Oct. 19, 1926. 1,603,853

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SLANT FOR CRANKLESS ENGINES

Filed Sept. 4, 1925 3 Sheets-Sheet 1

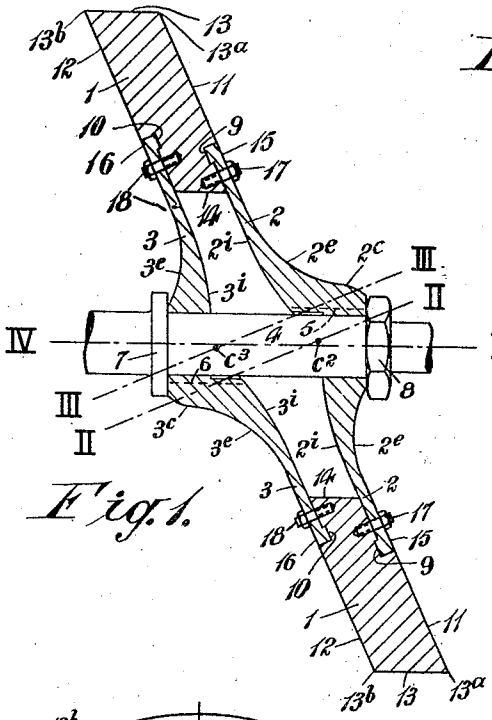


Fig. 1.

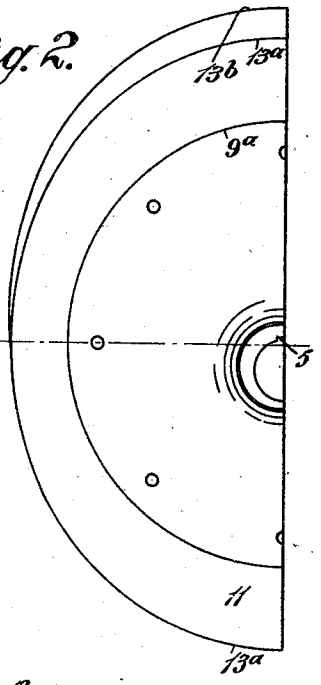


Fig. 2.

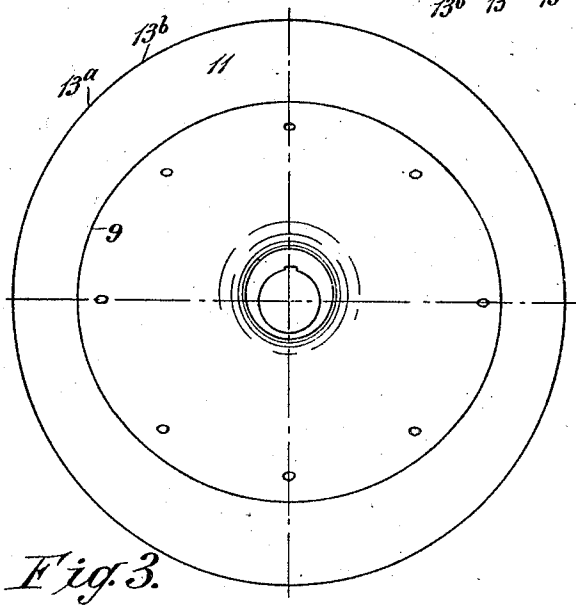


Fig. 3.

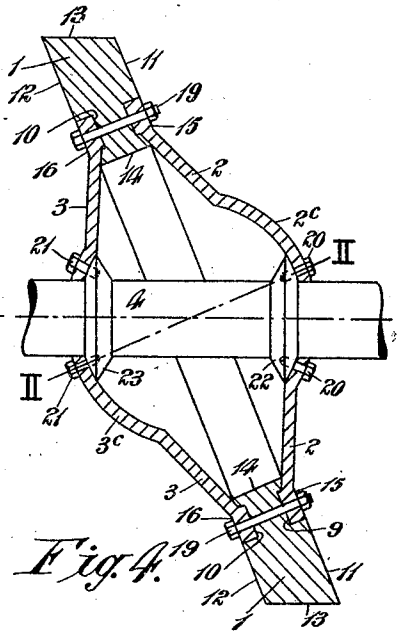


Fig. 4.

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SLANT FOR CRANKLESS ENGINES

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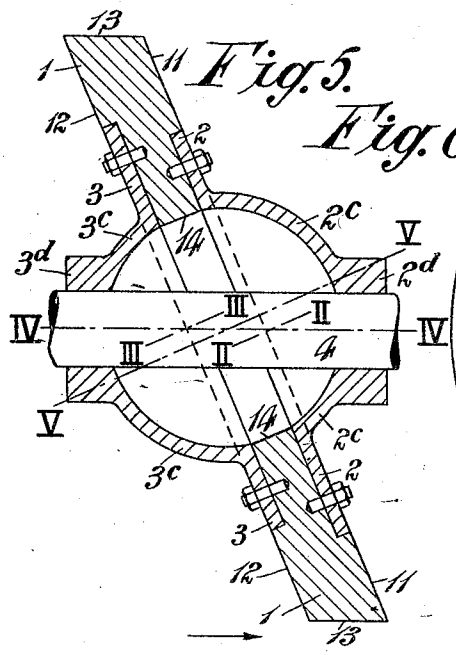


Fig. 5.

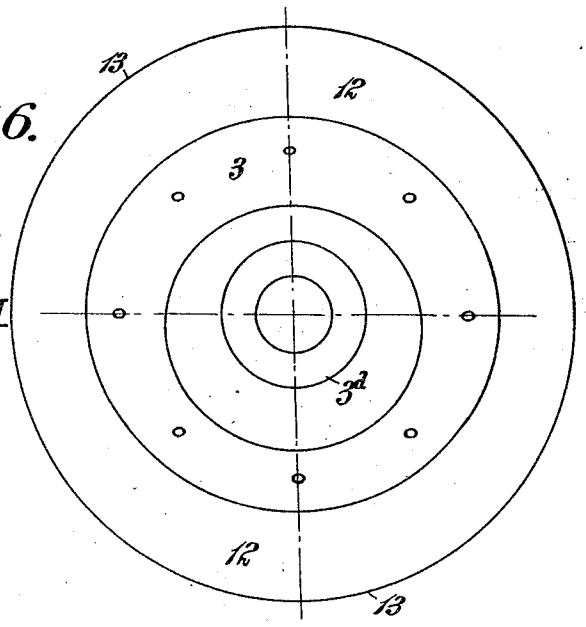


Fig. 6.

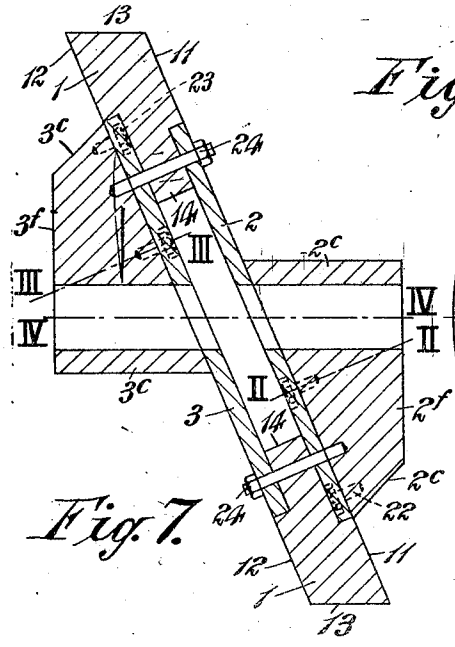


Fig. 7.

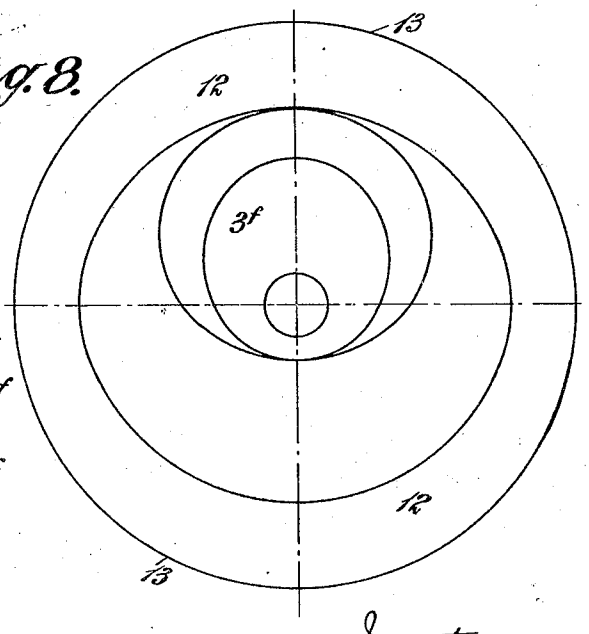


Fig. 8.

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SLANT FOR CRANKLESS ENGINES

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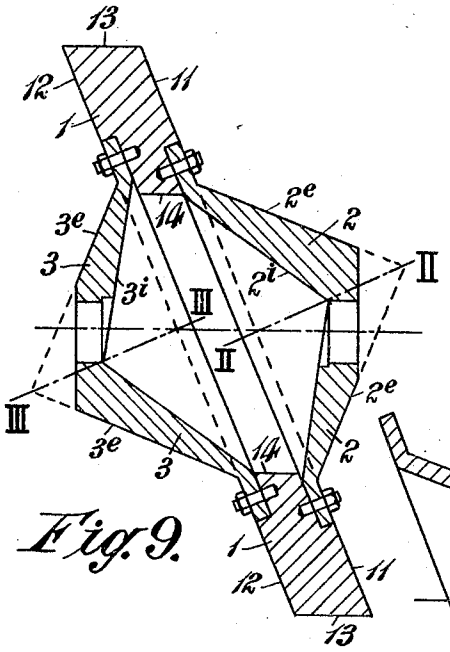


Fig. 9.

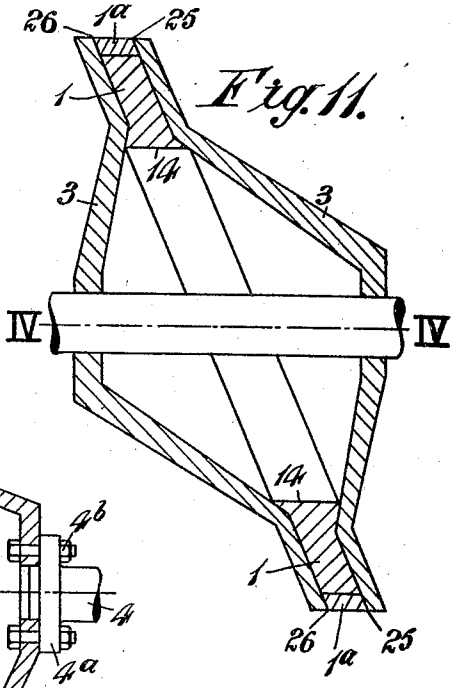


Fig. 11.

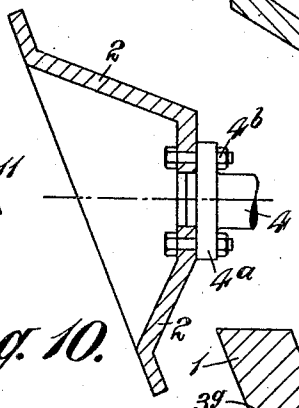


Fig. 10.

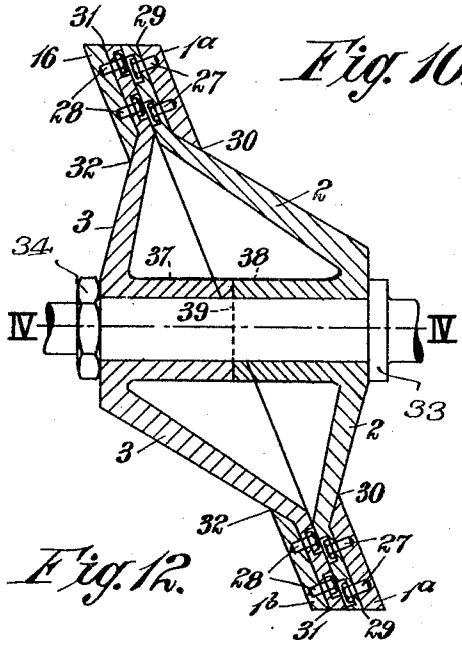


Fig. 12.

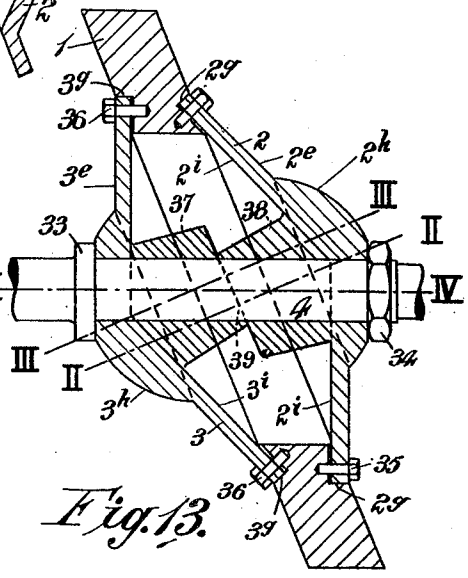


Fig. 13.

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UNITED STATES PATENT OFFICE.

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SLANT FOR CRANKLESS ENGINES.

Application filed September 4, 1925, Serial No. 54,545, and in Australia December 5, 1924.

The present invention relates to improved methods of construction of the slants or swash-plates of crankless engines of the type described in the specifications of United States Patent 1,409,057 and pending United States patent application Serial Number 545,193.

The slants described in the specifications and drawings of the patents above-mentioned consist in each case of a single piece mounted directly upon the shaft of the engine. This construction is the simplest possible, and is quite satisfactory in the case of engines of small and moderate sizes. In the case of large engines, however, considerations of the cost and convenience of manufacture and handling have indicated that the simple form of one-piece slant has disadvantages, which it is desirable to remove.

The present invention aims at the elimination of such disadvantages by the provision of a slant construction involving an assembly of several parts capable of accurate manufacture in simple geometrical forms which, when assembled, possess the conditions essential for the dynamical balance of the engine as laid down in above Patent 1,409,057.

The improvements herein described are more particularly directed to the construction of such large slants, and the advantages resulting from the improvements will be indicated in the course of the description.

In the attached drawings, Figure 1 shows in axial section a slant construction according to the present invention;

Figures 2 and 3 being side views.

Figures 4, 5, 7, 9, 10, 11, 12 and 13 are axial sections corresponding to Figure 1, of variously modified forms of the construction, while Figures 6 and 8 are projections of the slants respectively shown in Figures 5 and 7 on planes normal to their shafts.

As shown in Figures 1, 2 and 3, the complete slant is composed of an annular rim 1, and two web-members 2, 3, which form the connection between the rim 1, and the engine shaft 4, being fixed to the latter in any usual way as by keys 5, 6, flange 7, and screwed nut 8. The webs 2 and 3 are circular in outline and fit circular key recesses 9, 10, turned in rim 1. The portions 11, 12 of the lateral faces of the rim extending beyond the recesses 9, 10 are plane and parallel and oblique to the axis of the shaft 4, (these being the working surfaces of the slant and adapted for co-action with slippers as described in the prior patents above cited), and the external and internal peripheries 13, 14 of the slant are turned to a cylindrical form co-axial with the shaft 4.

In other words, the general form of the annular rim 1 may be described as an oblique slice of a hollow cylinder.

The side views 2 and 3 are respectively projections on a plane parallel to the face 11 of the slant, and on a plane normal to the axis of the shaft, one half only of the projection being shown in Figure 2. The peripheral edges 13^a, 13^b of the slant consequently appear as circles in Figure 3, and as ellipses in Figure 2, while the edge 9^a of the recess 9 appears as a circle in Figure 2, and as an ellipse in Figure 3.

The surfaces, both internal and external, of the webs 2 and 3 are surfaces of revolution described respectively about the axes II—II and III—III, these axes being in one plane with the axis IV—IV, of the shaft 4, and normal to the plane faces 11, 12 of the slant.

The webs 2 and 3 are thus adapted to be turned on their external and internal faces, 2^e, 2^i, and 3^e, 3^i, as well as on the peripheral portions 15, 16, which latter have internal flanges respectively engaging with the recesses 9, 10, of the rim.

For maximum strength consistent with light weight the webs are preferably formed of increasing thickness towards their centres as shown, and in order to provide bosses suitable for reception of the keys 5, 6 their central portions 2^c, 3^c, may be formed as spherical segments whose centres C_2, C_3, are respectively located on the axes II—II, III, III. These bosses are bored parallel to the axis IV—IV for the reception of the shaft 4, and faced at right angles to the same axis for the nut 8 and collar 7, between which they are clamped together lengthwise to the shaft. This boring and facing are preferably effected after

attachment of the webs 2, 3, to the rim 1, for which purpose screws or stud-bolts 17, 18 may be employed.

The form of construction shown in Figure 4 is particularly applicable in cases in which extreme lightness is required. It is similar to the form illustrated in Figures 1, 2 and 3, and the description above given of the rim 1, webs 2 and 3, with their spherical bosses 2^e, 3^e, is applicable with the exception that in the form illustrated in Figure 4, the axes of the webs 2 and 3 coincide in the line II—II, that the spherical bosses 2^e, 3^e, are hollow and that the internal periphery 14 of the rim is cylindrical with axis II—II, instead of with axis IV—IV as in Figures 1 to 3. The webs 2, 3 are attached to the rim 1, by through bolts 19, and to the shaft 4, by screws 20, 21, entering respectively the shaft bosses 22, 23 which have spherical surfaces, fitting the internal surfaces of the hollow bosses 2^e, 3^e.

The slant shown in Figures 5 and 6 (Figure 6 being a projection on a plane normal to the shaft) is a simplified form of those shown in Figures 1 to 3, and 4, the webs 2 and 3, in this simplified form being flat, plane plates of circular outline, with hollow spherical bosses 2^e, 3^e, with integral cylindrical rings 2^d, 3^d, reinforcing them where they receive the shaft 4.

In this form of construction, the spherical bosses are eccentric with respect to the peripheries of the webs, that is to say the centres of the spherical segments are on the line V—V while the centres of the web plates 2, 3 are respectively on the lines II—II and III—III, all three of these lines being in one plane, and normal to the faces 11, 12 of the slant. It is to be noted that, owing to the presence of the cylindrical rings 2^d, 3^d, the whole of each of the external surfaces of the spherical bosses 2^e, 3^e, cannot be turned at a single fixed setting in the lathe, but can be completed by a series of such settings.

The form of construction shown in Figures 7 and 8, (Figure 8 being a projection on a plane normal to the shaft) differs from that shown in Figures 5 and 6 in that the bosses 2^e, 3^e, of the webs 2, 3 instead of being spherical are cones whose respective axes are II—II and III—III these cones being truncated by planes 2^f, 3^f, normal to the axis IV—IV of the shaft 4. In cases where considerable mass is required in the slant to secure the condition of dynamical balance explained in Patent 1,409,057, these cone bosses are advantageously made solid and of large basal diameter, as shown, their product of inertia in the plane of Figure 7, then forming an effective addition to that of the rim 1, in counterbalancing the inertia of the reciprocating members. For convenience of construction, the relatively heavy conical bosses 2^e, 3^e, may be constructed as separate parts from the relatively light plate portions 2, 3 of the webs, and respectively connected thereto as by screws 22, 23, and or studs 24, which latter also attach the webs 2, 3 to the rim 1.

In cases on the other hand in which it is not desired that the webs 2, 3 should have a large product of inertia, the construction shown in Figure 9, may be employed, this being similar to the form shown in Figures 7 and 8, with the exception that the coned web-bosses, 2^e, 3^e, are hollow, each of the internal conical surfaces 2^i, 3^i, being co-axial with its corresponding external conical surface 2^e, 3^e, the common axes being II—II, III—III, which may be also the axes of the first peripheral portions of the webs 2, 3.

By a minor modification of the construction of Figure 9, illustrated by the sectional view of a web, Figure 10, the web may be attached to the flange 4^a, of the shaft 4, by bolts 4^b, extending through the web. This construction enables the line of shaft to be assembled in sections thus facilitating the handling of large machines.

The construction of the rim shown in Figure 9, or any of the preceding figures, may be modified by extending the outer flange portions of the webs 2 and 3, so as to cover the lateral faces of the rim 1, and to form in lieu of the latter the working faces of the slant. Such a modification is shown in Figure 11. As a further modification, illustrated in the same figure, the peripheral portion of the rim 1 may be formed as a separate band 1^a, the inner and outer peripheries of which are cylindrical and the lateral edges planes oblique to the axis IV—IV of these cylinders. The band 1^a, can consequently be completely machined in the lathe. In such construction the webs 2 and 3 and band 1^a, are preferably formed of wrought steel and the band 1^a, may be attached to the webs, by welding the joints 25, 26 where these parts make contact. The remaining portion of the rim 1, may be either of iron or steel machined in the manner already explained, and placed in position before the welding is effected, or may be of lead cast in position after the welding operation, the slant being rotated rapidly on the axis IV—IV, during the casting and solidifying of the metal of the rim. The metal thus assumes automatically the form shown in Figure 11, its inner periphery 14, being cylindrical with axis IV—IV. This method of construction is specially advantageous, when it is desired to reduce the bulk of the slant to a minimum consistently with maintaining the dynamic balance of the machine.

As a further variation of the construction, the webs 2, 3, instead of having the rim 1 enclosed between them, may be brought into immediate contact at their peripheries as

shown in Figure 12, and the rim member may be in the form of two annuli 1^a, 1^b, attached to the webs by screws 27, 28, or by welding the joints 29, 30, 31 and 32.

The form of construction shown in Figure 13, differs from those shown in the preceding figures in method of connection between the webs 2, 3 and the rim 1. In this form, as in Figure 9, the webs 2, 3 are mainly conical on both their inner and outer faces, the axes of these cones being respectively II—II and III—III. In the construction according to Figure 13, however, the webs have no flat peripheral portions for attachment to the rim 1. In lieu thereof the outer edges of the conical webs 2, 3 are turned to conical surfaces 2^g, 3^g, respectively normal to the surfaces 2^e, 2^i, and 3^e, 3^i, and with the axes II—II, III—III. The boss portions of the webs may be plane as in Figure 9, or segments or spheres 2^h, 3^h, as shown in Figure 13. By means of the flange 33 and nut 34 on the shaft 4, the webs 2, 3 are drawn together and clamp between them the rim 1, the surfaces 2^g, 3^g abutting upon corresponding conical seats turned in the latter.

Screws 35, 36 may be employed to supplement the clamping pressure exerted by the nut 34.

By a further modification shown in Figures 12 and 13 and applicable to the construction shown in all the figures except Figure 4, the webs 2 and 3 are formed with internal cylindrical or conical bosses 37, 38, meeting at a joint 39, the rigidity of the construction being thus increased. These bosses may however be omitted,

It will be understood that, although for convenience, the webs forming each of the pairs described above and shown in the respective figures are alike, this is not necessarily the case. The web on one side of the slant may be of different convexity or concavity or may be differently attached from that on the other side, and a web constructed according to one of the illustrated forms may be used on one side of the slant with a web of another of the forms on the other side.

I claim:

1. In crankless engines of the type set forth, a slant comprising a flat annular rim element oblique to the engine shaft, and a pair of web plates each having their axes oblique to the engine shaft, the outer peripheral portions attached to said rim element and the inner periphery attached to the engine shaft.

2. In crankless engines of the type specified, a slant comprising a rim element and a pair of web-plates connected to said element and the engine shaft, the surfaces of such plates being surfaces of revolution described about axes inclined to the axis of rotation of the slant.

3. In crankless engines of the type specified, a slant comprising an annular rim element, a pair of web plates of circular outline having the outer periphery connected to said rim, a central boss on each of said plates connected to the engine shaft the internal and external surfaces of such plates being surfaces of revolution described about axes inclined to the axis of revolution of the slant.

4. In crankless engines of the type specified, a slant consisting of an annular rim, a pair of web plates of circular outline one on each side of said rim, a recess in each side of the rim, an outer peripheral portion on each web plate fitting said recess, a central boss member on each of said web plates, and means securing said bosses to the engine shaft and the outer periphery of the web plates to the annular rim.

5. In crankless engines of the type specified, in combination, a slant comprising an annular rim, a pair of web plates of circular outline, the internal and external surfaces of said plates being surfaces of revolution described about axes inclined to the axis of rotation of the slant, a central boss on each of said plates having a central bore coincident with the axis of the slant, each boss having a central portion formed as a spherical segment, means on the slant shaft for securing said plates thereto and means clamping the rim element between the outer periphery of the web plates.

6. In crankless engines of the type specified, a slant comprising an annular rim element, a pair of web plates of circular outline, central boss members on said plates, means for securing said bosses to the slant shaft and the outer peripheral portions of the plates to said rim, said peripheral portions diverging from the rim towards the slant shaft and having the outer edges turned to conical surfaces engaging in conical recesses in said rim, as herein described.

7. In crankless engines of the type specified, a slant comprising an annular rim element and a pair of web plates each having the outer peripheral portion attached to said rim element, a central boss member on each of said plates, said boss member being located internally of the plates and means for securing said boss members in juxtaposition to the slant shaft.

Dated this twenty fifth day of August, 1925.

ANTHONY GEORGE MALDON MICHELL.