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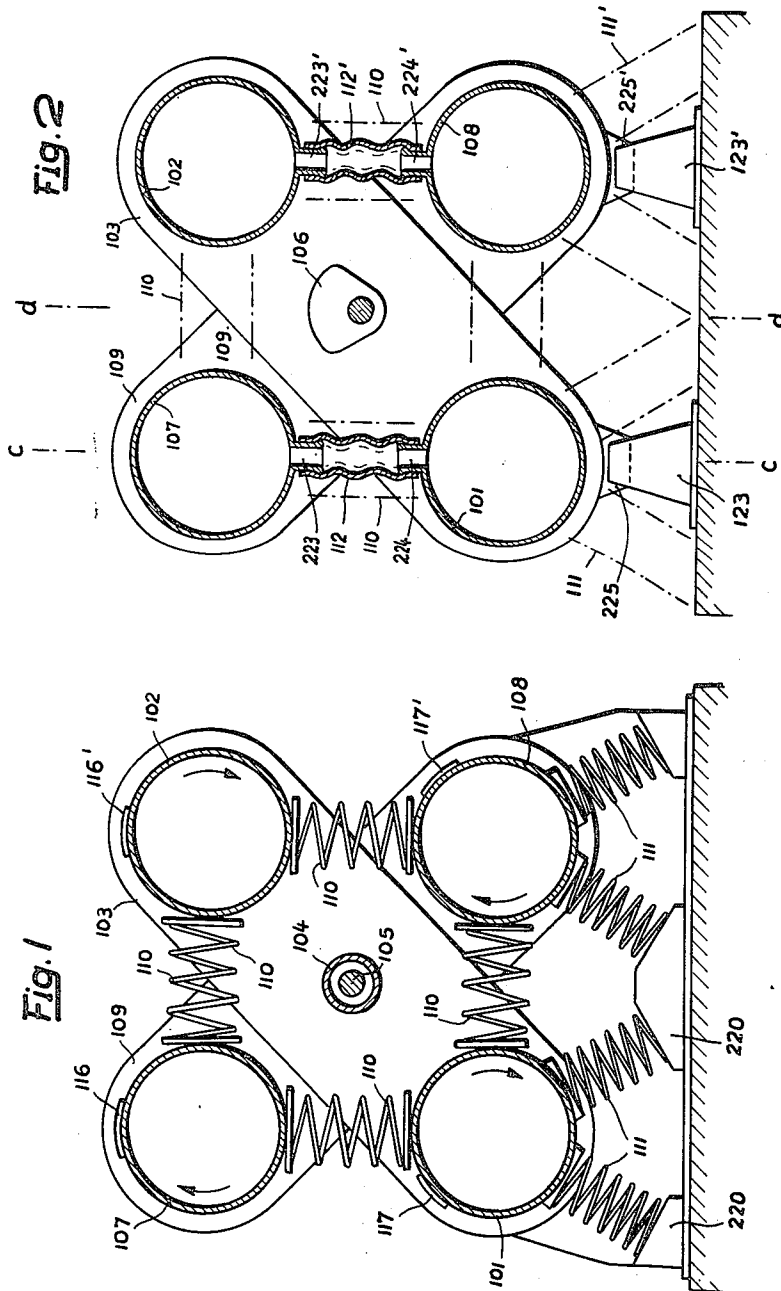
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VIBRATING CRUSHER

Filed April 8, 1952

5 Sheets-Sheet 1



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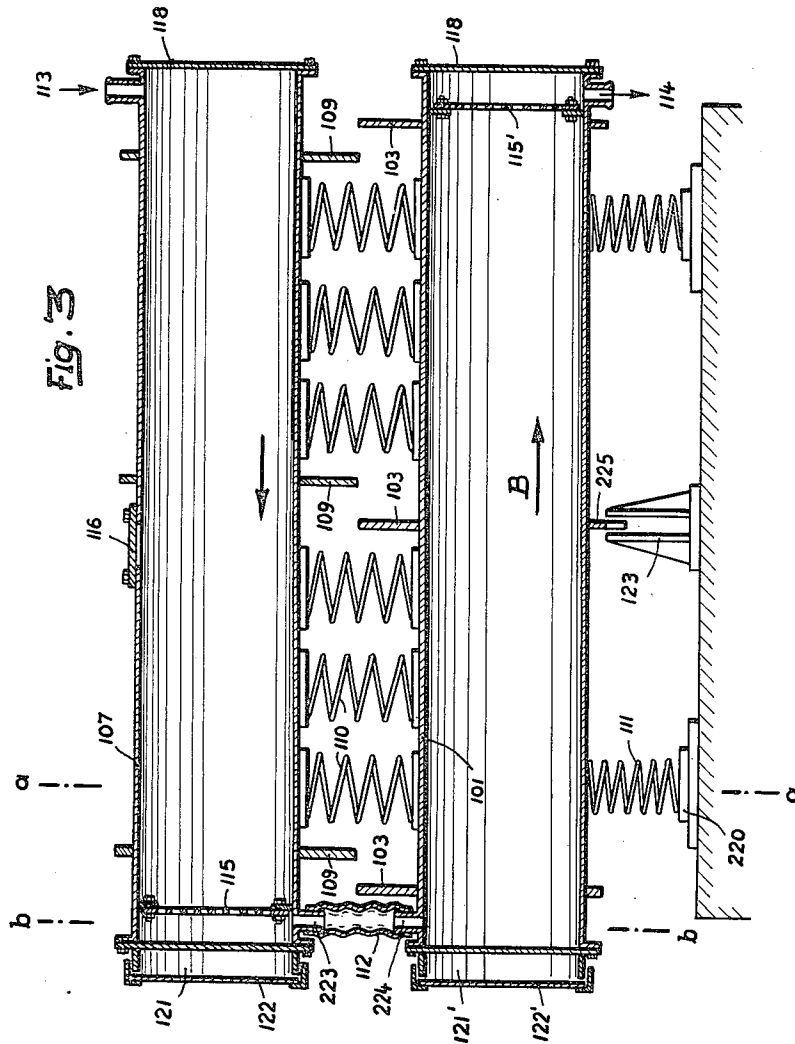
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VIBRATING CRUSHER

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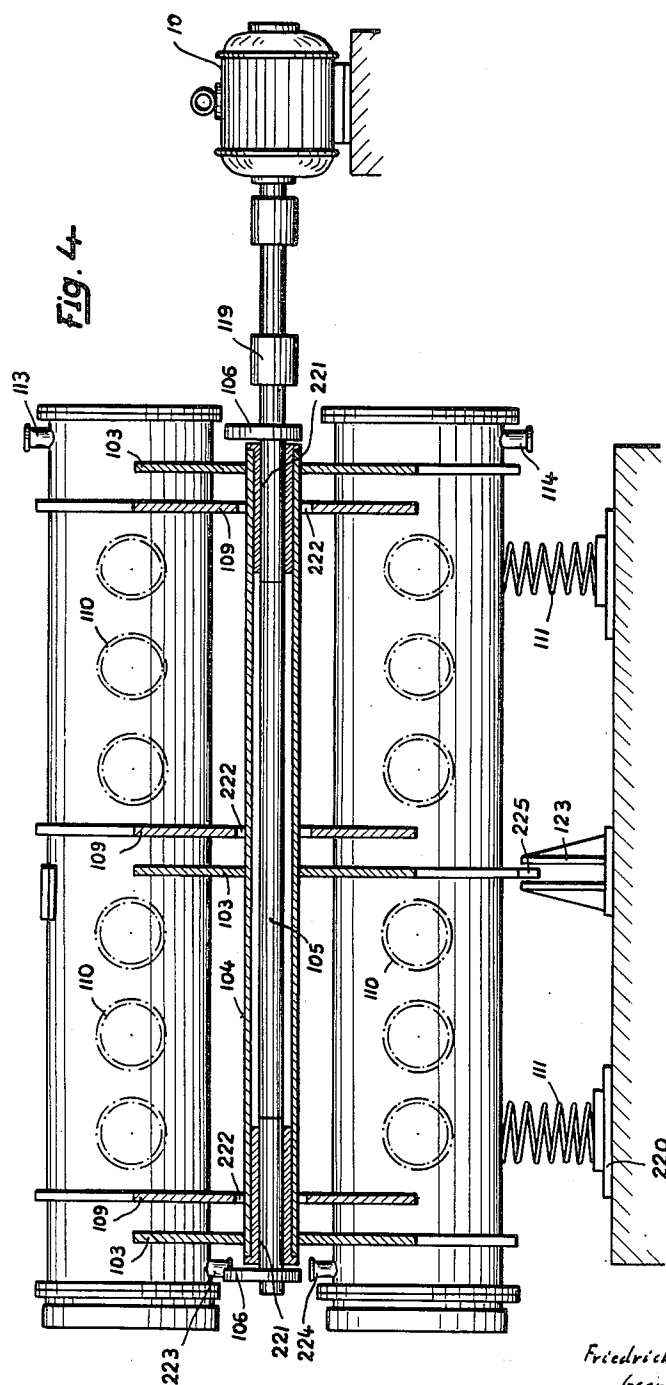
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VIBRATING CRUSHER

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5 Sheets-Sheet 3



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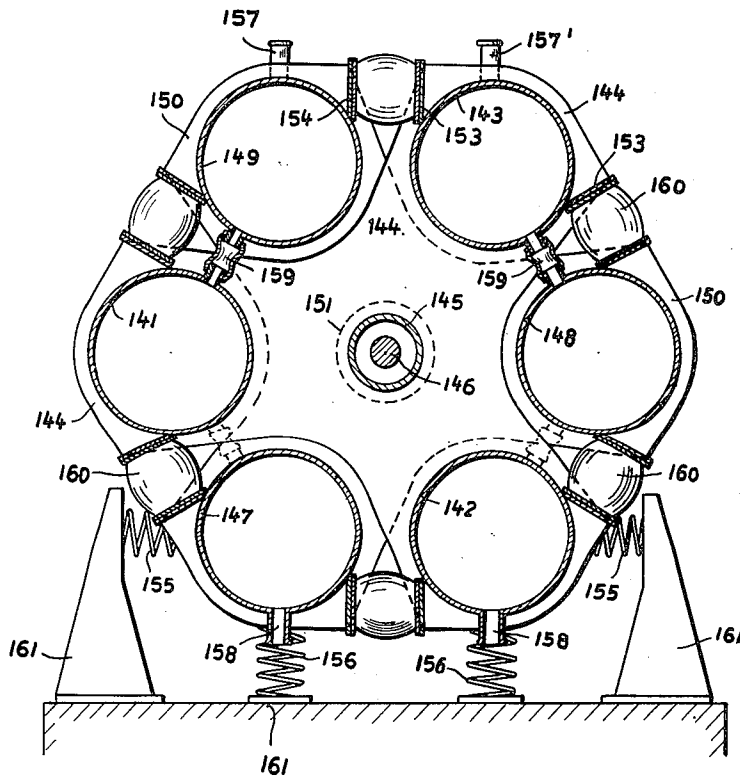
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Fig. 5



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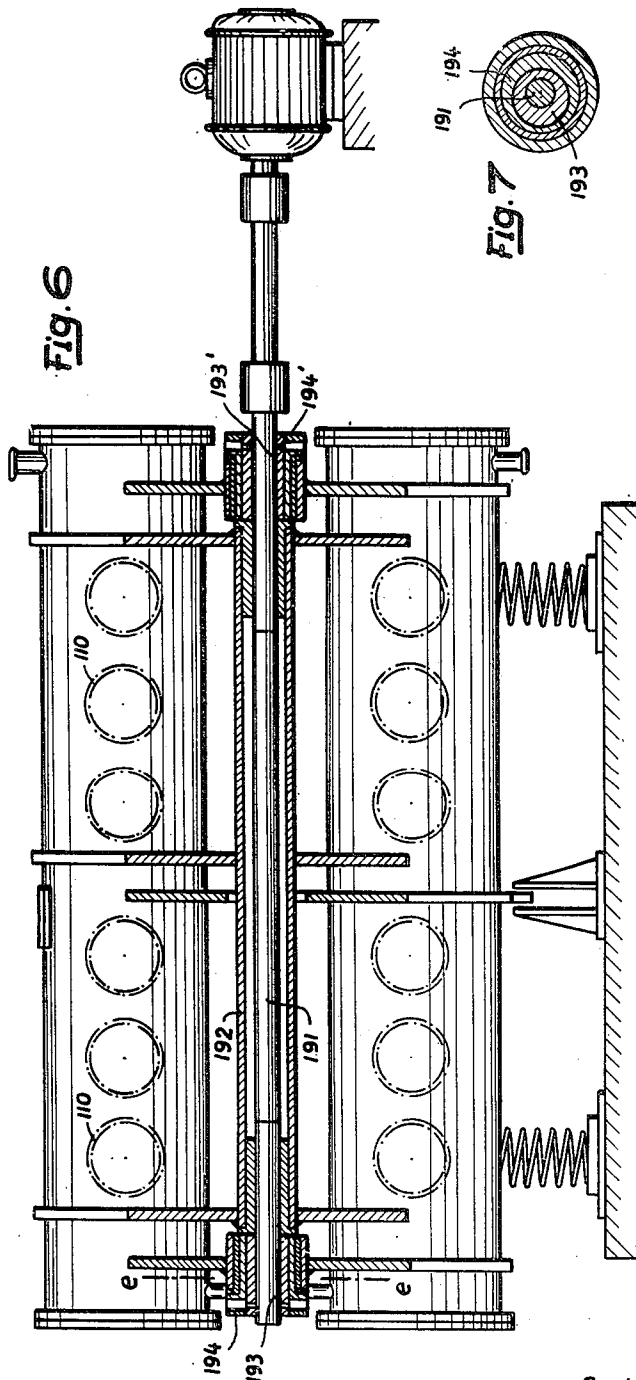
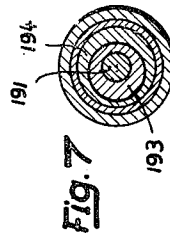
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2,760,729

VIBRATING CRUSHER

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19 Claims. (Cl. 241—137)

This invention relates to crushers, and more particularly to vibrating crushers.

Although a vibrating crusher has a considerably better efficiency with respect to the crushing effect than a tube mill or crusher, the tube mill is superior to the vibrating crusher with respect to its mechanical efficiency, easier way of manufacture in large dimensions and adaptability for continuous operation.

It is an object of this invention to provide a vibrating crusher having an improved mechanical efficiency.

Another object of the invention is to provide a vibrating crusher which may be readily manufactured in large dimensions.

A further object of the invention is to provide a vibrating crusher which may be used for continuous operation.

Another object of the invention is to provide a vibrating crusher wherein the masses are well balanced, so that, during the operation of the crusher, the parts of a floor below and adjacent to the base of the crusher are protected from too high a vibration and, consequently, the crusher can be used in the upper floors of a building, even if the resilient means arranged between the base and the vibrating masses should be insufficient to absorb the vibrations.

A further object of the invention is to improve on the construction of vibrating crushers as now customarily made.

Other objects and structural details of the invention will be apparent from the following description when read in conjunction with the accompanying drawings forming part of this specification, wherein:

Fig. 1 is a sectional view, taken on line *a—d* of Fig. 3 of a vibrating crusher according to the invention, having two mass systems, each system comprising two crushing drums,

Fig. 2 is a sectional view, taken on line *b—b* of Fig. 3,

Fig. 3 is a sectional view, taken on line *c—c* of Fig. 2,

Fig. 4 is a sectional view, taken on line *d—d* of Fig. 2,

Fig. 5 is a sectional view of another embodiment of a vibrating crusher having two mass-systems, each system comprising three crushing drums,

Fig. 6 is a longitudinal sectional view of a vibrating crusher substantially corresponding to the crusher shown in Figs. 1—4, wherein, however, the unbalance-drive is replaced by an eccentric-drive, and

Fig. 7 is a sectional view, taken on line *e—e* of Fig. 6, on an enlarged scale.

The vibrating crusher shown in Figs. 1—4 comprises four crushing drums 101, 102, 107, 108, each pair of oppositely arranged drums 101, 102 and 107, 108 constituting a system of masses. The drums 101 and 102 are rigidly connected with each other by a plurality of tie plates 103 and the drums 107 and 108 are rigidly connected with each other by a plurality of tie plates 109. Springs 110 are interposed between the drums of one system of masses and adjacent drums of the other system of masses. The crushing device is resiliently supported by the base 220 of the vibrating crusher through

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the medium of springs 111 having a low spring constant and being interposed between the base 220 on one hand and the drum 101 of one of the systems of masses and the drum 108 of the other system of masses on the other hand. Thus, both systems of masses are resiliently supported relative to the base. A center tube 104 secured to the tie plates 103 in the axis of the center of gravity passes with clearance through openings 222 of the tie plates 109. As best shown in Fig. 4, a shaft 105 carrying two unbalances 106 and passing through said center tube 104 is journaled in bearings 221. The unbalance-shaft 105 is driven by an electromotor 10 through the medium of an elastic clutch 119. The unbalances 106 cause the first system of masses 101, 102, 103 to oscillate. The springs 110 transmit oscillatory impulses to the second system of masses 107, 108, 109 whereby the latter is likewise vibrated. The large openings 222 of the tie plates 109 permit an unobstructed vibration of the center tube 104.

Approximately half of the volume of the crushing drums is filled with crushing elements, for example steel balls, which may be introduced into the drums through apertures, which may be closed by covers 116, 116', 117, 117' (see Fig. 1).

Each pair of superimposed crushing drums 101, 107 and 108, 102 constitute a crushing group. The material to be crushed supplied to the upper drums 102 and 107 through inlets 113 (only one being shown in Fig. 3) passes through said upper drums in the direction of the arrow A shown in Fig. 3. The crushed material may pass through a perforated sieve wall 115, arranged near the end of the upper drum, which retains the crushing elements in said upper drum. Then, the crushed material is discharged from the upper drums 107, 102 through the outlets 223, 223'. The latter are connected by elastic hoses 112, 112' with inlets 224, 224' of the lower drums 101, 108 pertaining to the other system of masses. The material supplied to the lower drums through the hoses 112, 112' and inlets 224, 224' passes through the lower drums in reversed direction as indicated by arrow B in Fig. 3. The crushed material passing through a perforated sieve plate 115' arranged near the end of the lower drum is discharged through an outlet 114 from each lower drum. The sieve plate 115' retains the crushing elements in the lower drum.

As best shown in Figs. 2 and 3 brackets 123, 123', each comprising two spaced plates, are arranged on the base of the crusher, for cooperation with lugs 225, 225' arranged on and projecting from the lower drums 101, 108. Said lugs 225, 225' extending into the space between the plates of the brackets 123, 123' permit only slight movements of the crushing device in the direction of the longitudinal axis of the drums, so that the crushing device is prevented from undesired large oscillations in the direction of its longitudinal axis.

According to the embodiment shown in Fig. 5 the vibrating crusher comprises six crushing drums. The drums 141, 142 and 143 rigidly connected with each other by tie plates 144 constitute a first system of masses and the drums 147, 148 and 149 rigidly connected with each other by tie plates 150 constitute a second system of masses. A center tube 145 secured to the tie plates 144 of one of the systems of masses passes with clearance through comparatively wide openings 151 of the tie plates 150 of the other system of masses. An unbalance-shaft 146 is journaled in said center tube 145 in the same manner as described above in connection with the unbalance-shaft 105 shown in Fig. 4. Said two systems of masses support each other resiliently by a series of rubber buffers 160 arranged between the tie plates 144 and 150 of the two systems near each crushing drum of one system of masses and the adjacent crushing drum of

the other system of masses. The structure comprising said two systems of masses and being capable of performing vibrations is resiliently supported by the base 161 through the medium of springs 155 and 156 having a low spring constant and being interposed between the base and the lower drums 142 and 147 of the two systems of masses. The six drums of the crusher form two crushing groups, each group having three drums symmetrically arranged relative to the vertical plane of the driving axis. The drums 149, 141 and 147 form one of the two crushing groups, the drums 143, 148 and 142 forming the other. Approximately half of the volume of the drums is filled with crushing elements. Each of the upper drums 149 and 143 has an inlet 157 and 157' respectively for the introduction of the material to be crushed. The material passes in reversed directions through the individual drums of each crushing group, reaching through elastic hoses 159 respectively the next drum and being discharged through outlets 158 respectively. Perforated sieve plates, of the type of the sieve plates 115, 115' shown in Fig. 3, arranged in the drums of the crusher permit the passage of the material but retain the crushing elements.

According to the embodiment shown in Figs. 6 and 7 the vibrating crusher has four drums, divided into pairs of two, each pair forming a system of masses of the type described above in connection with Figs. 1-4. According to Figs. 6 and 7, however, the unbalance-drive is replaced by an eccentric-drive. A center tube 192 is secured to the tie plates of one of the systems of masses. The shaft 191 carrying the inner eccentrics 193 and 193' is journaled in said center tube 192. The outer eccentrics 194 and 194' are rotatably arranged on said inner eccentrics. Said outer eccentrics may be held in predetermined positions relative to said inner eccentrics by means of screws, so that vibrations of different degrees between 0 and a maximum value. The bearings of said outer eccentrics are mounted in the tie plates of the outer system of masses.

All of the vibrating crushers described above are operated in such a manner that the frequency of the drive conforms entirely or approximately with the natural frequency of the system capable of performing vibrations, i. e., in other words, that the spring constant of the springs arranged between the vibrating masses is chosen in such a way that, for example, for a number of rotations of the drive of 1000 rotations per minute the natural frequency of the vibrating system likewise amounts to approximately 1000 rotations per minute. In hitherto known vibrating crushers the customary positive drive by eccentrics or by so-called physically controlled movement, i. e. by an unbalance-drive with soft support of the vibrating masses of the crusher, cause high pressure in the bearings resulting in a heating thereof, so that high frictional losses occur in the bearings of the drive causing a mechanical efficiency inferior to the mechanical efficiency of the tube mills and making a construction in large dimensions prohibitive. These disadvantages are overcome by the construction of a vibrating crusher according to this invention as described above.

We have described preferred embodiments of our invention, but it is understood that this disclosure is for the purpose of illustration and that various omissions or changes in shape, proportion and arrangement of parts, as well as the substitution of equivalent elements for those, herein shown and described, may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What we claim is:

1. In a vibrating crusher, the combination of: a base, a first system of masses including at least two crushing drums, means rigidly connecting said drums with each other so as to form a first unit, a second system of masses including at least two additional crushing drums, means rigidly connecting said additional drums with each other

so as to form a second unit, resilient means between said first and second systems of masses resiliently holding one apart from the other, said two systems of masses together with said resilient means forming a structure capable of performing vibrations, springs between said base and said structure for resiliently supporting the latter on the former, said springs having a low spring constant, and a drive connected with one of said rigid connecting means imparting oscillating impulses to one of the systems of masses of said structure, said drive having an operating frequency conforming substantially with the natural frequency of said structure.

2. In a vibrating crusher as claimed in claim 1, said drive being formed by an unbalance-drive.

3. In a vibrating crusher as claimed in claim 1, said drive being formed by an eccentric-drive.

4. In a vibrating crusher as claimed in claim 1, said springs being engaged with said first system of masses of said structure.

5. In a vibrating crusher as claimed in claim 1, said springs being engaged with said second system of masses of said structure.

6. In a vibrating crusher as claimed in claim 1, said springs comprising two sets of springs, the first set of springs being engaged with said first system of masses, and the second set of springs being engaged with the second system of masses.

7. In a vibrating crusher as claimed in claim 1, each crushing drum of one system being arranged between successive crushing drums of the other system.

8. In a vibrating crusher as claimed in claim 1, each crushing drum of one system being arranged between successive crushing drums of the other system, first conduits connecting the interiors of adjacent crushing drums of both systems with each other at one side of the crusher, and second conduits connecting the interiors of adjacent crushing drums of both systems with each other at the opposite side of the crusher, whereby two separate groups of crushing drums are formed, each group including drums of both systems.

9. In a vibrating crusher, the combination of: a base, a first system of masses including a first series of crushing drums and a first frame work rigidly connecting said drums with each other so as to form a first unit, a second system of masses including a second series of crushing drums and a second frame work rigidly connecting said second drums with each other so as to form a second unit, resilient means between said first unit and said second unit for resiliently holding said units apart from each other, said first unit, said second unit and said resilient means forming a structure capable of performing vibrations, springs between said base and said structure for resiliently supporting the latter on the former, said springs having a low spring constant, and a drive connected with one of said rigid connecting means to impart oscillatory impulses to one of the systems of masses of said structure, said drive having an operating frequency conforming substantially with the natural frequency of said structure.

10. In a vibrating crusher as claimed in claim 9, a center tube passing through said units and being rigidly connected with the frame work of the first unit, said second unit being movable relative to said center tube, and said drive being operatively engaged with said center tube.

11. In a vibrating crusher as claimed in claim 9, the drums of one unit being arranged between successive drums of the other unit, and said resilient means being arranged between the drums of one unit and the adjacent drums of the other unit.

12. In a vibrating crusher as claimed in claim 9, the drums of one unit being arranged between successive drums of the other unit, said resilient means being arranged between the drums of one unit and the adjacent drums of the other unit, and said springs having a low

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spring constant being arranged between said base and drums of both units.

13. In a vibrating crusher as claimed in claim 9, a center tube passing through said units and being rigidly connected with the frame work of the first unit, said second unit being movable relative to said center tube, the drums of one unit being arranged between successive drums of the other unit, the drums being symmetrically arranged on opposite sides of a vertical plane passing through the axis of said center tube, first conduits connecting the interiors of the group of drums at one side of said vertical plane passing through the axis of the center tube with each other, and second conduits connecting the interiors of the group of drums at the other side of said vertical plane passing through the axis of the center tube with each other, said resilient means being arranged between said units, and said drive being operatively engaged with said center tube.

14. In a vibrating crusher as claimed in claim 9, a center tube passing through said units and being rigidly connected with the frame work of the first unit, said second unit being movable relative to said center tube, the drums of one unit being arranged between successive drums of the other unit, said resilient means being arranged between the drums of one unit and the adjacent drums of the other unit, and said drive including an unbalance-drive operatively engaged with said center tube.

15. In a vibrating crusher as claimed in claim 9, a center tube passing through said units and being rigidly connected with the frame work of the first unit, said second unit being movable relative to said center tube, the drums of one unit being arranged between successive drums of the other unit, said resilient means being arranged between the drums of one unit and the adjacent drums of the other unit, and said drive including an eccentric-drive operatively engaged with said center tube.

16. In a vibrating crusher as claimed in claim 9, the drums of one unit being arranged between successive drums of the other unit, and said resilient means being arranged between the frame works of said two units.

17. In a vibrating crusher as claimed in claim 9, the drums of one unit being arranged between successive drums of the other unit, said resilient means being arranged between the frame works of said two units, and said springs having a low spring constant being arranged between said base and the frame works of both units.

18. In a vibrating crusher as claimed in claim 9, a center tube passing through said units and being rigidly connected with the frame work of the first unit,

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said second unit being movable relative to said center tube, the drums of one unit being arranged between successive drums of the other unit, the drums being symmetrically arranged on opposite sides of a vertical plane passing through the axis of said center tube, first conduits connecting the interiors of the group of drums at one side of said vertical plane passing through the axis of the center tube with each other, and second conduits connecting the interiors of the group of drums at the other side of said vertical plane passing through the axis of the center tube with each other, said resilient means being arranged between the frame works of said two units, and said drive being operatively engaged with said center tube.

19. A vibrating crusher, comprising in combination: a base, a first system of masses including at least two crushing drums, means rigidly connecting said drums with each other to form a first unit, a second system of masses including at least two additional crushing drums, means rigidly connecting said additional drums with each other to form a second unit, resilient means between said first and second systems of masses for resiliently holding one from against the other, said two systems of masses together with said resilient means forming a structure capable of performing vibrations, springs between said base and said structure for resiliently supporting the latter on the former, said springs having a low spring constant, first conduits connecting the interiors of adjacent drums of both of said systems with each other at one side of the crusher, second conduits connecting the interiors of adjacent crushing drums of both of said systems with each other at the opposite side of the crusher, and a drive cooperating with one of said systems to impart oscillatory impulses thereto, said drive having an operating frequency conforming substantially with the natural frequency of said structure.

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