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PATENT SPECIFICATION

Application Date, May 25, 1916. No. 7401/16.
Complete Left, Nov. 24, 1916.
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PROVISIONAL SPECIFICATION.

Improvements in, or relating to, the Valve Mechanism of Internal Combustion Engines having Triple Rows of Cylinders.

We, WOLSELEY MOTORS, LIMITED, of Adderley Park, in the City of Birmingham, Manufacturers, and JAMES DAVIES PITT, of the same address, Engineer in the employment of the said Company, do hereby declare the nature of this invention to be as follows :—

This invention relates to the type of internal combustion engine which has a triple row of cylinders of which the pistons are all connected with a common crank-shaft, a type which is specially adapted for air-craft ; and has for its object to simplify, and in consequence reduce the cost of, the means by which the valves are operated from the said shaft.

According to this invention, the cam-shafts, which are arranged overhead, are all driven, from the crank-shaft, by a pair of bevel wheels of which the driven wheel is rigid with a vertical shaft which drives the middle cam-shaft through the medium of a pair of bevel wheels. The cam-shafts for the side rows of cylinders are each driven by an inclined shaft which at its lower end has rigid therewith a wheel which gears with a wheel of the vertical shaft which is common to the two wheels which are on the lower ends of the inclined shafts, those wheels consequently lying at obtuse angles with the common wheel. The inclined shafts drive the corresponding cam-shafts through the medium of pairs of bevel wheels.

The three cam shafts can all be driven in the same direction of rotation by arranging that the bevel wheel of the middle cam-shaft is driven at the side which is away from the axis of the crank-shaft, while the bevel wheels of the other cam-shafts are driven at their sides which are towards the axis of the crank-shaft, or *vice versa*, which permits of the cam-shafts being all made exactly alike.

Conveniently, in the case of a 4-stroke cycle engine, the drive from the crank-shaft to the vertical shaft is arranged to give a two-to-one speed, in which case the wheel of the vertical shaft which gears with the lower wheels of the inclined shafts, and such wheels, are preferably of the same diameter, which requires that the wheels by which the drive is transmitted from the vertical and inclined shafts to the cam-shafts shall be mitre wheels. The gears may, however, be proportioned in any desired manner to ensure the required speed of revolution of the cam-shafts in relation to the crank-shaft, whether the engine is of the 4-cycle type or of other type.

As is usual in this class of engine, provision, such as sliding couplings, would be made, in connection with the vertical and inclined shafts, to compensate for expansion which might slightly modify the distance between the cam-shafts

[*Price* 6*d*.]

and the crank-shaft, and also to compensate otherwise as may be required, such as in respect of non-lineability, and to simplify dismantling and assembling.

Dated this 24th day of May, 1916.

STEPHEN WATKINS, SON & GROVES,
Chartered Patent Agents,
Metropolitan Chambers, Wolverhampton,
Agents for the Applicants.

COMPLETE SPECIFICATION.

Improvements in, or relating to, the Valve Mechanism of Internal Combustion Engines having Triple Rows of Cylinders.

We, WOLSELEY MOTORS, LIMITED, of Adderley Park, in the City of Birmingham, Manufacturers, and JAMES DAVIES PITT, of the same address, Engineer in the employment of the said Company, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

This invention relates to the type of internal combustion engine which has a triple row of cylinders of which the pistons are all connected with a common crank-shaft, a type which is specially adapted for air-craft ; and has for its object to simplify the means by which the valves are operated from the said shaft.

According to this invention, overhead cam-shafts for operating valves of the rows of cylinders respectively, are driven from the crank-shaft, through the medium of shafts (hereinafter termed, when required to distinguish them, " intermediate shafts "), respectively, which are inclined in relation to one another but of which the middle shaft would usually be vertical, and the three intermediate shafts are driven from the crank-shaft through the medium of a pair of bevel wheels of which the driven wheel is carried preferably by the middle intermediate-shaft, that is to say, the shaft which drives the middle cam-shaft, and the other intermediate shafts are each driven from the intermediate shaft which is driven by the crank-shaft. The intermediate shafts drive the cam-shafts, respectively, through the medium of pairs of bevel wheels. The two outer intermediate shafts are geared with the middle one of such shafts by means of bevel wheels on their lower ends which gear with a single bevel wheel of the middle shaft.

The three cam-shafts can all be driven in the same direction of rotation by arranging that the bevel wheel of the middle cam-shaft is driven at the side which is the more remote from the axis of the crank-shaft, while the bevel wheels of the other cam-shafts are driven at their sides which are towards the axis of the crank-shaft, or *vice versa*, which permits of the cam-shafts being made all exactly alike.

Conveniently, in the case of a 4-stroke cycle engine, the drive from the crank-shaft to the intermediate shaft which drives the other intermediate shafts is arranged to give a two-to-one speed, in which case the wheel of the middle intermediate shaft which gears with the wheels of the other intermediate shafts, and such wheels, are preferably all the same diameter, which requires that the wheels by which the drive is transmitted from the intermediate shafts to the cam-shafts shall be mitre wheels. The gears may, however, be proportioned in any desired manner to ensure the required speed of revolution of the cam-shafts in relation to the crank-shaft, whether the engine is of the 4-stroke or 2-stroke cycle.

Provision is made, such as by sliding connections, between separately-formed

lengths of the intermediate shafts, to compensate for slight modifications in the distance between the cam-shafts and the crank-shaft, due to expansion and contraction of the engine frame, and also to compensate otherwise as may be required, such as in respect of non-lineability, and to simplify dismantling and assembling.

In order that the invention may be clearly understood, we will now describe a convenient practical application thereof by reference to the drawing herewith, which shows the same as a vertical section thereof taken in the plane within which the axes lie of the intermediate shafts through which the cam-shafts are driven from the crank-shaft.

The crank-shaft A is indicated by a broken line circle, and carries a bevel pinion A^1 indicated by broken line circles. B is the middle intermediate shaft which drives the cam-shaft C for operating valves of the middle row of cylinders. B^1, B^1 are inclined intermediate shafts for driving, respectively, the cam-shafts C^1, C^1, for operating valves of the outer rows of cylinders. A bevel wheel D carried on the lower end of the shaft B gears with the bevel pinion A^1 and is driven thereby, and a bevel wheel E is also carried by the shaft B. Bevel wheels E^1 carried on the lower ends of the shafts B^1, respectively, mesh with the wheel E, which is common to them. The shaft B is consequently driven direct from the crank-shaft through the medium of the bevel gears A^1, D, and the shafts B^1 are driven from the bevel wheel E through the medium of the bevel wheels E^1. A bevel wheel F on the upper end of the shaft B meshes with the bevel wheel G, indicated by broken circles, which is carried by the cam-shaft C, and bevel wheels F^1 on the upper ends of the shafts B^1, respectively, mesh with bevel wheels G^1, indicated by broken circles, of the cam-shafts C^1, C^1, respectively. The bevel wheel F is shown to mesh with the teeth of the bevel wheel G at the side thereof which is the more remote from the axis of the cam-shaft C, and the bevel wheels F^1 are shown to mesh with the teeth of the bevel wheels G^1, respectively, at the sides of the axes of the cam-shafts C^1 which are towards the axis of the crank-shaft, whereby the three cam-shafts C, C^1, C^1, all rotate in the same direction, and may consequently be made all alike. Obviously, the same result would be obtained by meshing the wheel F with the wheel G at the side thereof which is towards the axis of the cam-shaft C, and meshing the wheels F^1 with the wheels G^1 at the sides of the axes of the cam-shafts C^1 which are the more remote from the axis of the crank-shaft. When the arrangement is applied to a 4-stroke cycle engine, preferably the drive between the bevel wheel A^1 and the bevel wheel D is two-to-one, the wheels E, E^1, E^1, all of the same diameter, and the wheels F, G, and F^1, G^1, mitre wheels; but, of course, the gearing can be proportioned in any manner which will give the desired result, depending on whether the engine is of the 4-stroke or 2-stroke cycle.

For the purpose more particularly of allowing the shafts B, B^1, B^1 to lengthen and shorten endwise under expansion and contraction of the engine frame, each such shaft has a lower length *b* which is formed separately from the upper length, and the upper length is slidable endwise in relation to the lower length, such as by fitting a tongue b^2 of the upper length slidably within an opening of the lower length in a manner which prevents the two lengths of shaft turning in relation to one another, an arrangement which is well known for allowing a shaft to lengthen and shorten. Conveniently, the lower length of the shaft B is formed in two lengths *b*, b^1, of which the length b^1 has the bevel wheel D formed on the lower end thereof, and has a shank b^3 which is screwed up within the upper length; and, conveniently, the bevel wheel E is formed on the lower end of the upper length. The bevel wheels E^1 are conveniently formed on the lower ends of the lower lengths *b*, respectively, of the shafts B^1, and the wheels F, F^1 may be formed on the upper ends of the shafts B, B^1, respectively.

The arrangement of bearings for, and of casings for enclosing, the vertical

and inclined shafts, are of the usual character of bearings and casings used in connection with shafts for driving cam-shafts from crank-axles, and need no description.

It will be obvious that in lieu of driving the middle shaft B from the crank-shaft and the other intermediate shafts from the shaft B, one of such other shafts may be driven from the crank-shaft and itself drive the other intermediate shafts through the medium of the wheels E^1, E, E^1.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. In valve mechanism of an internal combustion engine having a triple row of cylinders of which the pistons are all connected with a common crank-shaft, three intermediate shafts for driving the three cam-shafts, respectively, through the medium of bevel gear, of which one of said intermediate shafts is driven by the crank-shaft, through the medium of bevel gear, and itself drives the others.

2. The middle shaft of the intermediate shafts referred to in Claim 1 driven from the crank-shaft and itself driving the two outer shafts.

3. The outer shafts of the intermediate shafts referred to in Claim 1 having bevel wheels which mesh with a single wheel of the middle shaft of such shafts.

4. In the arrangement claimed in either of the preceding claims, the three cam-shafts driven by the gear in the same direction of rotation, whereby they may be made all exactly alike.

5. Valve mechanism of internal combustion engines of the type defined in the opening paragraph hereof, constructed and operating substantially as described with reference to the drawings herewith.

Dated this 23rd day of November, 1916.

STEPHEN WATKINS, SON & GROVES,
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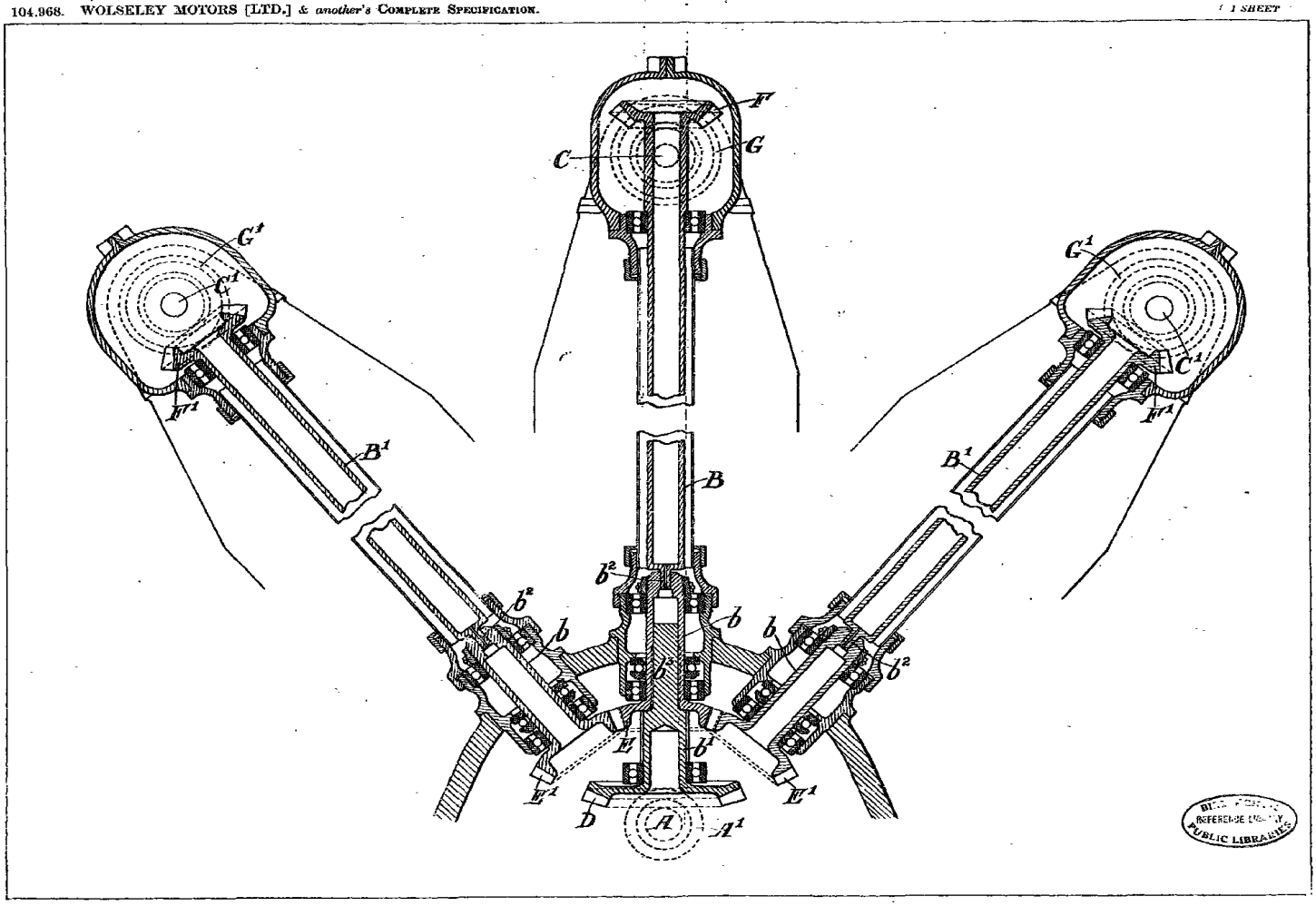

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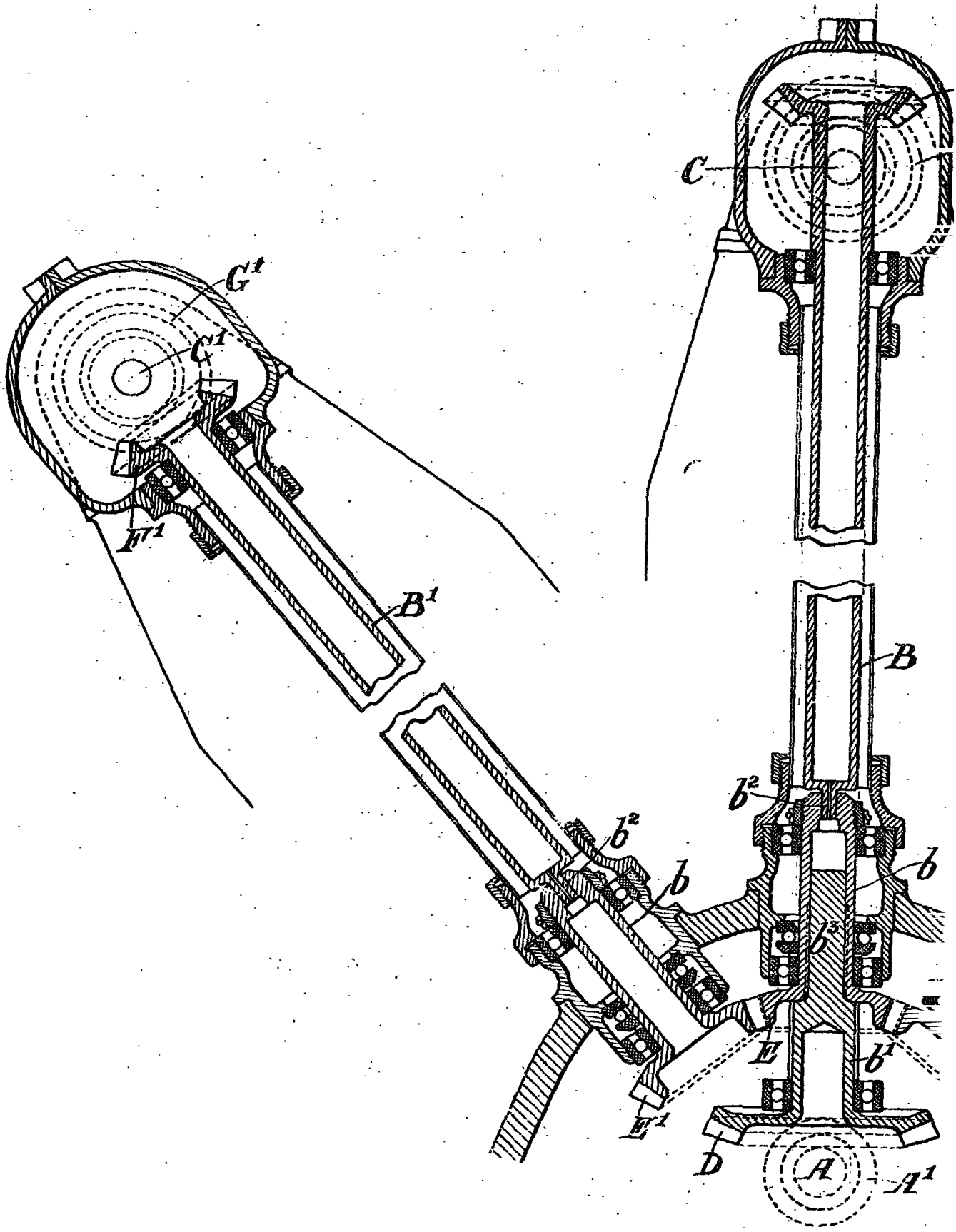
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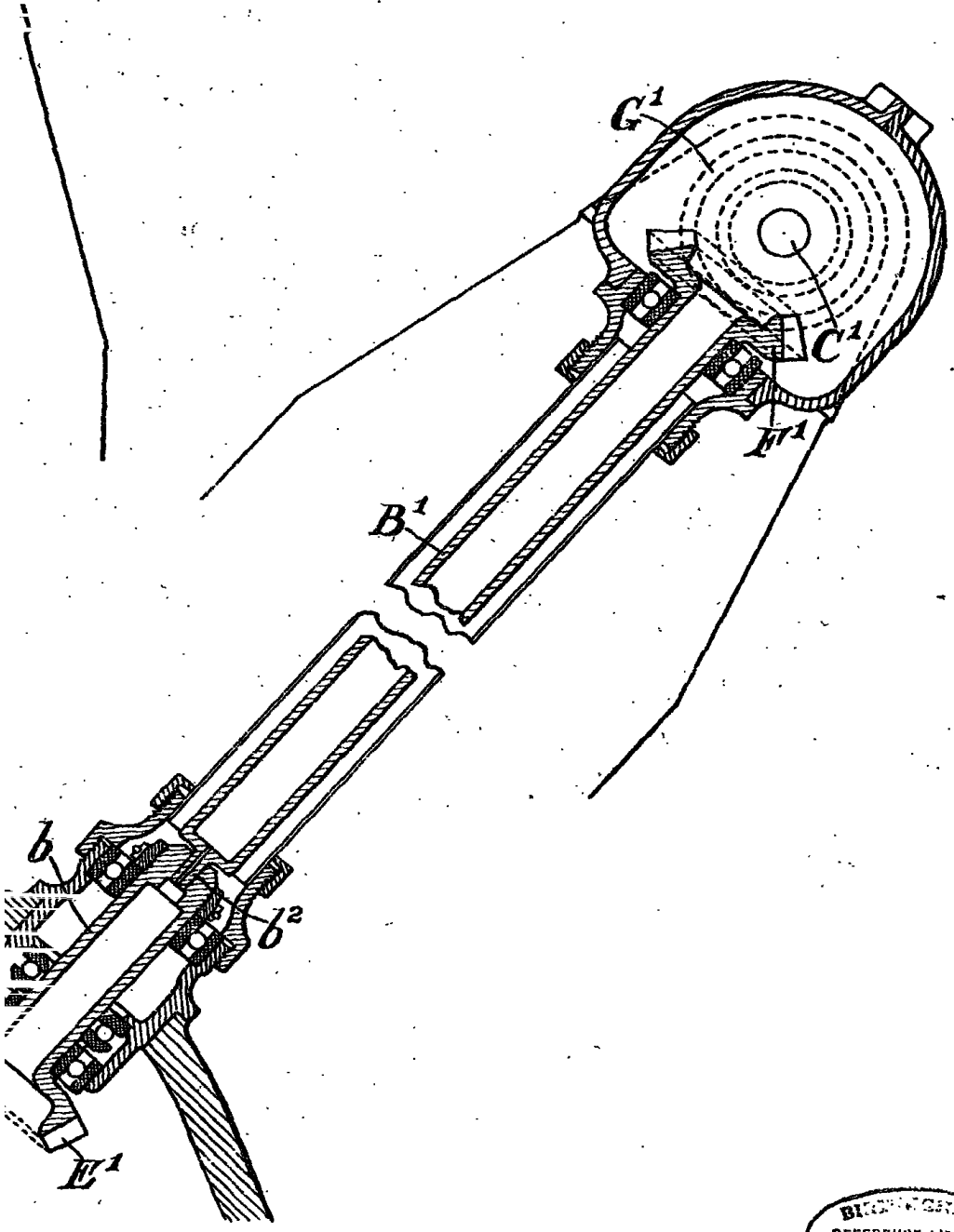

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