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[54] **GYRATORY CRUSHER WITH HYDRAULIC MEANS FOR LIFTING THE UPPER PART OF THE HOUSING FROM THE LOWER PART**

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[51] **Int. Cl.** **B02c 2/04**

[58] **Field of Search** 241/207-209, 241/211, 213-216, 259, 259.1, 259.2, 286

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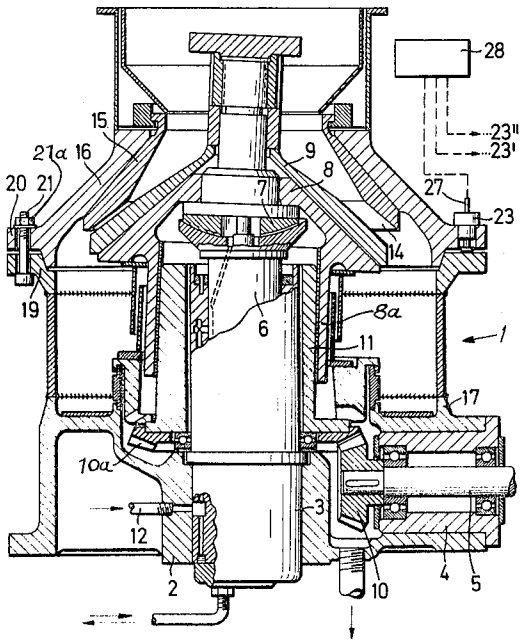
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[57] **ABSTRACT**

A gyratory crusher provided with a housing consisting of two superimposed parts provided with flanges traversed by bolts and nuts which releasably connect the two parts of the housing with each other and also provided with a plurality of hydraulically operating lifting devices arranged in apertures of one of the flanges and engaging the other flanges for lifting the upper part of the housing from the lower part of the same.

4 Claims, 3 Drawing Figures



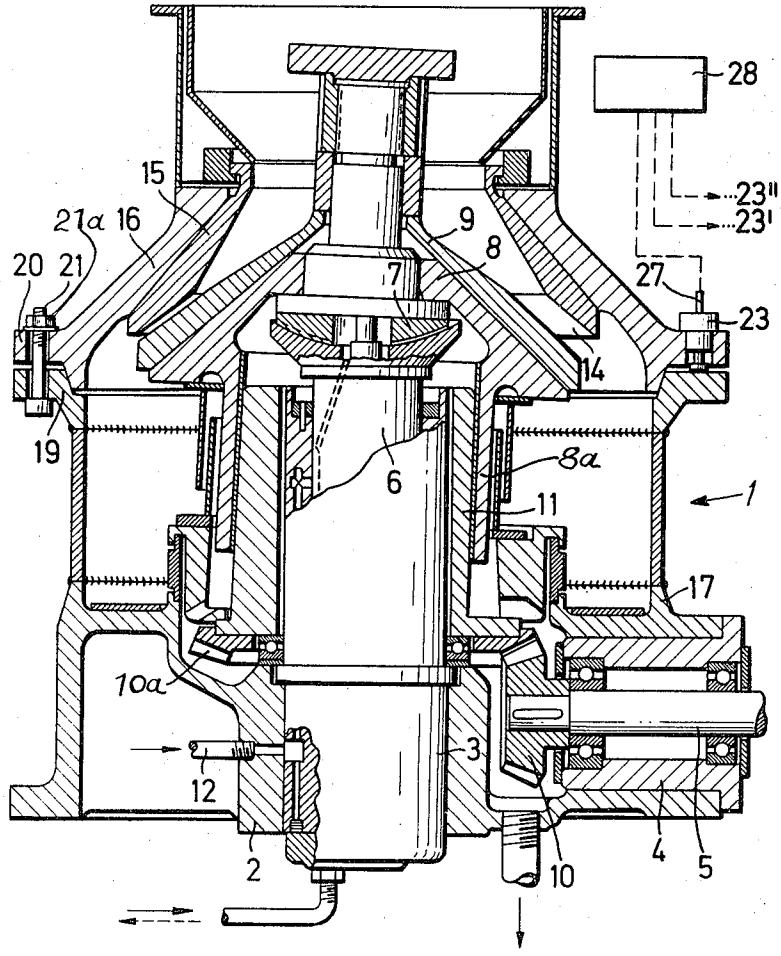


FIG. 1

FIG. 2

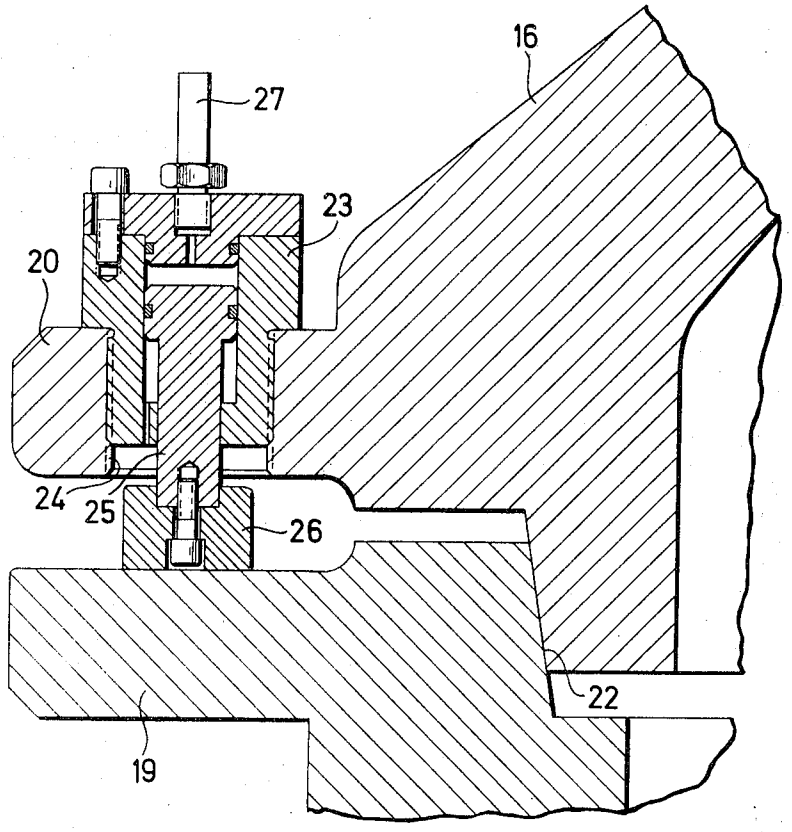
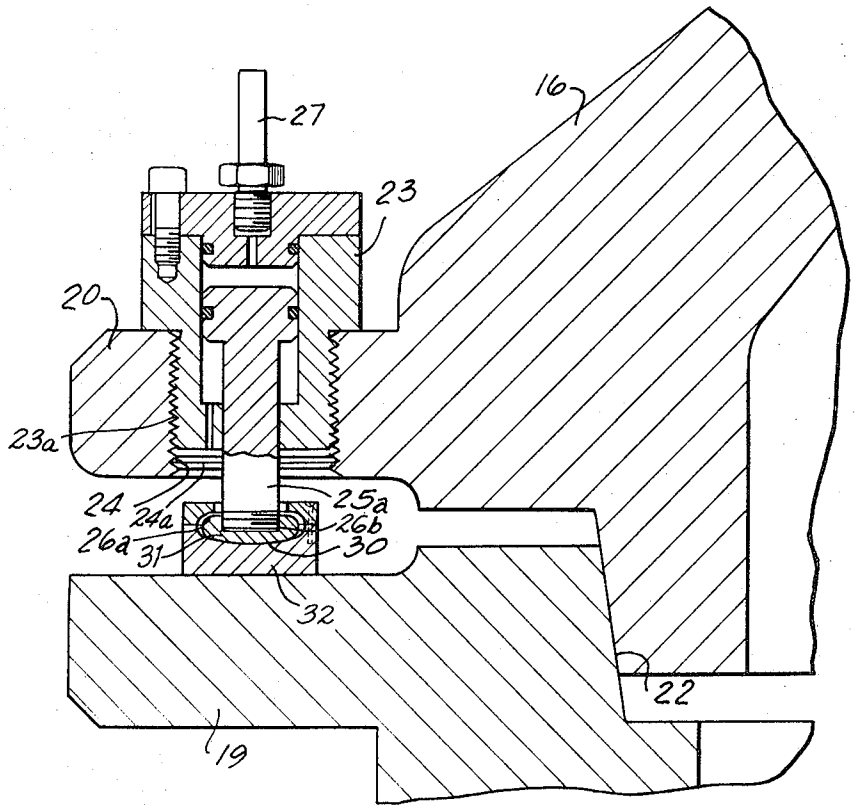


Fig. 3



GYRATORY CRUSHER WITH HYDRAULIC MEANS FOR LIFTING THE UPPER PART OF THE HOUSING FROM THE LOWER PART

The invention relates to a gyratory crusher the housing of which consists of at least two parts which are releasably connected with each other by a flange and bolt connection and whose upper part of the housing has attached to its inner face a crusher shell, while the crusher cone is vertically adjustable with respect to the housing.

In this type of gyratory crushers, particularly when they are of a large size, it is possible that during the crushing operation a blocking of the crusher cone takes place as a result of non-crushable foreign matter in the material to be crushed, such as iron or other hard pieces, which can not be removed by a simple clearing out of the crusher space. This disadvantage can only be overcome in that the upper part of the housing with its crusher shell, is raised from the crusher cone so that the crusher space formed between the latter and the crusher shell is enlarged and permits the removal of the non-crushable parts. However, the lifting equipment which is usually available at the place of operation and which could be used for raising the upper part of the housing is not suitable for such a procedure because the upper part of the housing is usually provided with a feed means for the material to be crushed and with suitable types of connection means which make the use of the customary lifting equipment unsuitable and difficult at the least.

The object of the invention is a gyratory crusher of the mentioned type which permits a quick removal of any blocking without the employment of complicated servicing operations. In accordance with the invention, the gyratory crusher is provided with hydraulic means for lifting the upper part of the housing. This hydraulic means permits, after a previous release of the flange and bolt connection, a very smooth and shock-free raising of the upper part of the housing. The employment of hydraulically operated lifting means permits the application of sufficient forces and requires very little space. Furthermore, with an hydraulic lifting means of the invention it is possible to raise the upper part of the housing without tilting and damaging the centering means provided on the parts of the housing within the range of connection of the parts of the housing. Since on the other hand the crusher forces which act upon the upper part of the housing have to be taken up completely by the mentioned flange and bolt connection, it is necessary that after loosening the connecting bolts only those forces act upon the upper part of the housing which are required for lifting the same. Since now these forces for lifting the upper part of the housing are substantially less than the mentioned crusher forces which are effective during the operation of the crusher, the hydraulic lifting means comprising piston-cylinder units need only be made relatively small in size.

Another object of the invention is to provide a hydraulic means comprising at least three hydraulic piston-cylinder units which are uniformly distributed along the circumference of the housing of the gyratory crusher. Owing to such an arrangement, it is possible to obtain in a very simple manner, a trouble-proof uniform lifting of the upper part of the housing without tilting the same.

In accordance with a preferred embodiment of the gyratory crusher of the invention, the cylinders of the piston-cylinder units are attached to the flange of one of the two parts of the housing and the free end of the piston rods which project from the cylinders engages the flange on the other part of the housing. The cylinder of the piston-cylinder units is preferably arranged in a suitable aperture which extends entirely through the flange of the part of the housing carrying the piston-cylinder units. This particular construction results in a very advantageous space-saving arrangement of the hydraulic means for lifting the upper part of the housing. In addition, there is the possibility that according to the size of the crusher and the forces necessary for lifting the upper part of the housing and under due consideration of the strength of the materials employed, a sufficient number of piston-cylinder units may be arranged in a simple manner on the gyratory crusher. Any extensive supporting brackets or the like, are avoided and the forces act directly upon the two flanges on the two parts of the housing.

According to a further object of the invention, the cylinders of the piston-cylinder units are provided on one of their ends with an exterior thread which is screwed into a correspondingly threaded aperture in the flange of one of the two parts of the housing. This type of construction and attachment of the piston-cylinder constitutes a substantial simplification and improvement.

With these and other objects in view, an embodiment of the gyratory crusher of the invention will now be described with reference to the accompanying drawing in which,

FIG. 1 illustrates a vertical sectional view of the gyratory crusher,

FIG. 2 illustrates an embodiment of one piston-cylinder unit of the hydraulic lifting means in sectional view and on large scale when compared with FIG. 1, and FIG. 3 is a similar view of another embodiment of a unit in the hydraulic lifting means.

Referring to FIG. 1, the illustrated gyratory crusher is provided with a housing having a lower part 1 provided with a centrally arranged hub 2 in which a vertical tubular crusher shaft 3 is secured. In addition, the lower part 1 of the housing is provided with a lateral opening in which a bearing sleeve 4 is mounted for supporting therein a horizontal drive shaft 5. In the upper portion of the bore of the tubular crusher shaft 3 is mounted a vertically adjustable shaft 6, the upper end of which is provided with a spherical cup for the support of a crusher cone which is provided with a suitable spherical bearing member 7 to which a crusher cone 8 is connected. The vertically adjustable shaft 6 effects an adjustment of the crusher gap by a vertical raising or lowering of this shaft which is accomplished by a not illustrated screw spindle operated means or by a hydraulically operated piston arranged below the shaft 6.

The lubricant feed line 12 supplies a spherical bearing member 7 with lubricant oil which from the feed line 12 passes through longitudinal channels in the wall of the tubular shaft 3, and in the vertically adjustable shaft 6. The outer surface of the crusher cone 8 is provided with a crusher cone lining 9 for protection against wear.

The inner end of the horizontal drive shaft 5 has attached thereto a bevel gear 10 which meshes with a

ring gear **10a** attached to the lower end of an eccentric sleeve **11** which is rotatably mounted on the fixed tubular crusher shaft **3.** In addition to its support in axial direction on the spherical bearing **7** arranged at the upper end of the shaft **6,** the crusher cone **8** is also provided with a downwardly extending tubular extension **8***a* which is rotatably mounted on the eccentric sleeve **11** so that the crusher cone **8,** during rotation of the eccentric sleeve **11** performs a rotating and tumbling movement.

The upper part **16** of the housing has secured to its inner wall a crusher shell lining **15** between which and the lining **9** on the crusher cone **8** a crusher gap is formed. The upper part **16** of the housing is releasably connected with the lower part **1** of the housing. For this purpose both parts **1** and **16** are provided at their plane of connection each with an outwardly extending flange **19** and **20,** respectively, and these flanges are connected with each other by a suitable number of circumferential uniformly distributed screw bolts **21** and nuts **21a.** The upper part **16** at the point of connection with the lower part **1** is also provided with a centering cone **22** (FIG. **2**) which engages a correspondingly formed conical recess in the lower part **1** of the housing. The cone angle is suitably selected in such a manner that a self-locking action is produced so that after the attachment of the bolts and nuts a portion of the component of the vertical crusher power is taken up by the frictional forces of the conical connection.

Depending upon the size of the gyratory crusher, the present invention provides the crusher with three or more hydraulic piston-cylinder units **23.** In the illustrated embodiment of the invention three piston cylinder units are connected to the flange **20** of the upper part **16** of the housing.

The enlarged illustration of FIG. **2** shows the individual parts of a piston-cylinder unit of the invention. The hydraulic cylinder **23** is provided at its lower end with an exterior thread which is screwed into an interior thread provided in an aperture **24** which extends completely through the flange **20.** The piston rod **25** projects downwardly from the cylinder **23** and thereby passes through a suitable aperture provided in the lower end wall of the cylinder. The downwardly and outwardly projecting free end of the piston rod **25** is provided with an abutment shoe **26.** This abutment shoe **26** is so dimensioned that for the selected material the permissible surface pressures are not exceeded which are produced between the abutment shoe **26** and the flange **19** on the lower part **1** of the housing. The embodiment of FIG. **3** is similar to that of FIG. **2** in every respect with the exception that spherical bearing surfaces are interposed at **30** between a member removably secured to the piston rod **25***a* and the abutment shoe **26***a*, whereby any detrimental effects caused by misalignment in manufacture of mounting of the various parts involved are eliminated. The cylinder unit **23** has external threads **23a** for threading it into internal threads **24***a* in a vertical hole **24** in the flange **20.** The shoe **26***a* is threaded to the lower end **26***b* of the piston rod and has a lower spherically shaped surface supported in an upwardly facing concave surface **31** in a pad **32** on the flange **19.**

The size of the entire piston-cylinder unit is preferably so selected that the diameter of the aperture **24** is larger than the diameter of the abutment shoe **26,** so that damaged hydraulic units may be easily exchanged.

During the normal operation of the gyratory crusher the hydraulic units do not perform any work and therefore they are separated from the associated hydraulic pump **28.** In the event of a blocking of the crusher by non-crushable foreign matter, for instance iron parts or very hard pieces, the nipples **27** of the pressure hoses are connected with all of the hydraulic units **23, 23'** and **23''**, (FIG. **1**) and the other ends of the hoses are connected, in accordance with the invention, to the common hydraulic pump **28.** Upon operation of this pump, all pistons in the piston-cylinder units are provided with pressure at the same time. The connecting bolts **20** and nuts **21', 21''** on the flanges are now loosened. Upon further operation of the pressure pump, the pistons exert a pressure by means of the abutment shoes **26** to the flange **19** on the lower part **1** of the housing so that the upper part **16** of the housing is slowly lifted without shocks, from the lower part **1** of the housing. During this operation substantially only the frictional forces of the centering cones have to be overcome, in addition, of course, to the weight of the upper part **16** of the housing. When the upper part **16** of the housing is lifted the size of the crusher gap increases and then the blocking foreign bodies may be easily removed from the crusher.

We claim:

1. A gyratory crusher, comprising

a. a housing which includes a lower member and an upper member,

b. at least partly co-extensive radially outwardly projecting flanges on said lower and upper members,

c. releasable fastening means fixedly securing said flanges to each other,

d. a crusher lining secured to the inner side of said upper housing member,

e. a crusher cone mounted in said lower housing member for crushing cooperation with said crusher lining by wobbling movement in relation thereto,

f. at least three circumferentially spaced hydraulic lifting means operatively connected with said housing members for controllably lifting said upper housing member from said lower housing member upon release of said fastening means, each of said hydraulic lifting means including a cylinder element and a piston element reciprocably mounted in said cylinder element,

g. one of said elements being releasably secured in an opening in one of said flanges and accessible and removable from the side of said one flange facing away from the other flange, and

h. the other one of said cylinder and piston elements being engageable with said other flange.

2. A gyratory crusher according to claim **1,** in which the size of said opening in said one flange is such as to permit removal of both of said elements as a unit through said opening in said one flange, whereby said hydraulic lifting means may be removed for inspection, repair or replacement without separation of said upper housing member from said lower housing member.

3. A gyratory crusher according to claim **1,** in which said other one of said cylinder and piston elements that is engageable with the other flange, is provided with an abutment member for engagement with said other flange.

4. A gyratory crusher according to claim **3,** including a spherical bearing surface between said abutment member and the element to which it is attached.

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