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A. BERGER

MULTI-THROW CRANK SHAFT

Filed July 16, 1940

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Fig. 1.

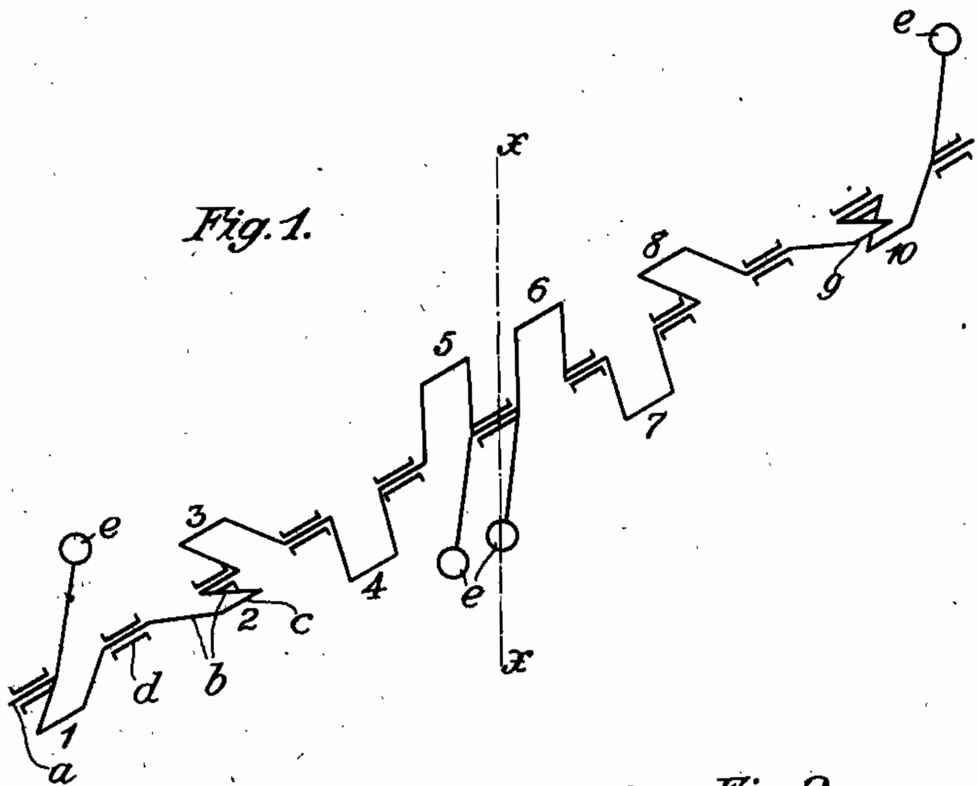
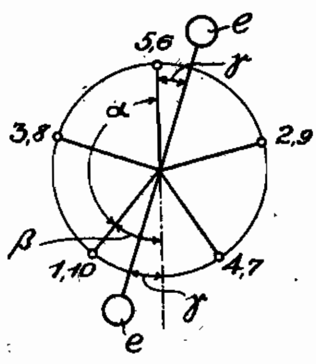


Fig. 2.



INVENTOR
ARTHUR BERGER
BY
ATTORNEYS

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ALIEN PROPERTY CUSTODIAN

MULTI-THROW CRANK SHAFT

Arthur Berger, Stuttgart-Oberturkheim, Germany; vested in the Alien Property Custodian

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The invention refers to a multi-throw crank shaft, specially to a ten-throw crank shaft for a four stroke combustion engine with the object of an improved power compensation on this kind of crank shafts. Furthermore the compensation should ensue at the smallest possible weight of the crank shaft.

The invention is of special importance for ten-throw crank shafts above all, for the following reasons:

While the arrangement of the cranks at a four- or also at a six-throw crank shaft is comparatively simple, as with such shafts the cranks result automatically without compulsion and are practically fixed, the formation of a ten-throw crank shaft for a four stroke combustion engine makes essentially greater difficulties. If for instance the cranks are transposed by 72°, the cranks being arranged symmetrically with respect to the middle of the shaft, a taking-off of the outer stresses on the bearing- and crank-casing is impossible, as with this arrangement of the cranks the outer forces engaging at the crank shaft do not compensate each other, but moment-forces remain active which must be taken up by the main bearings of the crank shaft and of the crank casing carrying these bearings.

Contrary to this, by means of the invention, such an arrangement of the crank shaft is attained that as well the bearing pressures resulting from the centrifugal forces as also the moments turning around an axis transverse to the crank shaft are most likely to compensate each other. The latter purpose serves a symmetric arrangement of the crank shaft around the transverse axis X—X of the crank shaft, while for the purpose of compensating the loads on each single bearing the cranks next to this bearing include an angle which should be as great as possible, i. e. as straight as possible, as far as this will be feasible with respect to the uniform sequence of ignition resulting for a ten-throw crank shaft. Advantageously, neighbouring cranks of each half of the crank shaft are inclined to each other at an angle of about 144°.

In consequence of this symmetric arrangement of the crank shaft and of the transposition of the cranks lying next to each other by about 144°, it is possible to do without or with comparatively few counterweights. These are arranged substantially at the central crank shaft bearing, lying in the symmetric axis X—X, in order to compensate the centrifugal forces arising at the central cranks of equal direction, lying next to each other. These centrifugal weights themselves may be compensated most practically by counterweights arranged at the end-bearings which guarantees a complete balance on the shaft. As however the central cranks on the one side, and the end-cranks on the other side, are inclined to each other at an angle of 144° it will be practical under circumstances to arrange the counterweights in such a manner that they include an angle of the same size with the central cranks on the one, and with the outer cranks on the other hand. If the outer cranks are inclined to the central ones at an angle of 144°, the resulting angle between the respective counterweights and the neighbouring cranks will be 162°.

In the drawing by way of example one type of the invention is diagrammatically shown, in which

Fig. 1 is a ten-throw crank shaft drawn in linear perspective

Fig. 2 is the crank shaft seen from the front end.

The crank shaft *a* for instance is journaled in the bearings *d* and contains the crank jaws *b* with the crank pins *c*. Starting from the center axis X—X the two central cranks **5** and **6** are directed vertically upwards. The next following cranks **4** and **7** are transposed against these cranks by an angle of $\alpha=144°$. The next cranks **3** and **8** also include an angle of $\alpha=144°$ against the preceding cranks **4** and **7** etc. The counterweights *e* are arranged for instance at the crank jaws *b* of the cranks **1**, **10** and **5**, **6** and that in such manner that they are transposed against each other by 180° respectively but include a same size angle γ or δ with the pertaining neighbouring cranks. As the outer cranks **1** and **10** are transposed against the central cranks **5** and **6** by an angle $\alpha=144°$ the angles of transposure result, $\alpha+\beta=180°$ and

$$\gamma+\frac{\beta}{2}=18°$$

to

$$\delta=\alpha+\beta-\gamma=\alpha+\frac{\beta}{2}=162°$$

ARTHUR BERGER.