Jan. 23, 1951 W. HARPER 2,539,132

CRANKCASE FOR INTERNAL-COMBUSTION ENGINES

Filed Jan. 25, 1945 5 Sheets-Sheet 1

Fig. 1.

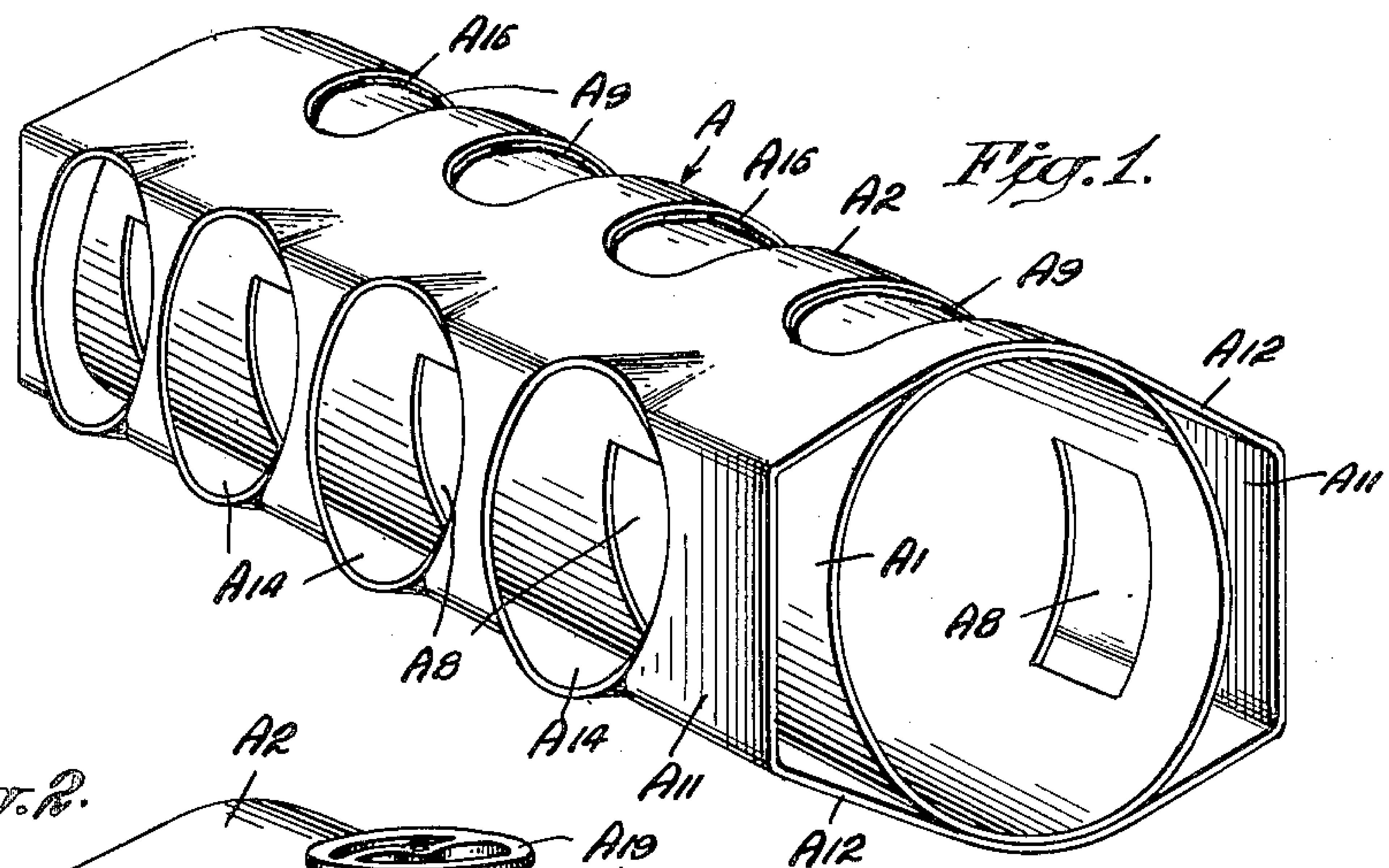


Fig. 2.

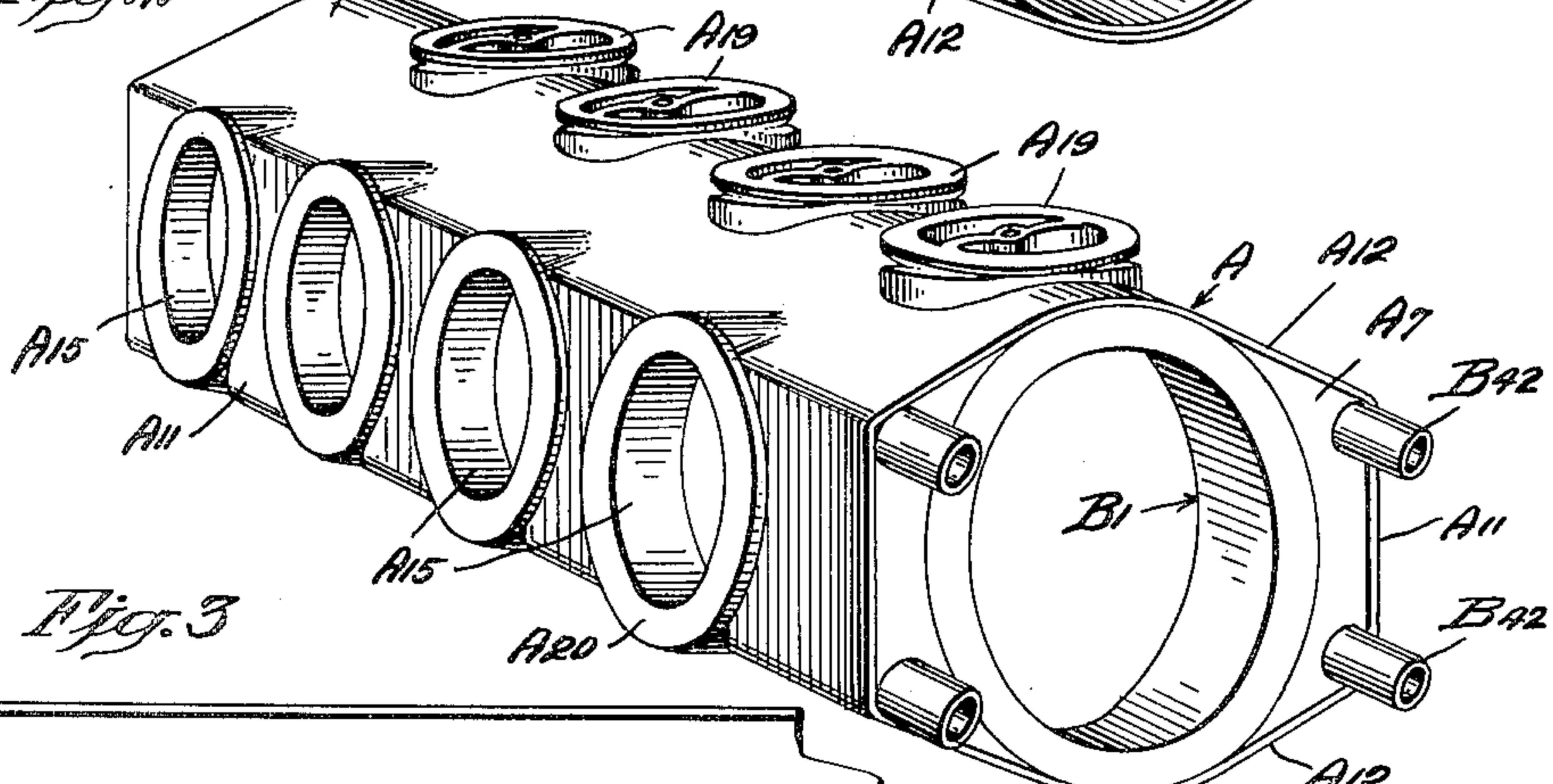
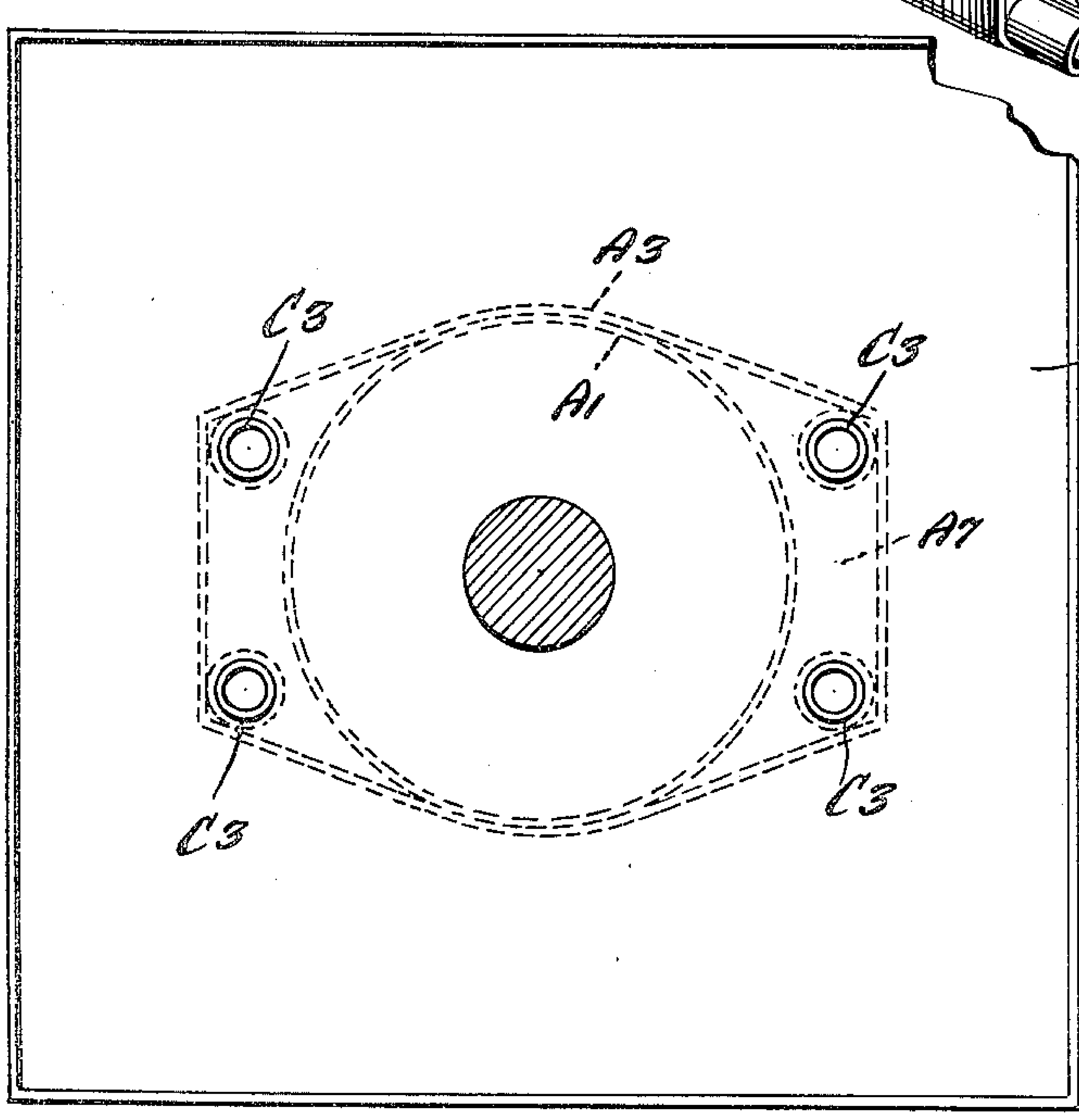


Fig. 3



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CRANKCASE FOR INTERNAL-COMBUSTION ENGINES

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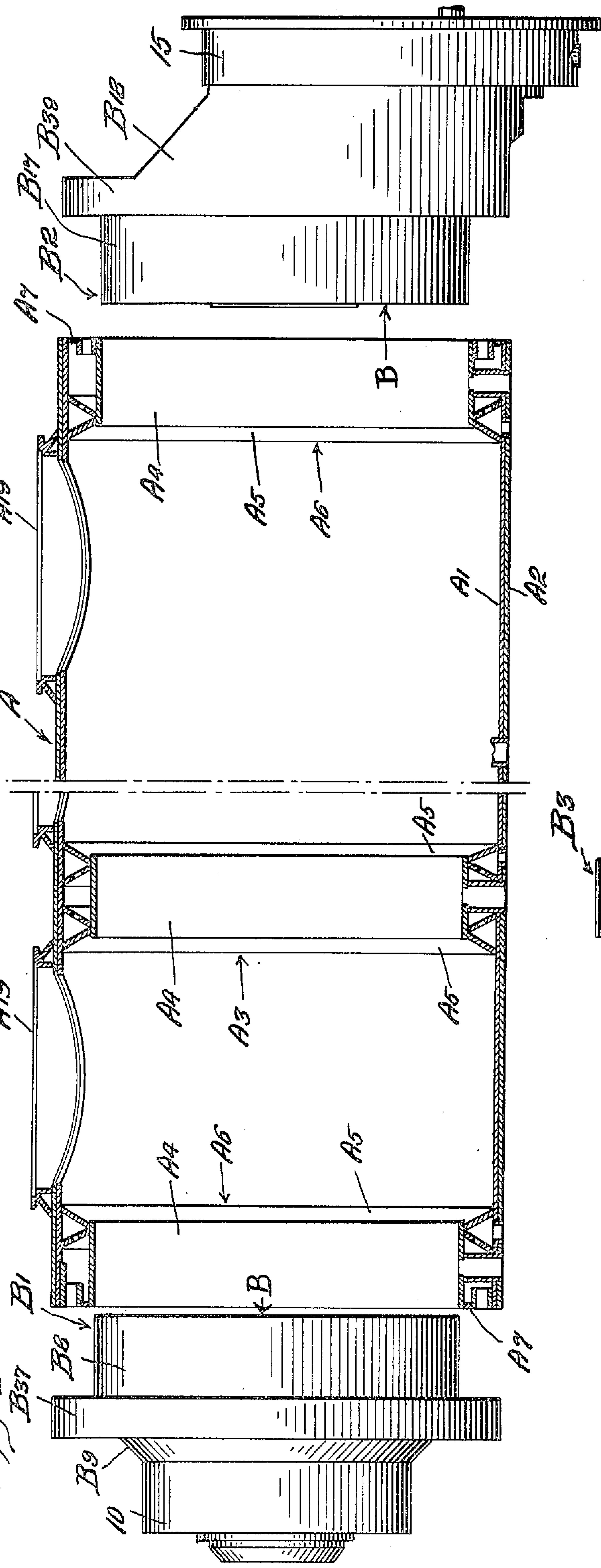

Fig. 4.

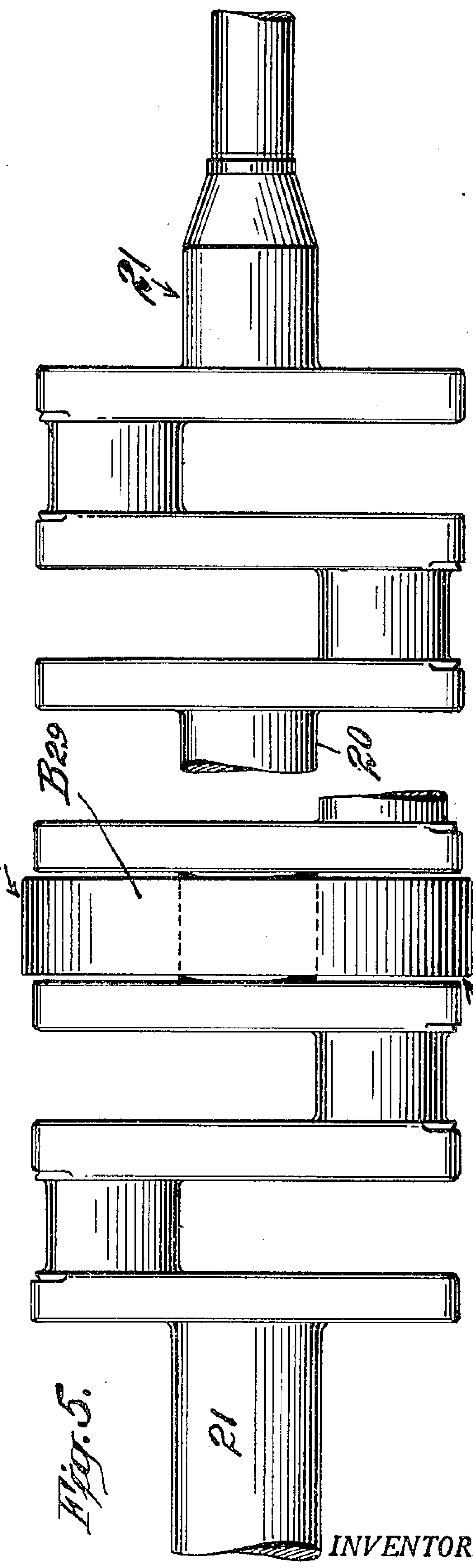

Fig. 5.

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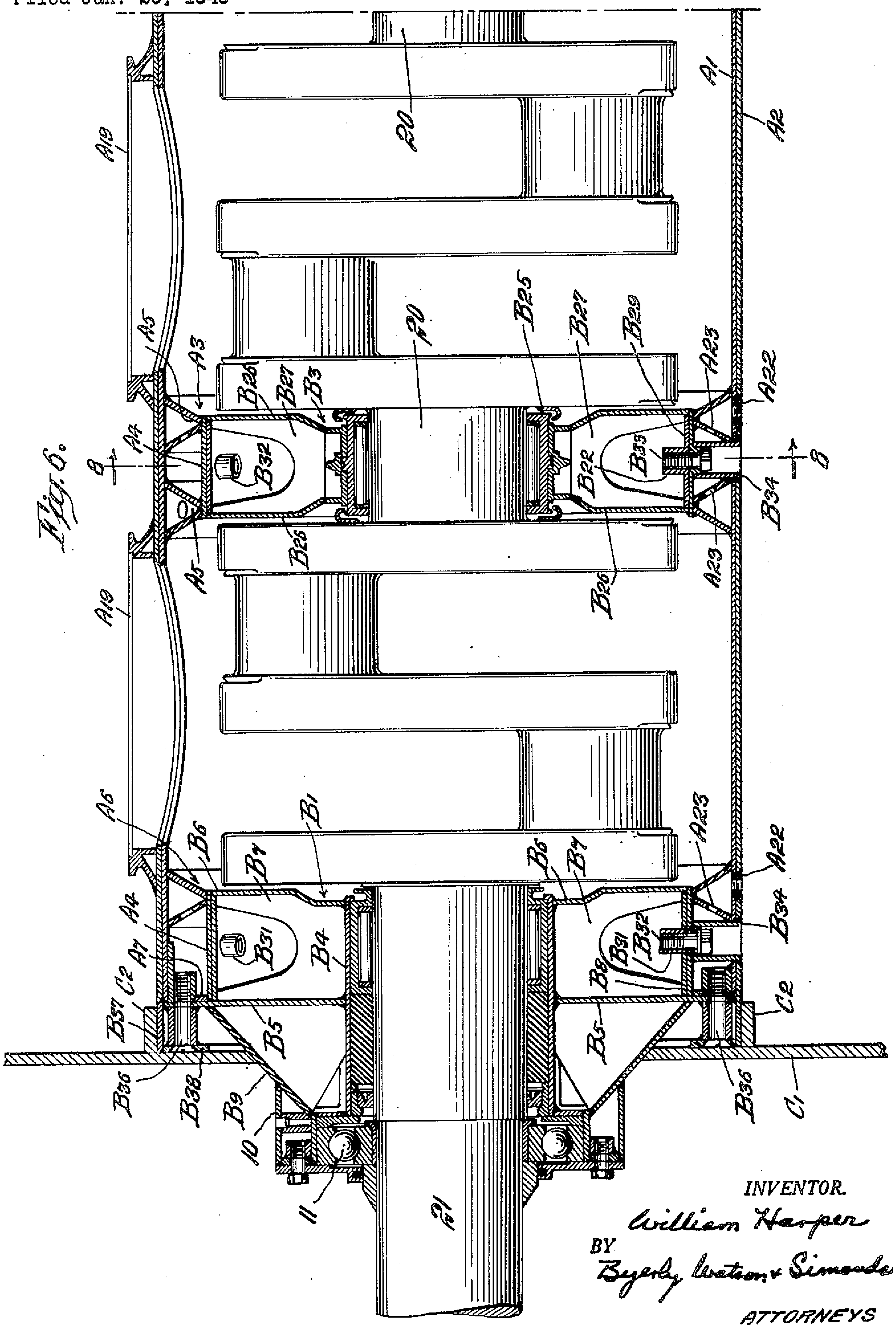

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CRANKCASE FOR INTERNAL-COMBUSTION ENGINES

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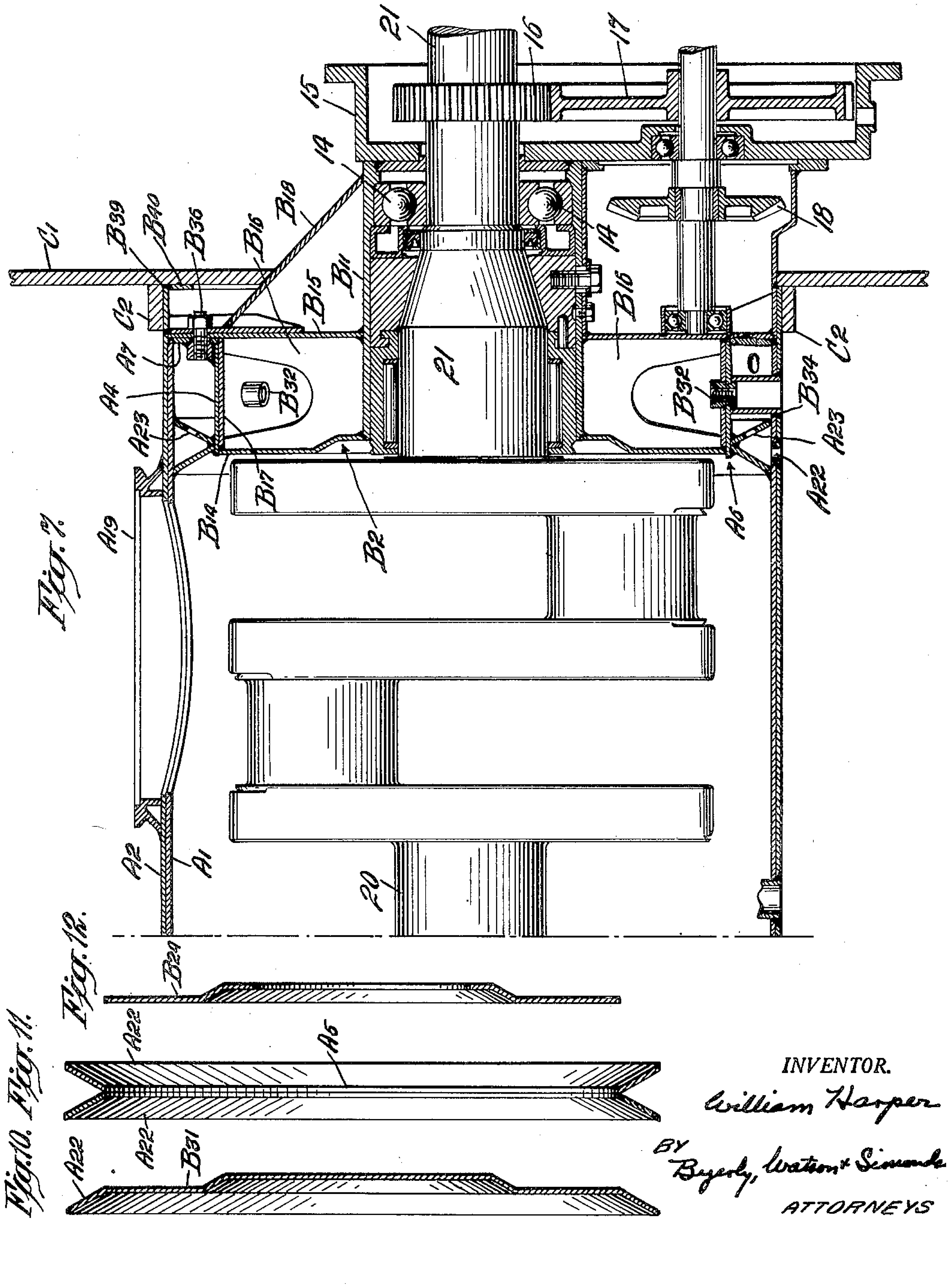

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Fig. 8.

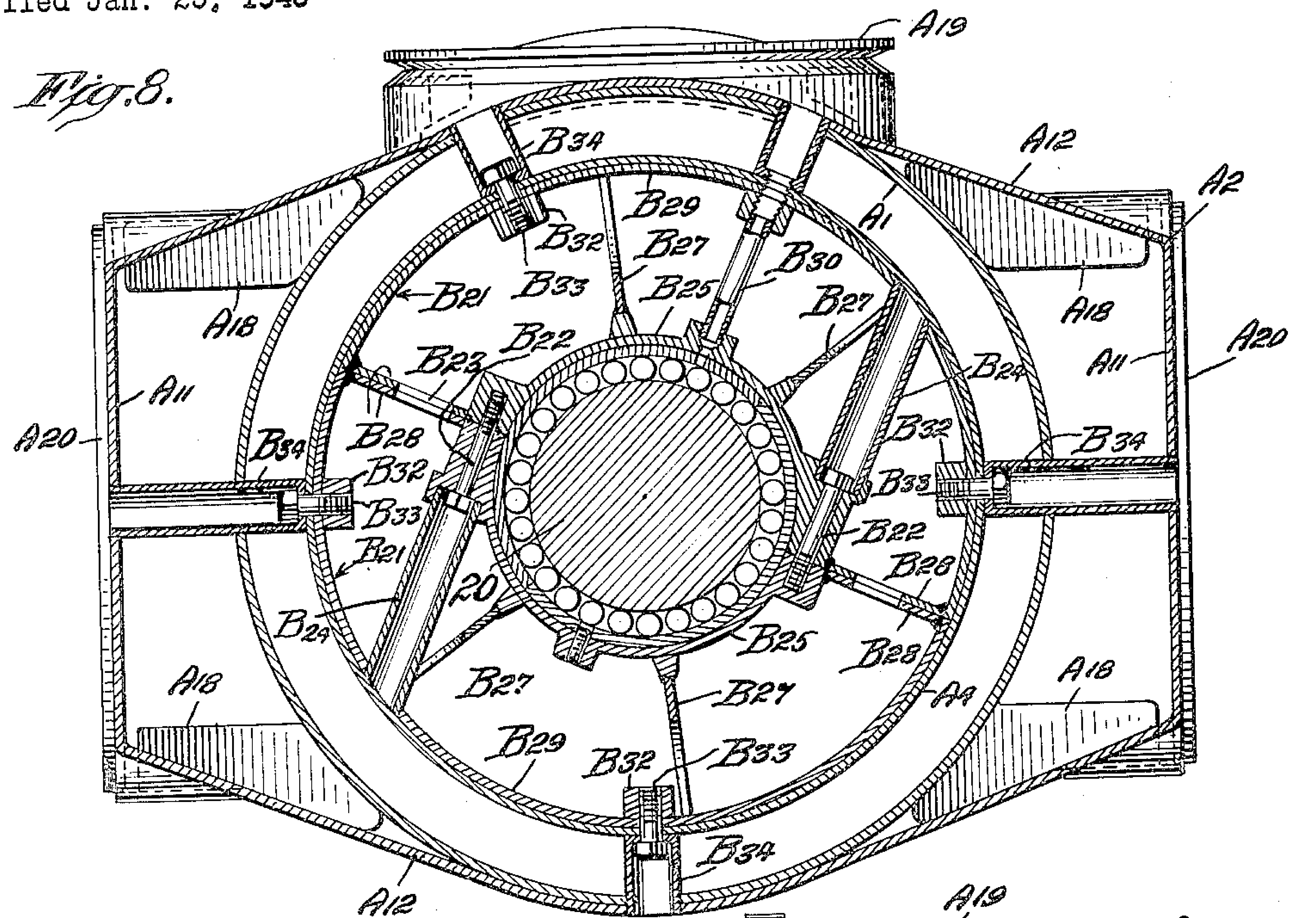
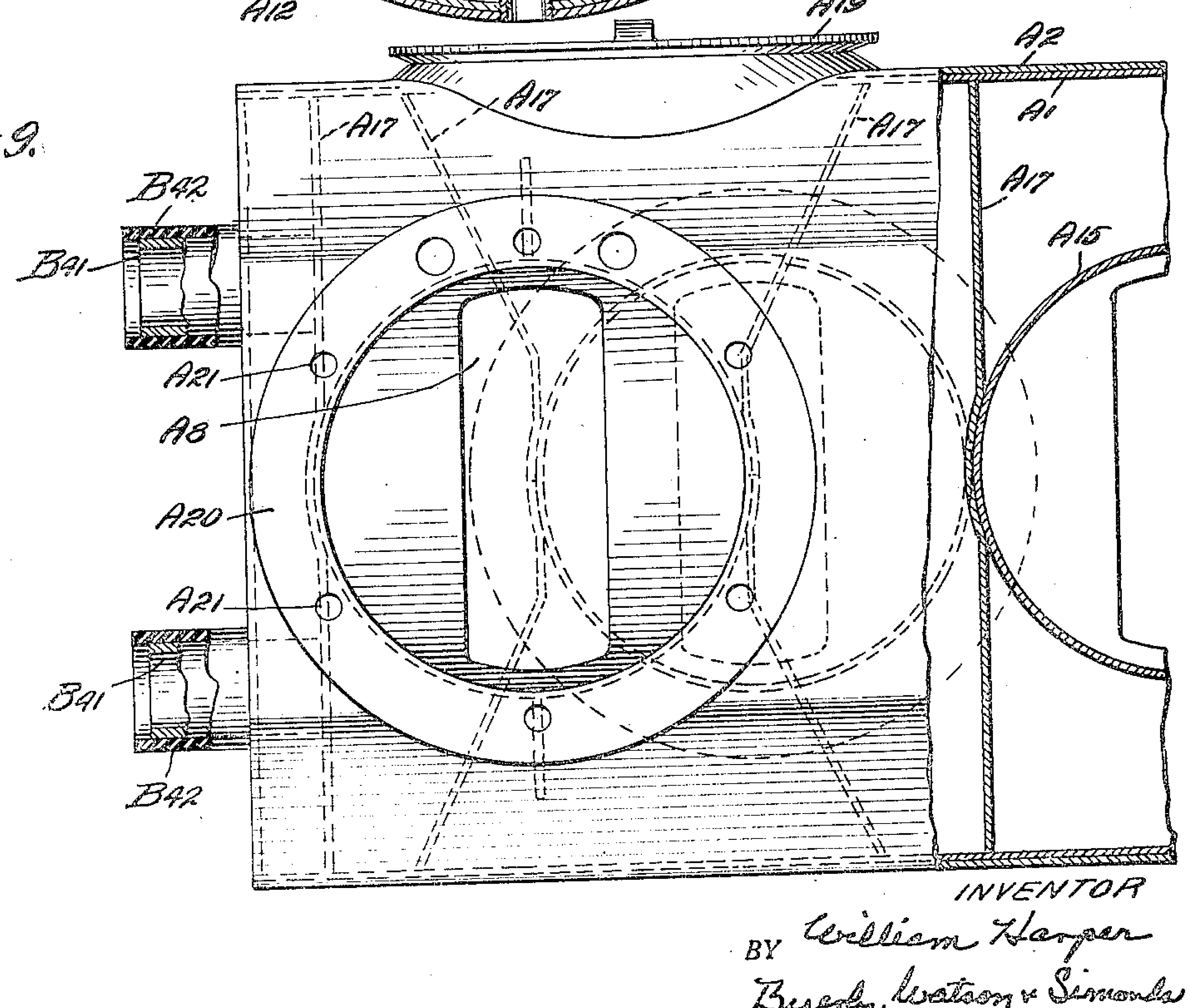


Fig. 9.



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UNITED STATES PATENT OFFICE

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CRANKCASE FOR INTERNAL-COMBUSTION ENGINES

William Harper, Montreal, Quebec, Canada

Application January 25, 1945, Serial No. 574,517

16 Claims. (Cl. 121—194)

This invention relates to crank cases and aims to provide an improved crank case for internal combustion engines.

The heaviest part of an ordinary internal combustion engine is the cast engine-base or crank case which supports the cylinders and houses the crank shaft and provides supporting bearings for it. I have discovered that it is possible to effect a radical reduction in the weight of internal combustion engines by substituting for the castings of which the engine-base or crank case is ordinarily made, a fabricated structure for supporting the cylinders and crank shaft bearings which, while using very much less metal than the ordinary castings, attains the required strength and rigidity.

The ordinary crank case or engine-base consists of a casing having transverse end walls to support the shaft bearings, and transverse interior bearing-supporting walls in the case of a multi-cylinder engine. In order that the crank shaft may be assembled with the crank case initially and in order to permit removal and repair of the crank shaft, the crank case is made of two separate castings meeting and bolted together on a longitudinal plane of the crank case which cuts the bearing-supporting walls so as to permit removal of the crank shaft and its bearings by separating the two castings.

The fabricated crank case which I have invented departs radically from this conventional construction. It consists of a continuous tubular member open at its ends, and transverse walls which are separate from the tubular member and are compressively gripped in it. The tubular member supports the engine cylinders and the transverse walls support the crank shaft bearings. The walls are gripped so firmly in the tubular member as to make the entire crank case in effect a single integral member after it has been assembled with the crank shaft within it. The transverse walls may nevertheless be removed endwise from the tubular member by releasing its grip on them by shrinking the walls and expanding the tubular member. For this purpose, means are provided for creating a wide difference in temperature between the tubular member and the walls. It is thus possible to insert transverse walls with the crank shaft endwise into the tubular member when the crank case is first assembled, and to remove the walls and the crank shaft endwise whenever examination or repair of the crank shaft is required.

The tubular member of the new crank case, in the construction which I find most desirable, is double walled having an inner sheet-steel shell formed to withstand compression and an outer sheet-steel shell formed to withstand tension. The inner shell has the form of a cylinder. The outer shell has a wall to which the engine cylinders are attached. This is spaced from, and of less width than the diameter of, the inner shell. Flat walls extend from the spaced wall in planes tangent to the inner shell and carry the tension strains of the engine cylinders to the inner shell in such manner as to produce compression strains on it which it is well adapted to withstand. The inner and outer shells have different natural periods of vibration owing to their different shape and size, so that any vibrations of the natural period of either of them is damped by the other.

A further feature of my invention consists in suspending the crank case at its ends from rigid supports so that it may react to the torque of the engine in a semiflexible manner. Each end of the crank case is provided with a round bearing which may be engaged by a complementary bearing fixed to a rigid plate so that the crank case may rotate about the axis of the crank shaft. This rotation is limited by a set of spaced projections fixed to the ends of the crank case and resiliently engaged by the supporting plates.

Other features and advantages of my invention will be described in connection with a description of the specific crank case embodying my invention which is illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view of the inner and outer sheet-steel shells of the tubular member of the crank case;

Fig. 2 is a perspective view of the tubular member;

Fig. 3 is an end elevation of the crank case support;

Fig. 4 is a fragmentary section along the axis of the tubular member with the transverse end walls in position for insertion;

Fig. 5 is a fragmentary side elevation of the crank shaft showing one of the intermediate transverse walls mounted on its bearing;

Fig. 6 is a sectional elevation on the axis of the crank case, showing one end of the crank case with the crank shaft assembled therein;

Fig. 7 is a similar view of the other end of the assembled crank case and crank shaft;

Fig. 8 is a transverse section, on a slightly reduced scale, along the line 8—8 of Fig. 6;

Fig. 9 is a side elevation of one end of the crank case partly broken away;

Fig. 10 is a transverse section of a stamped disc used in the fabrication of the transverse walls and the braces for the tubular member;

Fig. 11 is a transverse section of a brace for the tubular member; and

Fig. 12 is a transverse section of a side plate of one of the transverse walls.

The crank case illustrated in the drawings is intended for use in connection with a multi-cylinder internal combustion engine of the opposed-piston type. While my new crank case possesses special advantages for such an engine, it may readily be adapted to any type of internal combustion engine.

The crank case consists of a tubular member A open at its ends and separate transverse walls B including end walls B1, B2 and intermediate walls B3. It is suspended at its ends from supports C.

The tubular member A is a double wall structure including an inner shell A1 and an outer shell A2.

The inner shell A1 is a steel cylinder formed by rolling a steel sheet and welding its abutting edges. It is provided internally with hollow flat reinforcing collars A3 consisting of circular bands A4 smaller than the cylinder and supported on V-shaped transverse braces A5 which are welded to the cylinder and its bands. The two reinforcing collars A6 at the ends of the cylinder are of slightly different construction, as the outer edges of their bands A4 are held by the end plates A7 hereinafter mentioned instead of by V-shaped braces. As hereinafter explained, the reinforcing collars provide means for gripping the separate transverse walls B. Slots A8 for connecting rods are provided in the shell A1 between the reinforcing collars, and a series of circular access openings A9 is provided along the top of the shell.

The outer shell A2 is also formed from a sheet of steel which is bent into the form of a tube and has its abutting edges welded together. The outer shell A2 has a pair of opposite walls A11 which are spaced outwardly from, and are of less width than the diameter of the inner cylindrical shell A1, and pairs of walls A12 which connect the walls A11 to the inner shell A1 and extend tangentially to the inner shell A1 to provide tension members transmitting the pull of engine cylinders mounted on the walls A11 to the shell A1 in such a way as to produce compression strains on that shell. The spaced walls A11 are provided with a series of round openings A14 adapted to receive sleeves A15 for the engine cylinders. Along the top of the outer shell A2 is a series of round openings A16 registering with those in the top of the inner shell A1.

The inner and outer shells A1, A2 are welded together along their lines of contact and are connected by sleeves A15, tie members A17 and A18, and end plates A7 which are welded to both of them. Covers A19 are provided for the access openings A9.

The sleeves A15 have external flanges A20 at one end. They are inserted in the holes A14 in the outer shell A2, and the inner edges of the sleeves are welded to the inner shell A1. The flanges overlie the outer shell A2 at the periphery of the opening A14 and are provided with bolt holes A21 extending through the outer shell A2 for attachment of the engine cylinders.

The transverse tie members A17 (shown in Fig. 9) lie between the spaced portions of the inner and outer shells A1, A2 and are welded to both shells and to the sleeves A15.

The end plates A7 have outer peripheries conforming to the cross-section of the outer shell A2 and contain circular holes of a diameter less than that of the inner shell A1 and equal to the inner diameter of the circular bands A4 of the internal reinforcing collars A6. The end plates are welded to the end edges of the outer shell A2, of the inner shell A1 and of the bands A4 of the reinforcing collars A6 at the ends of the inner shell A1.

The end wall B1, as best shown in Fig. 6, is fabricated from a steel tube B4 to which are welded side plates B5, B6 and radial, generally U-shaped reinforcing members B7. After those parts have been welded to each other, cylindrical bands B8 are welded in place. The side plate B5 is of the same diameter as the inner shell A1 and is connected to the housing 10 for ball bearings 11 through conical plate B9 which, with the sleeve B4, supports that housing.

The end wall B2, as best shown in Fig. 7, is fabricated from a steel tube B11 to which are welded side plates B14, B15 and radial, generally U-shaped reinforcements B16. After those parts have been welded to each other, band B17 is welded in place. Side wall B15 is of the same diameter as the inner shell A1 and is connected with sleeve B11 by reinforcing plate B18. The sleeve B11 provides a housing for the ball bearings 14 and is connected also with the housing 15 for gears 16, 17 and 18 which are adapted to drive the cam shaft of the engine (not shown).

Each of the intermediate walls B3 consists of a pair of hollow semi-circular discs B21 connected by bolts B22 and communicating with each other through openings B23. Tubes B24 provide access to bolts B22 (Fig. 8). The discs B21 are fabricated from steel castings B25 to which are welded side plates B26, radial, generally U-shaped reinforcing members B27 and end plates B28. After those parts have been welded to each other, band B29 is welded in place. An oil channel B30 extends through disc B21 to provide lubrication for the bearings. In the fabrication of the walls B, the final closing welds should not be made until after the balance of the metal in the assembly has been permitted to solidify. As the assembly cools, the U-shaped members B27 give sufficiently to prevent shrinkage cracks.

The side plates B26 for walls B3, and the V-shaped braces A5 are preferably fabricated as follows: A disc of of sheet steel is given a dish shape, as by means of stamping, to provide flanges A22 and a central portion B31 (Fig. 10). The flanges A22 are severed from the central portion B31 and a pair of such flanges are welded to each other to form the V-shaped braces A5 (Fig. 11). The side plates B26 are formed from the central portion B31 by making an axial opening therein (Fig. 12).

The dimensions of collars A3, A6 and of the transverse walls B are such that the internal diameter of the collars is slightly less than the external diameter of the walls when their temperatures are substantially the same, but when the collars are approximately 200° F. hotter than the walls there is a slight clearance between them. In order that the transverse walls B may be fitted within their respective collars, means are provided for circulating a heating medium through the collars and a cooling medium through the walls:

Internally threaded discs A22 are inserted in holes drilled through the shells A1, A2 and provide passageways communicating with the interiors of the collars. The inner legs of the braces A5 are provided with openings A23. Internally threaded tubes B32 are inserted in holes in the bands B3, B17 and B29 and are welded to those bands. Bolts B33 are provided for those tubes. To permit access to the bolts B33 after the crank shaft and crank case have been assembled, conduits B34 extend through the shells A1, A2 to holes in the collars A3, A6 which are adapted to register with the threaded bores in the tubes B32.

To assemble the crank shaft and the crank case the pairs of semi-circular discs B21 forming the intermediate walls B3 are placed on the intermediate bearings 20 of crank shaft 21 and are bolted together. A cooling agent, such as compressed carbon dioxide, which may be admitted to the interiors of the transverse walls B through the tubes B32, is circulated within those walls to cool and shrink them. At the same time a heating agent, such as steam or hot oil, which may flow to the interiors of the collars A3, A6 through the passageways in discs A22 and through the openings A23, is circulated within those collars to heat and expand them. After the desired difference in the temperatures of those collars and walls is attained, the crank shaft is thrust endwise into the crank case so that the intermediate walls B3 are properly positioned in their respective collars A3. The end walls B1, B2 are then similarly slid over the ends of the crank shaft until they are properly positioned in their respective collars A6.

After the crank shaft and crank case have been placed in proper position, they are fastened by bolts B33, B36, and the temperatures of the collars and transverse walls are permitted to return to normal. The consequent shrinkage of the collars A3, A6 and expansion of the transverse walls B causes the collars to compress the walls, and, since the collars are prevented by the walls from fully contracting, they are kept under tension. As a result, the collars exert a powerful grip on the walls and an exceptionally rigid and strong construction is provided.

The crank shaft may be removed from the crank case by circulating a heating medium through the walls B and a cooling medium through the collars A3, A6 until there is a clearance between them. Then, when the bolts B33, B36 are removed, the walls may be slid out of their collars.

The support C for the crank case includes a pair of rigid plates C1. A cylindrical band B37 having an internal reinforcing flange B38 is welded to the side plate B5 of wall B1. A like band B39 having an internal reinforcing flange B40 is welded to the end plate B15 of wall B2. The bands B37, B39 form bearing members which may be engaged by circular flanges C2 fixed to the plates C1, so that the crank case may rotate about the axis of the crank shaft. Adjustable rubber bushings B42, which are mounted on tubes B41 fixed to the crank case and projecting beyond the end plates A7, are adapted to enter tubes C3 extending from the inner faces of the end plates C1 and resiliently limit rotation of the crank case. As a consequence, the crank case is held in accurate alignment with respect to the crank shaft but is permitted a limited amount of rotation about the axis of the crank shaft and expansion or contraction due to heating or cooling of the structure will not develop undue stresses at the mounting points.

It will be apparent to those skilled in the art that various changes and modifications may be made in the specific embodiment of my invention described above without departing from the spirit of my invention as defined in the following claims.

What I claim is:

1. A crank case for internal combustion engines, comprising a tubular member, removable transverse walls for said tubular member, and internal collars fixed in said tubular member around said transverse walls and adapted to exert a compressive grip on said walls.

2. A crank case for internal combustion engines comprising the combination with a tubular member, of internal hollow collars fixed in the tubular member and having openings for the introduction of a heating medium, and removable hollow transverse walls surrounded by the collars and adapted to be gripped compressively by said collars and having openings for the introduction of a cooling medium.

3. A crank case for internal combustion engines comprising the combination with a tubular member having open ends, of hollow collars fixed in the tubular member and having openings to permit circulation of a heating medium therein, and a set of removable hollow transverse walls including a pair of end walls and a diametrically split intermediate wall, said walls being surrounded by said collars and adapted to be gripped compressively by the collars and having openings to permit circulation of a cooling medium therein.

4. A crank case for internal combustion engines comprising the combination with a tubular member, of hollow collars fixed in the tubular member and each having a passageway from its interior to the exterior of the tubular member, removable hollow transverse walls having openings therein and surrounded by said collars and adapted to be gripped compressively by the collars, and conduits extending from the exterior of the tubular member through the collars to register with the openings in the transverse walls to permit introduction of a cooling medium.

5. A crank case for internal combustion engines comprising the combination with an inner cylindrical shell, of an outer shell having a base for engine cylinders and a pair of opposite walls attached to the cylindrical shell and extending tangentially therefrom to said cylinder base.

6. A crank case for internal combustion engines of the opposed-piston type comprising the combination with an inner cylindrical shell, of an outer shell having opposite walls spaced outwardly from the inner shell and of less width than the diameter of the inner shell to provide bases for engine cylinders and walls connecting said spaced walls and embracing the inner shell.

7. A crank case for internal combustion engines comprising the combination with a cylindrical shell, of a base for engine cylinders and tension members connecting said shell with the cylinder base.

8. A crank case for internal combustion engines of the opposed-piston type comprising the combination with a cylindrical shell, of a pair of opposite bases for engine cylinders spaced outwardly from the shell and of less width than the diameter of said shell and tension members connecting the cylinder bases and embracing the shell.

9. A crank case for internal combustion engines comprising the combination with a reinforced cylindrical shell adapted to withstand compressive strains, of a cylinder base, and ten-

sion members attached to said shell and extending tangentially therefrom to the cylinder base.

10. A crank case for internal combustion engines comprising the combination with an inner cylindrical shell, of an outer shell having a wall spaced outwardly from the inner shell and adapted to provide a base for engine cylinders, and a pair of walls welded to said inner shell and extending tangentially therefrom to the cylinder base, and sleeves extending from the cylinder base to the inner shell and welded to both of them.

11. A crank case for internal combustion engines comprising the combination with a cylindrical inner shell, of a shell having opposite walls spaced outwardly from the inner shell and of less width than the diameter of the inner shell to provide bases for engine cylinders and walls connecting said spaced walls and embracing the inner shell, and plates connecting the corresponding ends of the inner and outer shells and welded to both of them.

12. A crank case for internal combustion engines comprising the combination with a cylindrical shell, of a shell having a wall spaced outwardly from said cylindrical shell to provide an engine cylinder base and a pair of opposite walls welded to the cylindrical shell and extending tangentially therefrom to said cylinder base, and internal reinforcing collars welded to the cylindrical shell.

13. A crank case for internal combustion engines comprising the combination with a cylindrical shell, of a base for engine cylinders, tension members connecting the shell with the cylinder base, removable transverse walls for said shell, and means fixed in the shell for compressively gripping said walls.

14. A crank case for internal combustion engine comprising the combination with an inner cylindrical shell, of an outer shell having a wall spaced from the inner shell to provide an engine cylinder base and walls connected with the inner shell and extending tangentially therefrom to the cylinder base, hollow collars fixed in the inner shell, a passageway through the inner and outer shells to the interior of each collar to permit introduction of a heating medium, removable transverse hollow walls surrounded by said collars and adapted to be gripped compressively by the collars and having openings in their peripheries, and conduits adapted to register with said peripheral openings and extending through the shells and collars to permit introduction of a cooling medium in said walls.

15. A crank case for internal combustion engines having a round bearing and a set of spaced projections at each of its ends, and a support for said crank case having means engaging said bearing to support the crank case while permitting axial rotation thereof and resilient means adapted to limit rotation of the crank case.

16. A crank case for internal combustion engines comprising a sheet-steel cylinder adapted to house crank shaft bearings, spaced tubes attached to said cylinder and projecting beyond its ends, and a support for each end of said crank case having a cylindrical flange adapted to engage and support an end of the crank case while permitting it to rotate about its axis and resilient means adapted to limit rotation of the crank case.

WILLIAM HARPER.

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