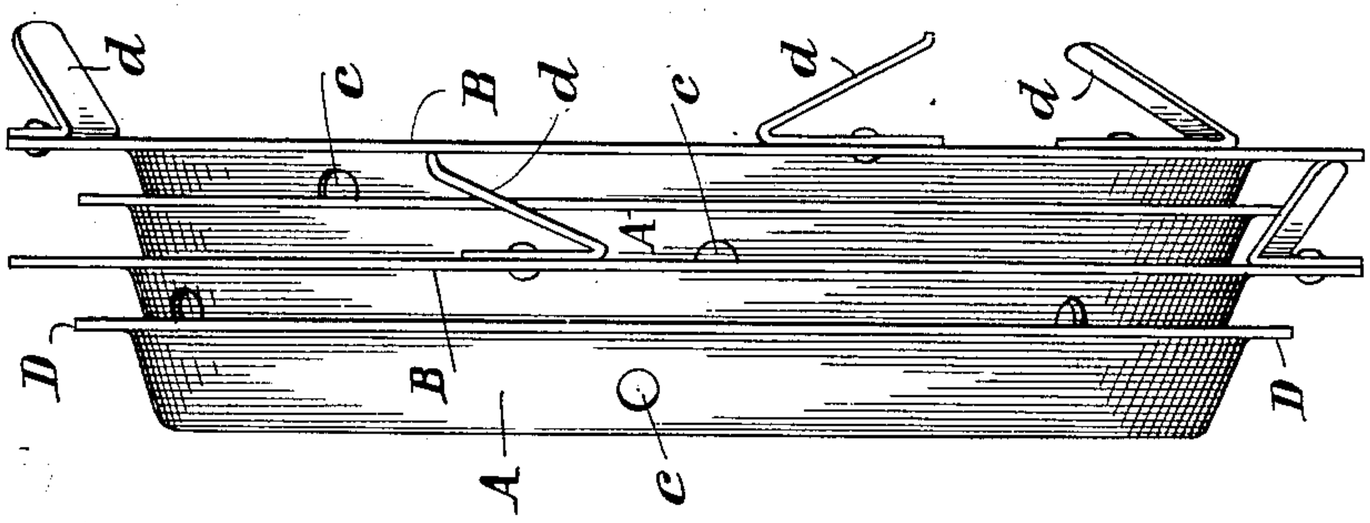


FIG. VIII.

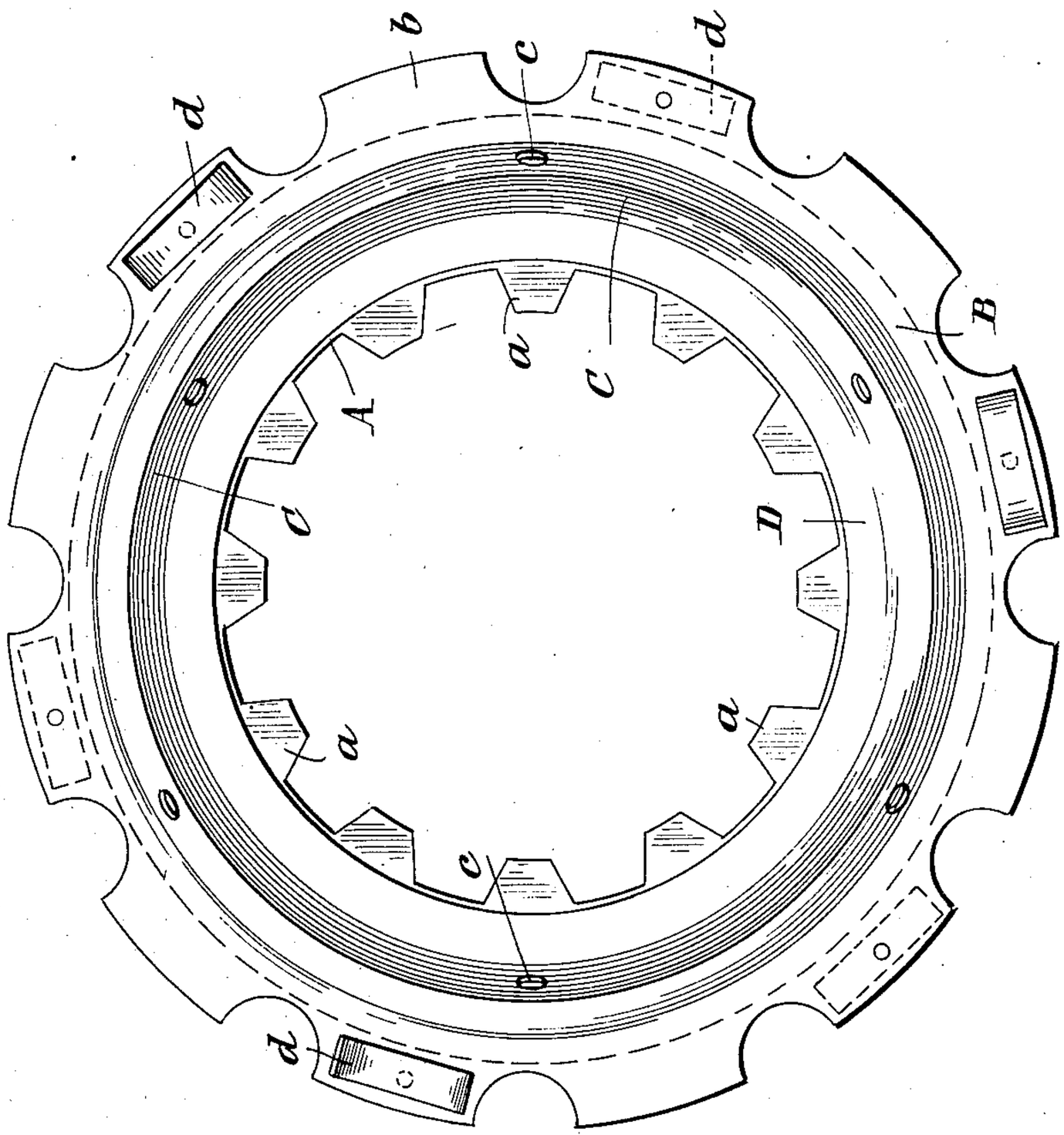
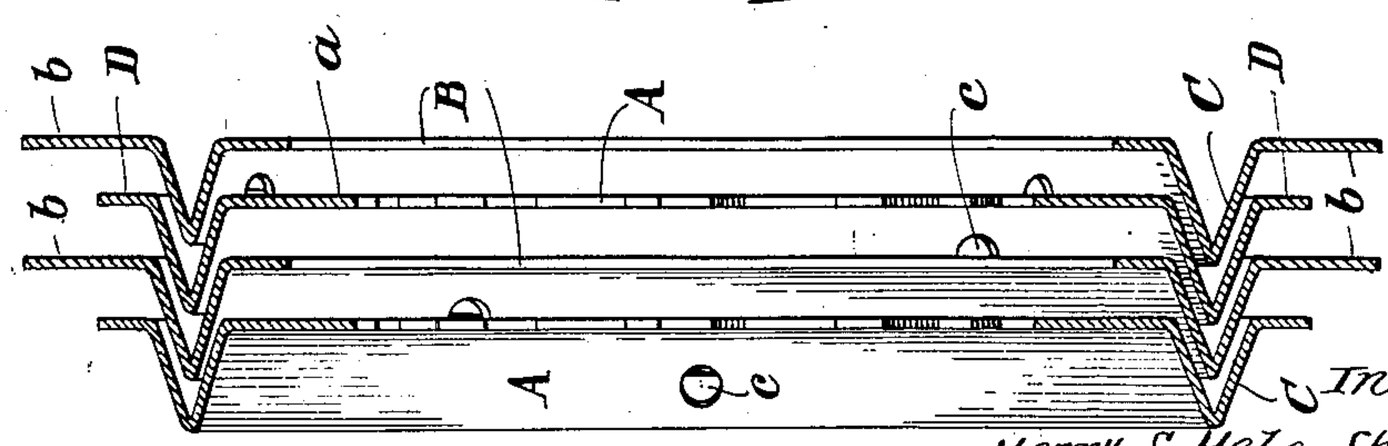


FIG. VII.



Attest:
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Inventor:
Henry S. Hele-Shaw.
by Ellis Spear & Company Attys

UNITED STATES PATENT OFFICE.

HENRY SELBY HELE-SHAW, OF LIVERPOOL, ENGLAND.

STARTING, STOPPING, SPEED-CONTROLLING, AND REVERSING GEAR.

No. 814,133. Specification of Letters Patent. Patented March 6, 1906.

Application filed December 16, 1903. Renewed January 9, 1906. Serial No. 295,321.

To all whom it may concern:

Be it known that I, HENRY SELBY HELE-SHAW, a subject of the King of Great Britain, residing in Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in Starting, Stopping, Speed-Controlling, and Reversing Gear, of which the following is a specification.

This invention relates to a starting, stopping, speed-controlling, and reversing gear—such, for example, as would be adapted for use with a marine engine of the turbine type or with a gas or petrol engine where it is desired to reverse and control the speed of the driven part, such as the propeller, without varying the speed or direction of the engine.

I have illustrated my invention in the accompanying drawings, in which—

Figure I is an axial section; Figs. II and III, transverse sections on the lines X X and W W, respectively, of Fig. I, and Figs. IV, V, and VI views of details, Fig. IV being a section on the line V V of Fig. V and Fig. VI a section on the line U U of Fig. II. Figs. VII, VIII, and IX are detail views of the engaging plates. Fig. X is a view of the means for operating the clutches.

The reversing-gear comprises, broadly, two clutches Q and R, Fig. I, and an interposed gear.

The clutches illustrated are those known as the "Hele-Shaw" clutch, which forms the subject-matter of another application for Letters Patent. Briefly described, each clutch comprises two sets A and B of identically-corrugated plates each formed of plates the engaging surfaces of which are corrugated, as at C, Figs. VII, VIII, and IX. The two sets of plates are connected, respectively, to the parts of the mechanism which require to be connected by the clutch, the plates A by the internal teeth *a* and the plates B by the external teeth *b*.

From an inspection of Figs. VII, VIII, and IX it will be noted that there is but the one fairly deep circumferential corrugation C and that in both the A plates and the B plates there are on the inside and on the outside of the corrugation plain annular parts D. These plain parts of the plates form, when the plates are assembled, a series of internal and external fins or flanges, which I find of great advantage, first, in strengthening the plates to resist distortion in the direction of their own planes, and, second, in providing very effective heat-radiating surfaces. The flanges are notched, as hereinafter described, and holes *c* are formed in the sides of the corrugations. The construction of these plates is fully described in the specification to an application for a United States patent made by me and filed on the same date as the present application—namely, December 16, 1903—No. 185,444.

The alternate plates B are normally held apart by springs *d* attached thereto, in which case the clutch runs "free." When engagement is desired, the plates are pressed together by a force sufficient to overcome the springs *d*. This force is usually supplied by springs normally tending to press the plates together, but held off when the clutch is to run free. The pressure of these springs may be controlled so that the force is sufficient either to produce an engagement which permits of no slip or to produce a slipping engagement. The plates are immersed in a lubricant inclosed in the outer casing 14, which circulates through the holes *c* and lubricates the plates and absorbs the heat generated.

Referring now to Fig. I, T is the shaft, the speed of which is constant and unidirectional—say the shaft of an engine. S is a prolongation of this shaft, attached, say, to the propeller. The two elements of the clutch R are attached, respectively, to these two shafts. The outer element comprises the plates B and the boss and end plates G, united by bars 8, which latter fit freely in the notches formed between the teeth *b* in the peripheries of the plates B. The internally-toothed wheel *t* is attached to or formed intergal with this element of the clutch R. The inner element of R comprises the plates A and feathered sleeve E, into the feather-ways of which the teeth *a*, formed on the inner peripheries of the plates A, freely fit. The externally-toothed wheel *s* is attached to or formed integral with this element of the clutch R. The end plate G at the left of Fig. I is keyed to the shaft T, and E is keyed to the shaft S.

The clutch Q is of similar construction. The outer element of this clutch comprises the plates B′ and the boss and end plates G′, united by the bars 8′. This element is held fixed by the foot G^2. The inner element of Q comprises the plates A′, feathered sleeve E′, and flange E^2. The teeth *a*′ of plates A′ loosely fit the feather-ways of E′, and the

sleeve can rotate freely on the shaft S, a bush being interposed, if necessary. This element of the clutch Q carries the series of pinions V, which gear with the wheels *s* and *t*. I find it advantageous to support the pinions at each end, and this may be done by forming abutments 9 on the flange E^2, from which abutments is carried the ring *v* by bolts, as shown. The pinions are journaled at each end, and these journals fit in bearings formed, respectively, in the ring *v* and in the flange E^2.

When both clutches are disengaged, no motion is transmitted between the shafts T and S. When, however, the plates A and B of the clutch R are engaged and the plates A′ and B′ of the clutch Q are free, the inner and outer elements of the clutch R being locked together rotate the internally-toothed wheel *t*, externally-toothed wheel *s*, pinions V, and the inner element of the clutch Q as a whole, and the shafts T and S are directly engaged and rotate in the same direction at the same speed when there is no slip or at different speeds when slip is permitted. If, as illustrated in Fig. I, the plates A′ and B′ of the clutch Q be engaged and those of R be free, the wheel *t* turns with the shaft T, and as the pinions cannot now rotate bodily they rotate on their own axes and turn the wheel *s* and the shaft S in the opposite direction to that of the shaft T.

The means for controlling the pressure between the plates A and B of each clutch comprise a sleeve 2, sliding on the boss G and urged forward toward the plates by springs N, located in holes in the sleeve. One end of each spring is adjustably held by the locking-nuts on the pin *o*, and the other end presses against the bottom of the hole. This pressure is transmitted by adjustable presser-pins 10 through a plate M to the plates A and B. The sleeve is operated by the forked lever 3, ring 4, and lugs 5, the ring 4 having a limited play in the groove formed on 2. This arrangement is fitted to the plates 2 of both clutches, although only shown in the section of the clutch R.

To hold the sleeve in its non-operative position, triggers 6 are fulcrumed in the sleeve, and when the sleeve is withdrawn the springs 7 engage the heels of the triggers and tilt them till the cylindrical portions of the triggers engage with the casing G. When the ring 4 is moved back it engages the shoulders of the triggers and tilts them till the cylindrical parts enter holes in G, and so allow the springs N to exert pressure on the plates.

The triggers are fitted to both clutches, although only shown in the section of the clutch Q.

The interlocked means for operating the clutches are shown in Fig. X. Each of the levers 3 and 3′ is connected by a rod 12 to a lever 11, fulcrumed at 13. The lever 11 thus disengages the one clutch as it engages the other, so that it is impossible to engage both at once. In mid-position both clutches may be disengaged.

I have referred to T as the engine-shaft and S as the prolongation. In this case the rotation of S when the clutch R is free and Q is engaged in the reverse direction is at a higher speed than T. It is obvious, however, that S may be the engine-shaft and T the prolongation, in which case the reverse rotation of T will be at a lower speed than that of S.

The whole apparatus is inclosed in a casing 14, out of which the shafts T and S pass through glands and stuffing-boxes 15, and the casing is partly filled with a suitable lubricant, and external means, such as the pump 16′ and refrigerator 17, may be provided, if desired, to circulate the lubricant through the casing and to cool the lubricant.

In the drawings similar parts of both clutches are indicated by the same reference letters and numerals, the parts relating to the clutch Q being distinguished by the addition of a prime-mark.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a reversing-gear, the combination of two shafts in axial alinement, a direct clutch between the two shafts at adjacent ends thereof, an externally-toothed wheel fixed to the one shaft, an internally-toothed wheel fixed to the other shaft, planetary pinions gearing with the said wheels and a second clutch the one part of which carries the said planetary pinions and the other part of which is fixed.

2. In combination the two shafts in axial alinement, a direct clutch between the two shafts, an internal gear associated with part of said clutch, a gear on the shaft to be driven, pinions between the said gear and the internal gear, a sleeve to which the pinions are connected, and a clutch associated with the said sleeve, substantially as described.

3. In combination, a fixed frame the two shafts in axial alinement, a direct clutch between the two shafts comprising a series of corrugated plates, an internal gear carried by a part of the said clutch, a gear fixed on the shaft to be driven, pinions between the said gear and the internal gear, a sleeve surrounding the shaft to be driven and loose thereon, and carrying the said pinions and a clutch associated with the said sleeve, said clutch comprising one set of plates carried by the sleeve and a second set of plates held against rotation in the fixed frame and means for operating the clutches, substantially as described.

4. In combination, the two shafts in axial alinement, a direct clutch between them, the internal gear, the external gear, the pinions, a clutch carrying the pinions, and interlocked

means for operating the clutches, substantially as described.

5. In combination with the shafts the clutches and the internal and external gear, a ring carried by the clutch-boss the pinions journaled at one end to the clutch-boss and at the other end to the ring, substantially as described.

6. In combination with the shafts the clutches and the gears, a fixed casing inclosing the adjacent ends of the shafts and closing the clutches and gears and adapted to contain lubricant, substantially as described.

7. In combination, the shafts, the clutches, the gears, the fixed casing inclosing these elements, the interlocked levers, and means passing fluid-tight through the casing connecting said levers to the clutch-operating devices, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

HENRY SELBY HELE-SHAW.

Witnesses:

J. E. LLOYD BARNES,

H. WATSON.