Dec. 19, 1939. G. H. SCHIEFERSTEIN 2,183,698

STONE CRUSHER

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Fig. 1

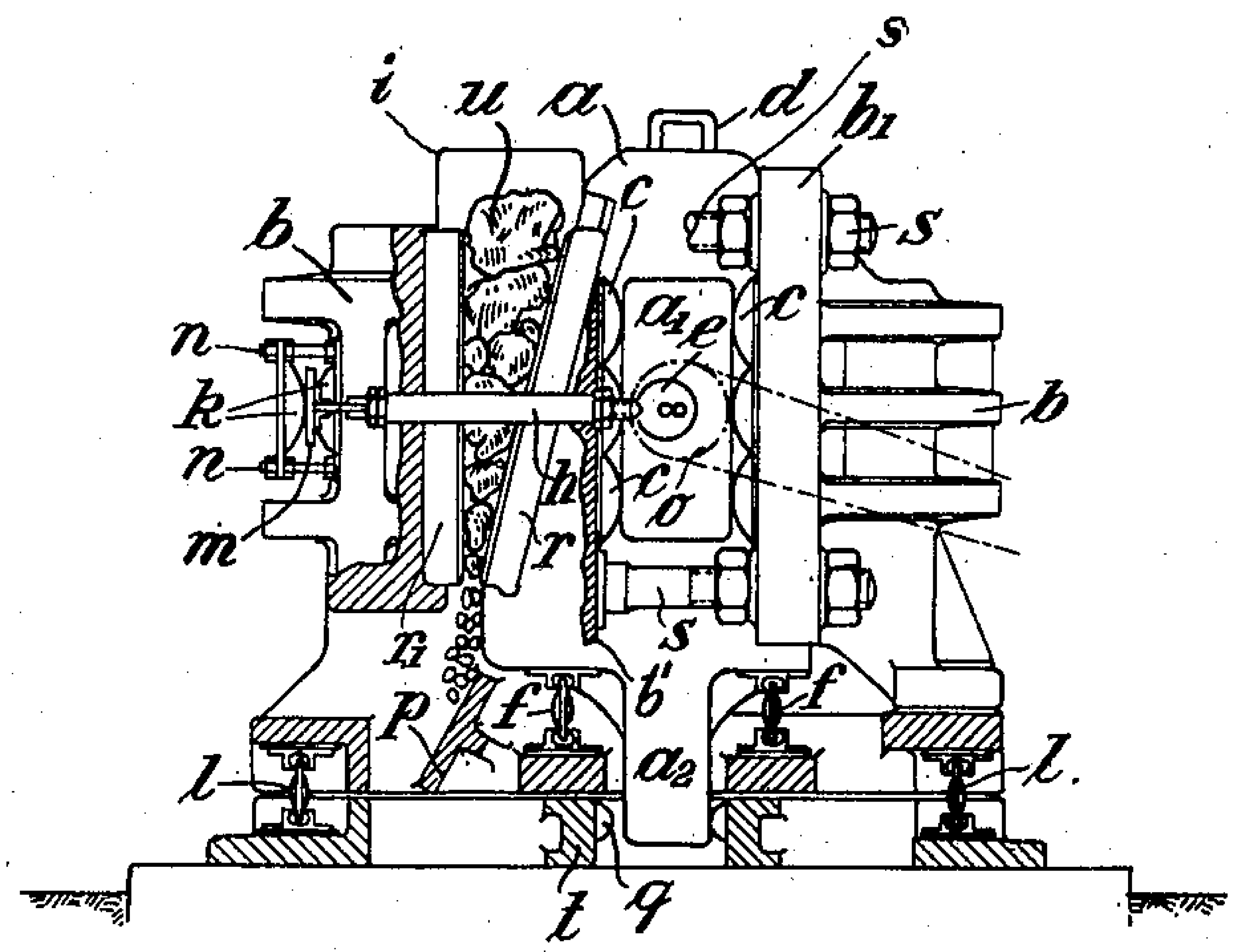

Fig. 2

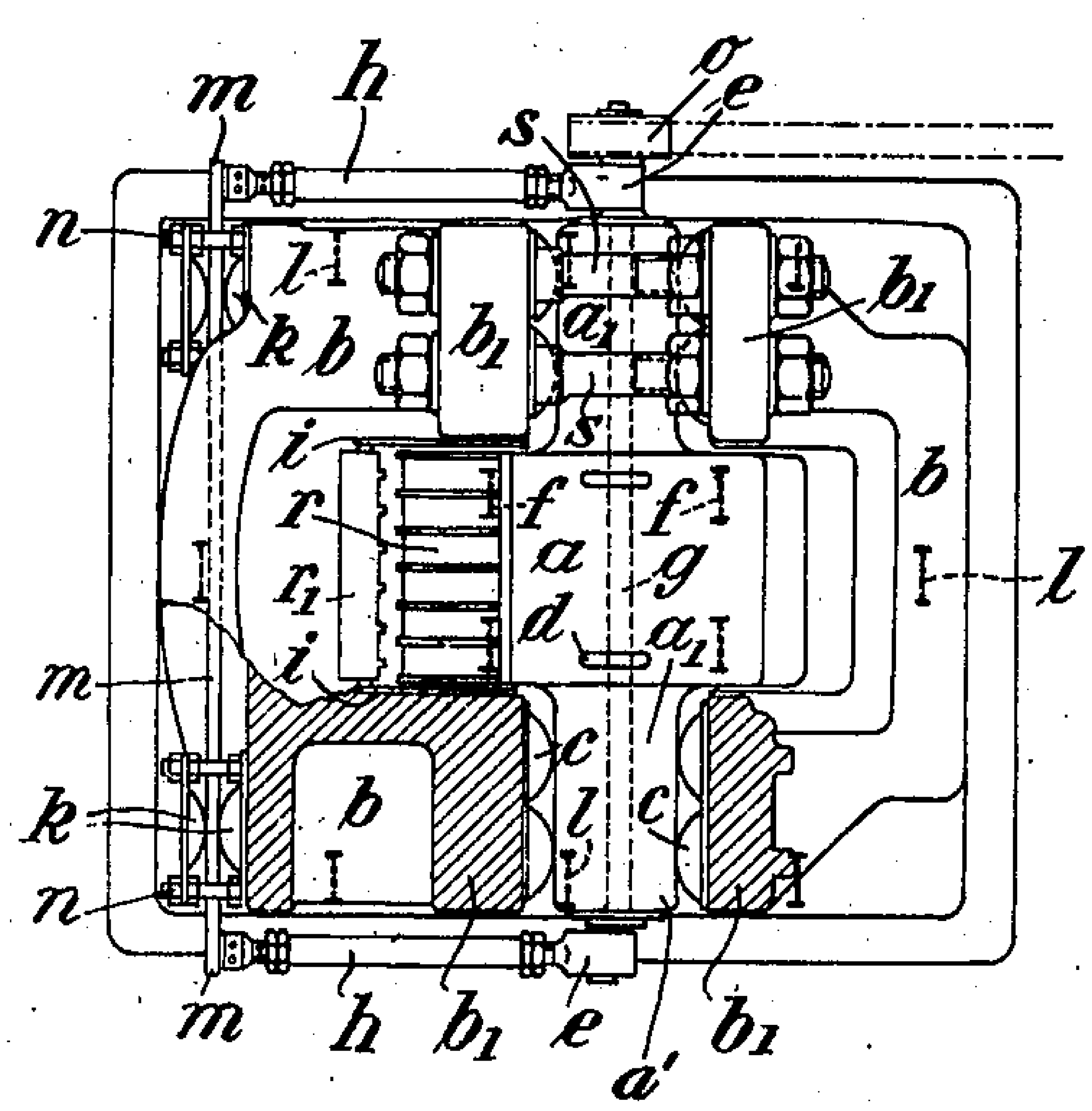

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Fig. 3

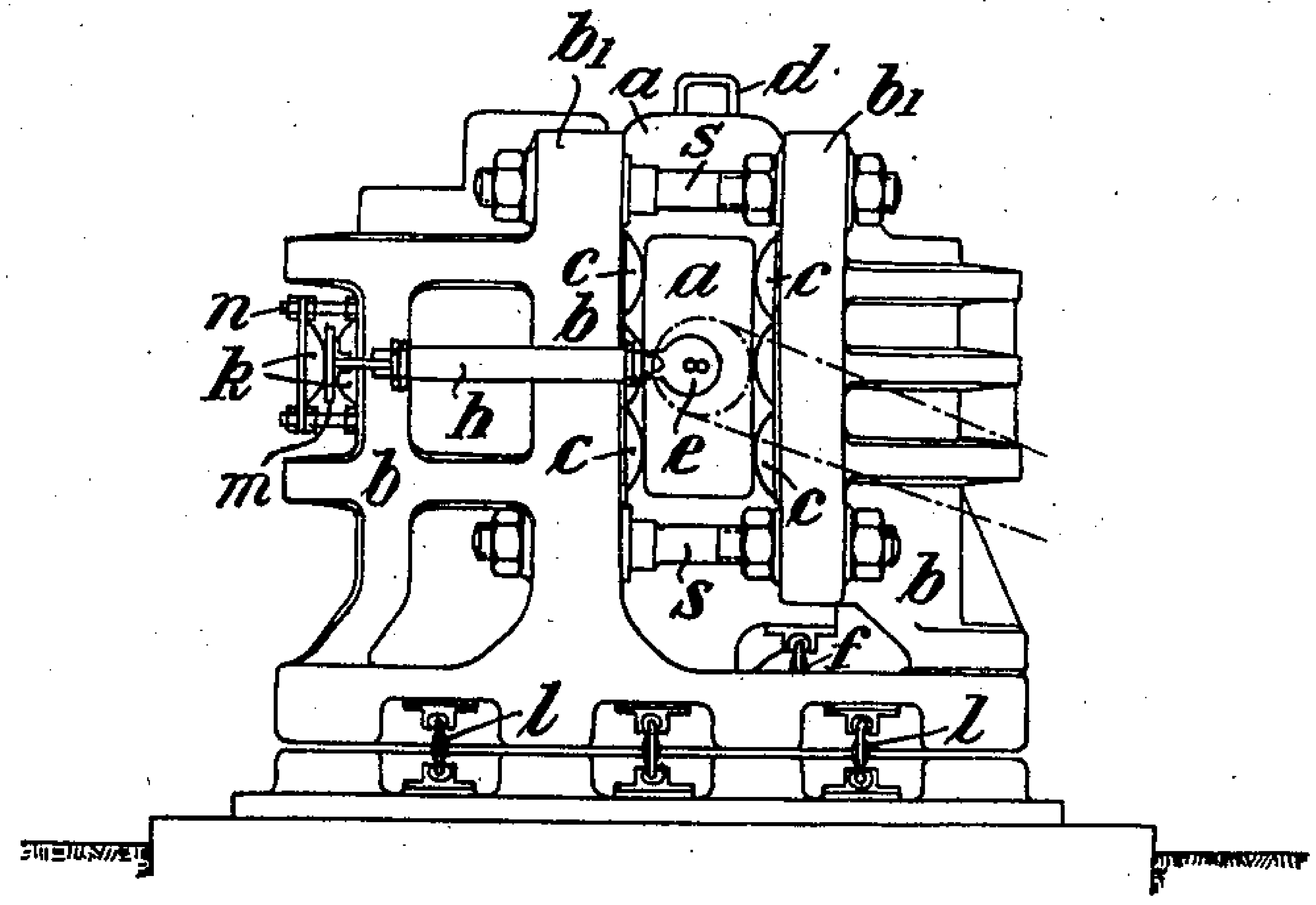
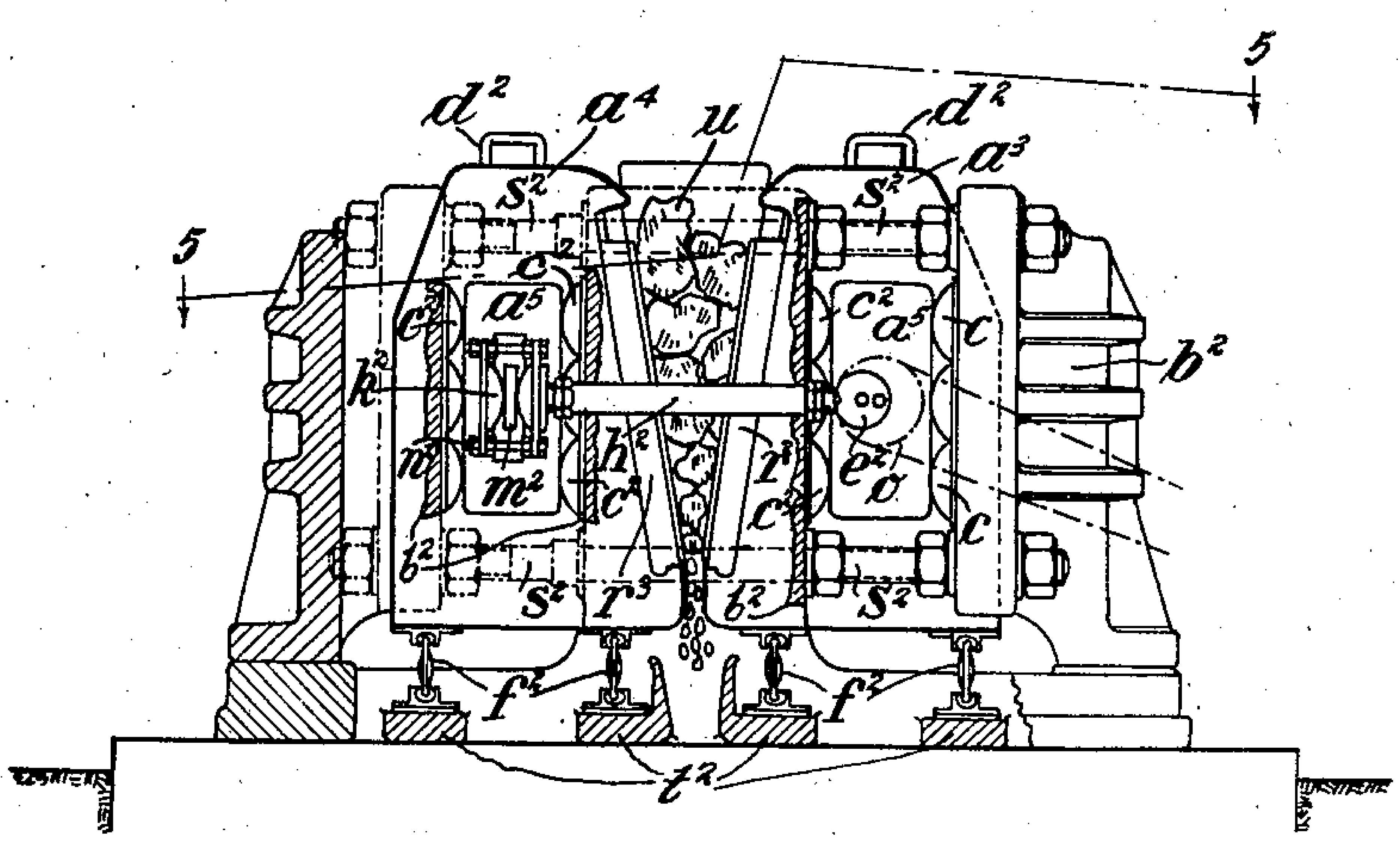


Fig. 4



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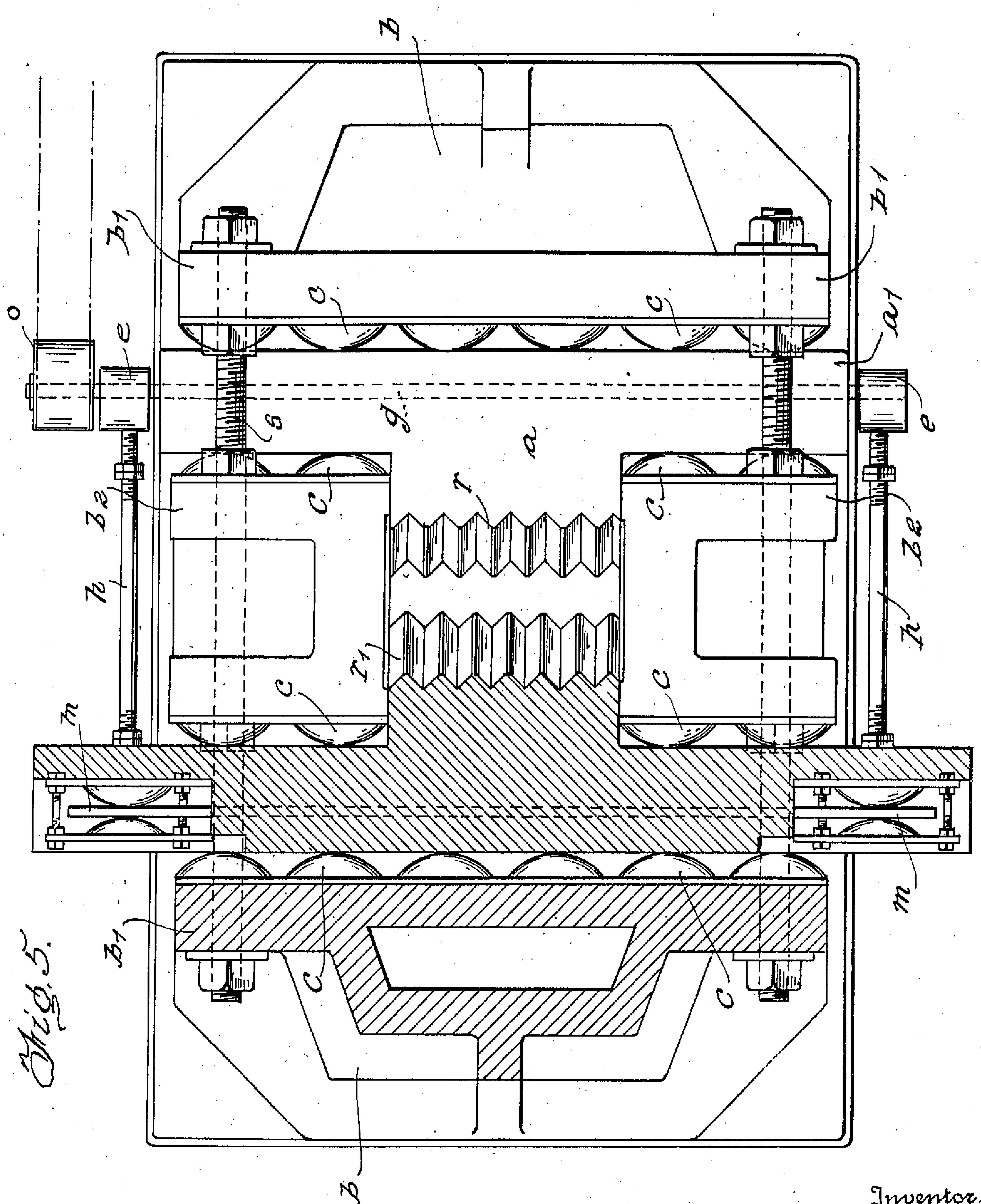

Fig. 5.

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UNITED STATES PATENT OFFICE

2,183,698

STONE CRUSHER

Georg Heinrich Schieferstein, Berlin-Charlottenburg, Germany

Application February 8, 1937, Serial No. 124,764
In Germany February 14, 1936

8 Claims. (Cl. 83—53)

This invention relates to stone crushers.

In the known stone crushers, two oppositely disposed jaws are caused to converge and diverge either by means of eccentric gear acting through toggle levers, or by means of connecting levers, in parallel connection, actuated by such gear. In both of the above embodiments very powerful reaction forces are transmitted to the driving shafts of the eccentrics and other rubbing members, the result being a considerable waste of energy and reduced efficiency of the crusher.

The present invention aims at obviating this drawback and is based on the new perceptions that the powerful forces required for crushing stones and other materials are advantageously generated and employed to produce a rocking motion, by means of oscillatory devices, and that, in addition, the harmful frictional reaction forces can be largely or entirely avoided by the use of oscillatory devices, if the forces required for crushing be applied, through rigid masses, to elastic means which give out said forces again, less the useful work performed, with a minimum of loss.

In order more clearly to understand the invention, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example, two embodiments thereof, and in which:

Fig. 1 is a side elevation partly in section;

Fig. 2 is a top plan view also partly in section;

Fig. 3 is a side elevation;

Fig. 4 is a side elevation, partly in section, of a modification in which a rigid frame and two oscillating crusher members are provided; and

Fig. 5 is a horizontal section taken substantially on the line **5—5** of Fig. 4.

The stone crusher shown in Figs. 1 to 3 comprises a main crusher member *a*, from the central main mass of which project two rigid lateral arms *a'*, by means of which said member *a* is rockably mounted in the frame *b* of the machine, with the aid of the interposed elastic means *c*. The member *a* is additionally guided between buffers *q* provided on the foundation *t*, by means of a stout rib a^2 extending downwards from the main mass of the member *a*. Insertion of the heavy main crusher member *a* into the frame *b* is facilitated by a handle *d* which is adapted to be engaged by lifting tackle. The member *a* is movably guided in the direction of the oscillations by means of spring supports, or link levers *f*, resting on the frame *b*, the latter also being similarly guided by guide springs and levers *l* which rest upon the foundation *t*. Mounted transversely in the member *a* is the shaft *g* provided at both ends, with eccentrics *e*. Said eccentrics are rigidly connected, by means of longitudinally adjustable rods *h*, with a coupling member *m*, yieldably mounted in the frame *b* by the aid of the elastic means *k*. The initial tension of said elastic means *k* can be adjusted by means of the tension screws *n*. In a similar manner, the initial tension of the elastic means *c*, between which the member *a* oscillates, can be controlled by the tension screws *s* provided in the cheeks b_1 of the frame *b*. Mounted on the member *a* is an interchangeable fluted crusher jaw *r*, of high-grade material, and a similar jaw r_1 is inserted in the frame *b* facing the jaw *r*. The V-shaped space between the jaws *r* and r_1, for the material *u* to be crushed, is bounded laterally by plates *i* detachably mounted on the frame *b* or the member *a*. Below said space is an inclined plane *p* for deflecting the crushed material as it falls from between the plates *r*, r_1 into a suitable container or conveyor (not shown). The aforesaid elastic means *c*, *k* and *q* preferably consist of domed rubber members, the elastic resistance of which increases to a more than linear extent, so that the oscillations are inharmonic.

On the mass of the member *a* being energized through the elastic eccentric gear *e*, *h*, *k*, *n*, *m*, it oscillates with a phase displacement of 180° in relation to the frame *b*. That is to say, the mouth of the crusher is narrowed and widened in conformity with the frequency of the oscillation, and the material *u* situated between the jaws *r* and r_1 is crushed by said jaws. Since the frame *b* by virtue of its connections *l* to the foundation *t* is also capable of movement in the direction of the oscillations, the mass of the member *a* acts in opposition to that of the frame *b*, and the interposition of the elastic means *c* sets up, between the two masses, a phase displacement of 180°, by which a complete balance of forces and inertia effects is established.

Fig. 4 shows an embodiment in which the frame b^2 is fixed to the foundation t^2, two main crushing members, a^3, a^4 being however provided, to which are attached the jaws r^2 and r^3. Both of said main members r^2 and r^3 are mounted, so as to move in the direction of oscillation, on spring supports, or link levers f^2, and yieldably disposed, by the aid of the elastic means c^2, in the frame b^2.

As in the embodiment described with reference to Figs. 1 to 3, the crusher is driven by way of the belt pulley *o* or the like. The driving belt is tensioned while members a^3, a^4 are oscillating in any known manner, as by spring means (not shown).

Unlike the previous embodiment, the member a^3 carrying the eccentric shaft is coupled, not with the frame b^2, but with member a^4, by way of the elastic coupling e^2, h^2, k^2, m^2, n^2. In this case also, the initial tension of the elastic means c^2 and k^2 is controlled by tension screws s^2 and n^2 respectively. Owing to this arrangement, the masses of the two main bodies a^3 and a^4 oscillate with a relative phase displacement of 180°. In so doing, the frame b^2, or the tension screws s^2 holding its parts together, absorb the tension and compression stresses, without, however, being set in oscillation, the stresses being relatively offset by exactly 180°.

The forces needed for crushing the materials can be easily increased to several hundred thousand kilo-grammes, since each group of rubber members can support several thousand kilogrammes and a large number of rubber members may be employed, so that all constructional problems, in this connection, can be solved without difficulty.

In principle, the loose coupling e^2, h^2, k^2, n^2, m^2 is known, and can be replaced by any other known type of coupling, according to requirements. The coupling effect can be increased within a wide range by the selection and dimensioning of the rubber members, or by employing a plurality of such members.

The two masses a and b (Figs. 1 to 3), or a^3 and a^4 (Fig. 4) which, by virtue of their kinetic energy $\frac{1}{2}mVo^2$ can be regarded at the mid-point of their oscillatory movement as transmitters of energy, are inherently comparatively heavy in machines of this kind. Their weight may, however, be further largely increased if greater mass action be desired. Consequently, by increasing the weight of the main members, on the one hand, and the elastic forces on the other, the energy per oscillation can be modified within a wide range, whilst the performance of work per second is increased in quadratic proportion by increasing the frequency.

In the present instance, the relative movement of the masses is rectilinear, by parallel displacement. However, the relative movement of the jaws may describe a circular, or otherwise curved, course, without departing from the nature of the invention or the principle of avoiding frictional shafts or other members. This can be achieved by employing rubber members of different dimensions, or by suitably designing the masses, in places where a rotational axis of the masses is desired, and constraining them to describe a rotational movement between comparatively flat rubber members.

It is evident, from the foregoing description and the drawings, that powerful oscillatory forces can be brought into action between the jaws without need for periodically heavily-loaded eccentric shafts, fly-wheels or other members which absorb large amounts of energy, and that consequently, in any event, machines of excellent efficiency must result, as is inherent in the case of resonance mechanism. At the same time the reaction forces are absorbed by the elastic means of the oscillatory system, and are given out again practically without loss, a circumstance which must be regarded as a special advantage. Moreover, the frequency, and therefore the output, of the crusher, can be modified at convenience, so that, in the case of each material treated, the optimum relation between the crushing performance, the oscillatory effect and the frequency, can be determined. The frequency can be modified by drawing the two parts of the frame, between which the mass a oscillates, more closely together by tightening the screws s, thereby modifying the initial tension which increases in more than linear proportion. Any other known form of energy may be employed without departing from the nature of the invention.

I claim:

1. A stone crushing machine comprising a base, a frame, said frame being spring-mounted for reciprocation on said base, a vertically arranged crusher jaw fast on said frame, a crusher body spring-mounted on said frame for reciprocation relatively thereto, a crusher jaw fast on said crusher body and opposed to said first crusher jaw in coacting relation, a pair of opposed members providing opposed vertical surfaces on said frame, lateral arms on said crusher body each disposed between said pair of opposed vertical surfaces, balanced groups of resilient rubber dome-shaped elements on said surfaces, said groups being opposed and arranged to contact on opposite sides of said arms, a driven shaft on said crusher body, eccentrics on said shaft, coupling members interconnecting said eccentrics and said frame, and a coupling including resilient rubber dome-shaped elements between said coupling members and said frame.

2. A stone crushing machine as claimed in claim 1 the resilient rubber elements having adjustable mountings.

3. A stone crushing machine comprising a stationary frame, two crusher bodies with opposed crusher jaws, said crusher bodies being spring mounted to reciprocate on said frame, a pair of opposed vertical surfaces on said frame, lateral arms on said crusher bodies each disposed between said pair of vertical surfaces, balanced groups of resilient rubber dome-shaped elements on said surfaces, said groups being opposed and arranged to contact on opposite sides of said arms, a driven shaft on one of said crusher bodies, eccentrics on said shaft, coupling members interconnecting said eccentrics and the other crusher body, and a loose coupling including resilient rubber dome-shaped elements between said coupling member and said other crusher body.

4. A stone crushing machine as claimed in claim 3, the resilient rubber elements having adjustable mountings.

5. A stone crusher comprising a crusher frame, a crusher member mounted in said frame in spaced relation to the sides thereof, elastic means interposed between said member and the sides of the frame, a main frame integral with the crusher frame, a crusher wear plate, means for supporting said crusher wear plate from said main frame, a driving shaft extending through said first crusher member transversely of the main frame, said shaft projecting at its ends beyond the member, driving means fixed on one end of said shaft, eccentrics fixed on the ends of said shaft, a transverse bar extending behind the crusher wear plate, elastic means supporting the bar yieldably with respect to the said crusher wear plate, and eccentric rods connecting said eccentrics and the end portions of said bar.

6. A stone crusher including a crusher frame, a crusher member mounted in said frame in spaced relation to the sides thereof, elastic means interposed between said member and the sides of the frame, a second crusher frame integral with the first frame, a second crusher member mount-

ed in said second frame in spaced relation to the sides thereof, elastic means interposed between the second crusher member and the sides of the second frame, a driving shaft extending through the first crusher member transversely of the first frame, said shaft projecting at its ends beyond the first crusher member, driving means fixed on one end of the shaft, eccentrics fixed on the ends of said shaft, a bar extending transversely through the second crusher member, and eccentric rods connecting the ends of the bar and said eccentrics.

7. In a stone crushing machine as claimed in claim 5, all of said resilient means being resilient rubber domes the elasticity of which increases on deformation in more than linear proportion.

8. In a stone crushing machine as claimed in claim 6 all of said resilient means being resilient rubber domes the elasticity of which increases on deformation in more than linear proportion.

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