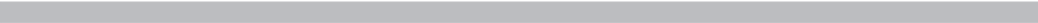


Introduction of Products



**Development of Mobile Impact Crusher BR480RG**



Hiroshi Yoshida

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*Komatsu developed its first mobile crusher in 1991 – 12 years ago. Since then, giving due consideration to the current environmental problems and market needs, the company has put on the market a good number of new mobile crushers which are capable of finely crushing debris from demolished concrete structures and processing the crushed debris into reusable aggregates. The newly-developed mobile impact crusher, BR480RG, is equipped with an entirely new impact-type crusher that can crush concrete debris into aggregates of desired size more efficiently than the conventional crusher. This paper describes the background to the development of BR480RG and the new technologies that are incorporated in it.*

**Key Words:** Mobile Crusher, Impact Crusher, Environmental Recycling, Concrete Debris, Automatic Gap Adjustment, Construction Recycling Law

1. Introduction

1-1 Market trends

The fundamental need of the market for mobile crushers is to replace stationary stone-crushing plants with mobile crushers. In recent years, mobile crushers have been increasingly employed in the field of environmental recycling that recycles debris from demolished concrete structures as aggregates. This trend can be observed not only in Japan but

also in the United States and Europe. Today, many mobile crushers, mainly those of European makers, are available on the market. In view of the above global market trend and ever-expanding U.S. market for mobile crushers (Fig. 1), we recently developed BR480RG (Photo 1) and put it on the market on the basis of a new concept.

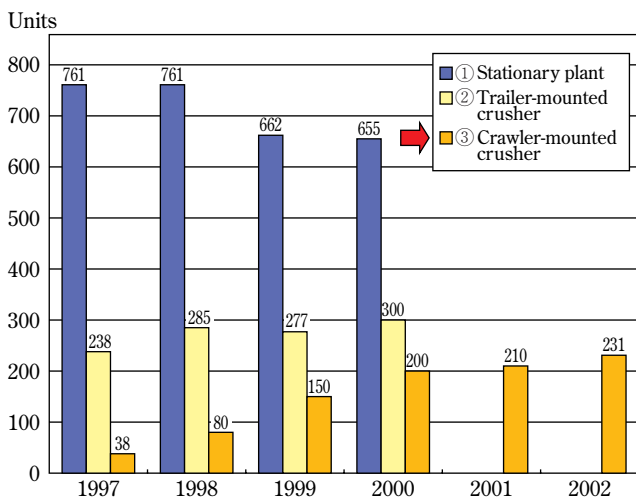


Fig. 1 Demand for stone crushers in the United States



Photo 1 Appearance of BR480RG

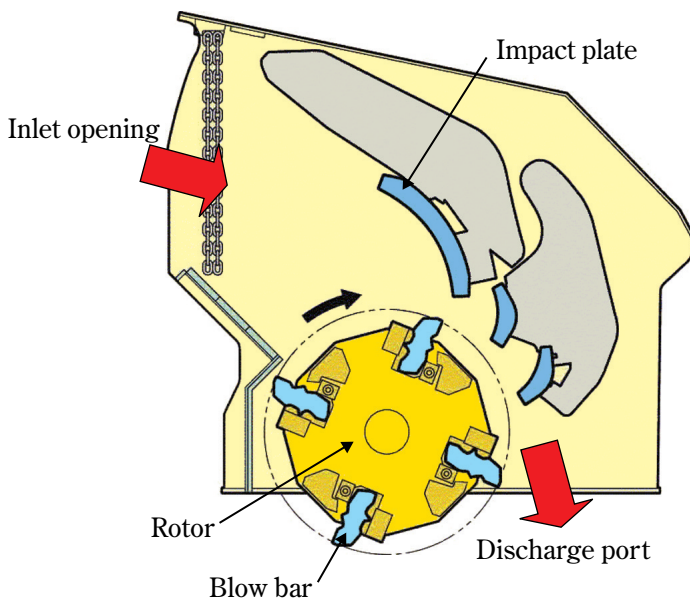
**1-2 Outline of impact crusher adopted for BR480RG**

Concrete debris which are put into the impact crusher are crushed into small pieces as they are repeatedly hit to impact plates by blow bars set on a rotor which rotates at a high speed (Fig. 2). Compared with compression-type crushers, such as the jaw crusher, the impact crusher produces pieces which are mostly rotundate in shape and is used as a secondary crusher or granulator. Since the impact crusher is 1.5 to 2 times higher in crushing ratio than the jaw crusher, it is suitable to produce aggregates of comparatively small particle size. The BR480RG is equipped with a feeder and a conveyor appropriate to the crusher width to allow for efficient crushing work. The outline of the crushing operation of the BR480RG is shown in Fig. 3.

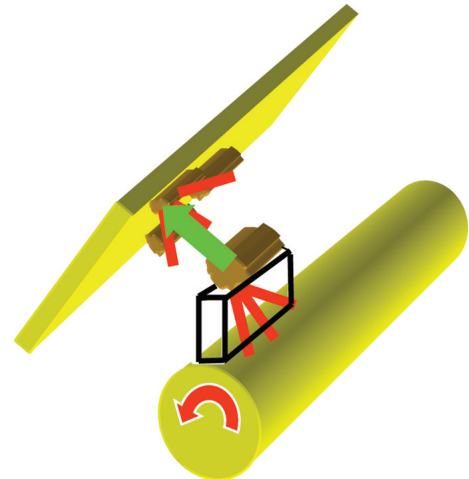
**2. Aims of development**

A survey of the U.S. market for crushers revealed the following facts.

- (1) More and more stationary crushing plants are being replaced by mobile crushers (Fig. 1).
- (2) Crawler-mounted mobile crushers, rather than trailer-mounted ones, are rapidly increasing.
- (3) Impact crushers are effective to produce fine aggregates (1 inch or smaller in size) from concrete debris (Fig. 2).



The input lumps of debris are crushed into small pieces as they repeatedly strike against one another between the blow bars that rotate at a high speed and the impact plates.



Although the impact crusher cannot treat large lumps, it is capable of efficiently crushing debris into small pieces and hence it is used as a secondary crusher. It is especially effective to crush concrete debris.

Fig. 2 Structure of impact crusher

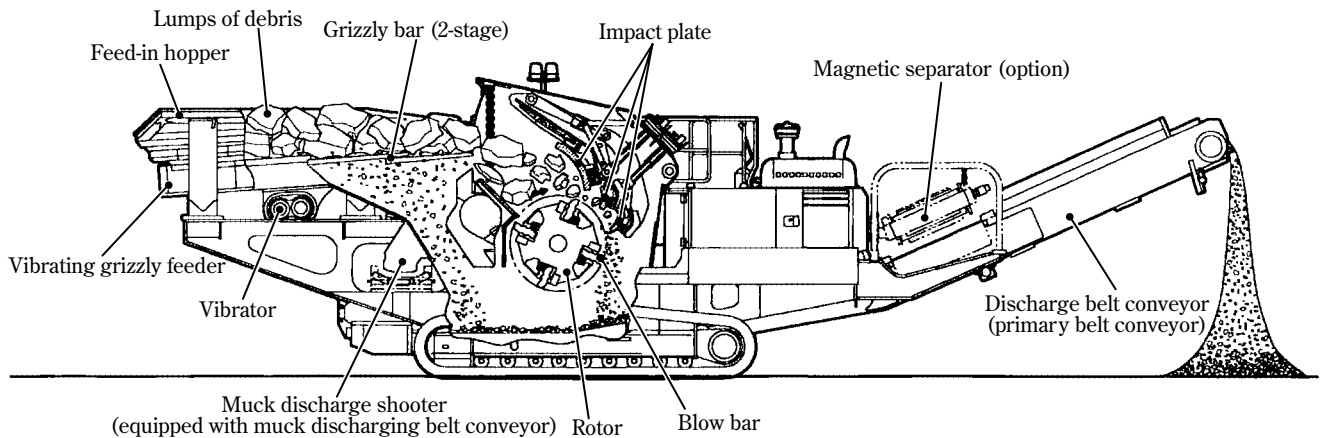


Fig. 3 Outline of crushing operation of BR480RG

On the basis of the above findings and to offer new functions that can easily be used even by the users of construction equipment, we set the following aims of development for a new mobile crusher.

- (1) The new mobile crusher shall be of such size that it can be transported within the United States without any of its parts disassembled.
- (2) In order to enable the new mobile crusher to carry an exceptionally large work load, a crusher having as large a capacity as possible shall be newly developed.
- (3) The maintainability of the new mobile crusher shall be as good as that of ordinary construction equipment.

In short, the development concept was a new mobile crusher which is equipped with a crusher having a very large capacity and which can be transported without any of its parts disassembled.

This has made it possible for the company to add a powerful new model to its mobile crusher series (Fig. 4) and offer optimum mobile crushers according to specific customer needs.

	10t	20t	30t	40t	50t	60t	70t	80t	90t	100t	170t
Jaw crusher	BR100JG	BR210JG	BR380JG	BR550JG					BR1000JG		BR1600JG
Impact crusher	BR100RG	BR250RG	BR480RG								
Cone crusher						BR700C					

Fig. 4 Komatsu's series of mobile crushers

### 3. Means of attaining aims of development

#### 3-1 High processing capacity

The productivity of an impact crusher is determined by the rotor diameter and width. For a mobile crusher of 40-ton class (the maximum weight that can be transported without disassembly), the BR480RG is equipped with a crusher (KR1313) of exceptionally high capacity to offer a maximum processing capacity of 400 t/h (includes 40% muck). In addition, the crusher operating speed can be changed in two steps (Fig. 5) to permit selecting the optimum driving speed according to the conditions of debris to be processed.

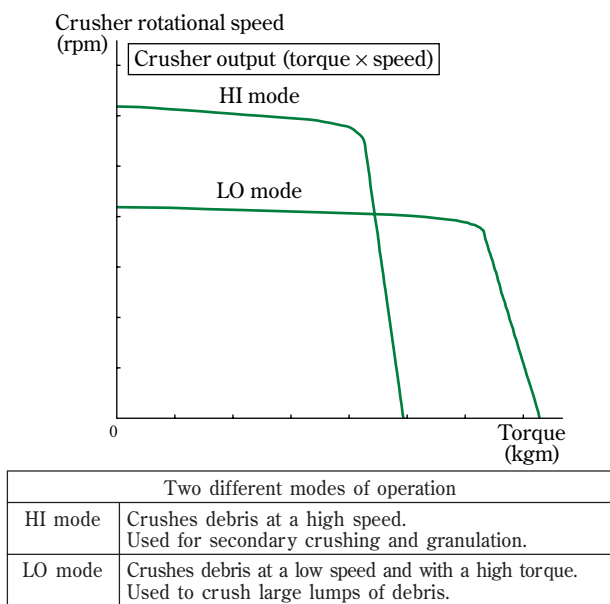


Fig. 5 Two different modes of crushing operation

#### 3-2 Securing good transportability

Since sales of mobile crushers are increasing continually, meeting the applicable transportation regulations was an important point in determining specifications of the BR480RG. Specifically, it was difficult to completely meet the U.S. transportation regulations that differ from one state to another. Therefore, we decided on the specifications paying special attention to the areas that were considered to have the greatest potential demands for the new mobile crusher (Table 1).

Table 1 Response to U.S. transportation regulations

	Specifications of BR480RG	U.S. regulations (subject to special approval)	Response to U.S. regulations
Operating weight	38,300kg	Max. 27,895 kg	Certain states require application for approval for transportation.
Overall length	14,250mm	Max. 16,336mm	The table shows minimum values since the regulations are different from one state to another.
Overall height	4,120mm	Max. 3,514mm	
During transportation	3,495mm		
Overall width	2,995mm	Max. 4,267mm	

Special approval is required for transportation within the U.S.

If a crusher having both the desired capacity and the desired maneuverability were directly employed, the overall height of BR480RG would have exceeded the allowable limit. However, we could satisfy the two requirements by adopting a crusher case slide mechanism (Fig. 6). As a result, it became possible to fully utilize the crusher capacity during crushing work and reduce the RB480RG height within 3.5 m during transportation.

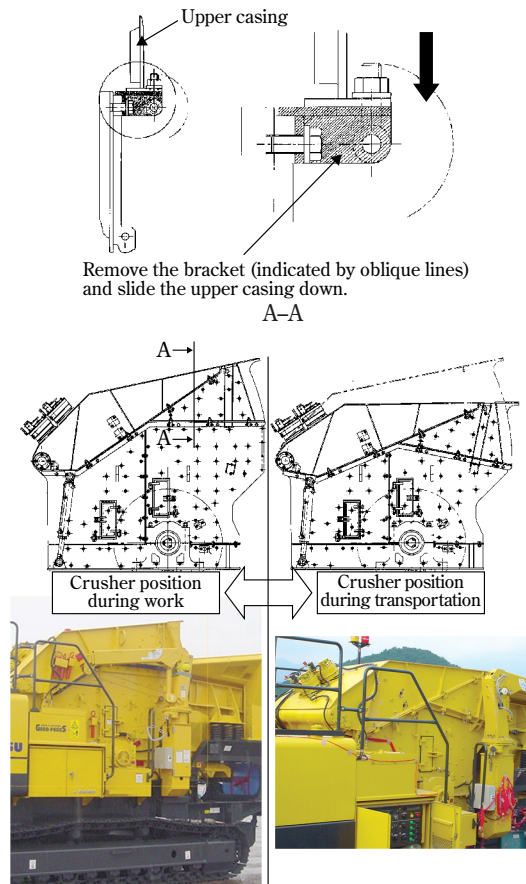
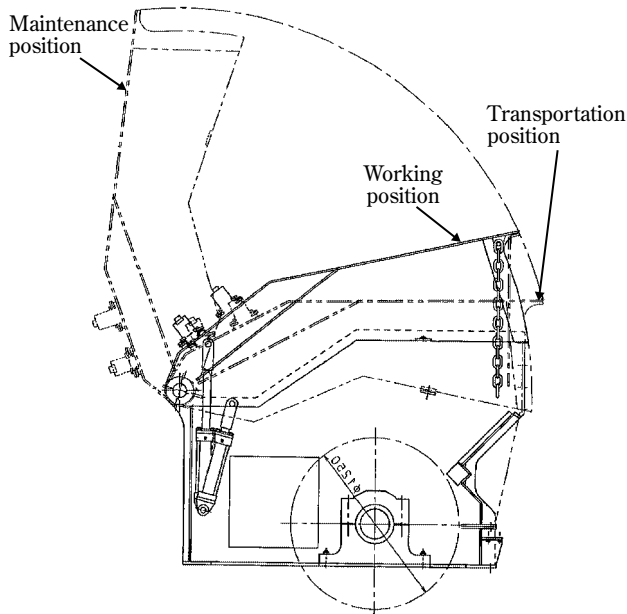


Fig. 6 case slide mechanism

Namely, during transportation, the upper crusher casing is slid down to the crusher side. In addition, since the upper and lower casings of the crusher are divided horizontally, they afford a wider opening than those of the conventional models. This facilitates the maintenance of the crusher (Fig. 7).



Condition of access to crusher for maintenance



Fig. 7 Crusher casing opening/closing positions

**3-3 Simple operation**

Although the people who handle concrete debris in the field are considered accustomed to the operation of ordinary construction equipment, they are not necessarily good at operating such equipment as the stone-crushing plant. Therefore, in designing the control panel of the BR series, special consideration was given to enabling the operator to use the panel easily.

(1) Adoption of centralized control panel

The operation of the BR480RG consists mainly of starting the work equipment, monitoring it in its neighborhood, and taking necessary corrective measures if some abnormal condition (e.g., a clogged crusher internal mechanism) occurs. Normally, there is no need for the operator to board the machine. Therefore, the control panel is installed at such a position on the machine that affords easy access of the operator on the ground. This minimizes the need for the operator to get on and off the machine.

In addition, all the devices, excepting those for moving the machine, can be operated from this control panel (Photo 2). The switches on the control panel are divided into blocks according to their functions so as to prevent incorrect operations and facilitate the understanding of the operation procedure.



Photo 2 Control panel

(2) Adoption of monitor panel

Since the base power unit of the BR480RG is the same as the one used for PC400-6, it can easily be inspected and maintained by the persons who have the knowledge of conventional construction equipment.

(3) Adoption of multi-panel

In addition to the above monitor panel, the BR480RG is provided with an improved edition of the multi-panel that is adopted for PC200-7 and subsequent models to inform the operator of the conditions of the work equipment (Fig. 8). Even if some abnormal condition occurs during crushing work and the machine stops automatically with an audible alarm, the operator can promptly identify the troubled work equipment and minimize the time required to restore it.

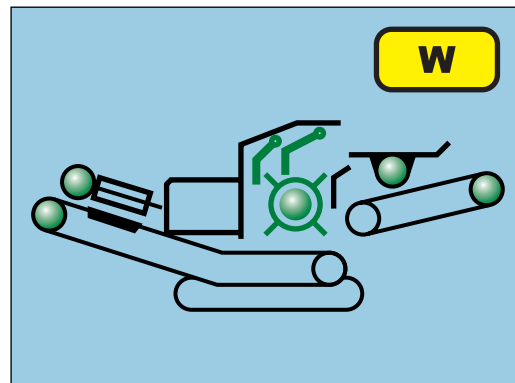


Fig. 8 Multi-panel screen

**3-4 Good maintainability**

(1) Crusher gap adjustment

Since the impact crusher turns at high speeds during crushing operation, it is necessary to adjust or replace worn blow bars and impact plates. Since the gaps between those plates affect the size of crushed debris materially, properly adjusting the gaps that have been increased by worn plates is important maintenance item for the crusher. With the conventional crushers, adjusting the gaps required moving up or down suspended rods by adjustment nuts. That was hard work involving large torque.



In the adjustment mechanism that has been newly developed for the BR480RG, a nut runner driven by a hydraulic motor is used to greatly facilitate the adjustment of gaps (Fig. 9).

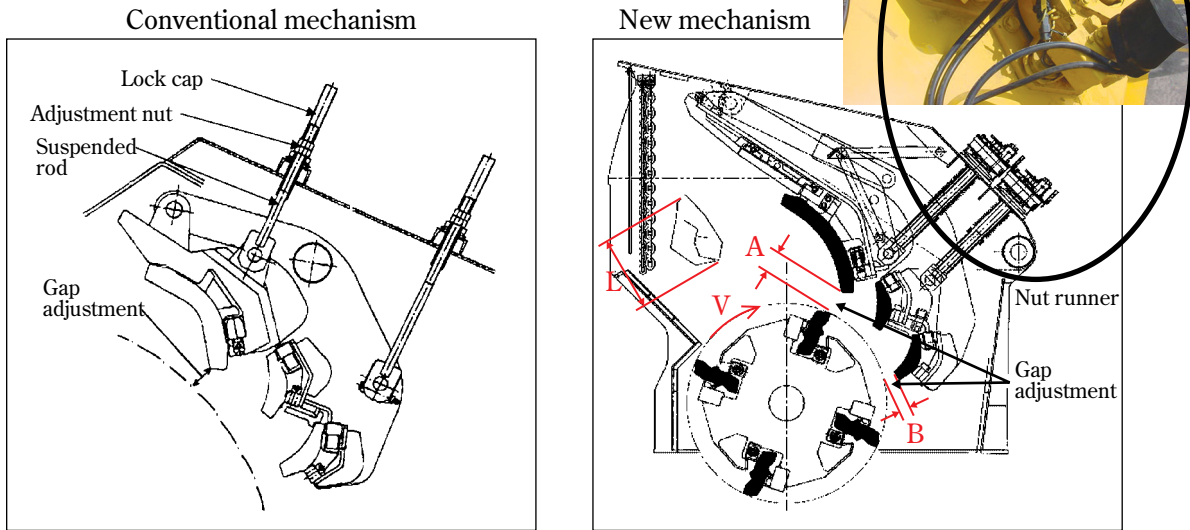


Fig. 9 Gap adjustment system

The nut runner system (Fig. 10) is provided with a hydraulic drive unit for the nuts that were formerly adjusted by using a tool. Even if impact plates are thrust up by a large load, causing the associated suspended rod to jump out, there is no fear that the drive unit should be damaged. In addition, the advanced hydraulic control system of Komatsu was applied to automate the gap adjustment.

(2) Automatic crusher gap adjustment

The nut runner system permits adjusting crusher gaps simply by inputting the correct gaps to the multi-panel (Fig. 11). Therefore, it is possible to complete the gap adjustment in about five minutes without using any tools.

The outline of control in automatic gap adjustment is described below. The crusher gap refers to the gap between blow bars and impact plates. The gap increases as the plates wear during crushing operation. It cannot be judged from the outside. Formerly, the operator used to measure the amount of crusher gap through an inspection window in the side of the crusher and adjust the gap as required by turning the adjustment rods on the impact plates to lower the impact plates.

The newly-developed automatic gap adjustment system first lowers the impact plates hydraulically and stops them when they reach the rotor. (A sensor is provided to tell the time when they make contact with the rotor.) Then, the direction of rotation of the hydraulic motor is reversed to raise the impact plates again. At the same time, the rotor is turned to search for a point at which the impact plates no longer make contact with the blow bars. Now that the rotor can turn freely, the detected point is judged as the zero point of gap. Finally, the amount of impact plate movement from the point is controlled to adjust the crusher gap. This system has made it possible to adjust the crusher gap frequently without using any tools, whereby the size of crushed debris has been stabilized appreciably (Fig. 12).

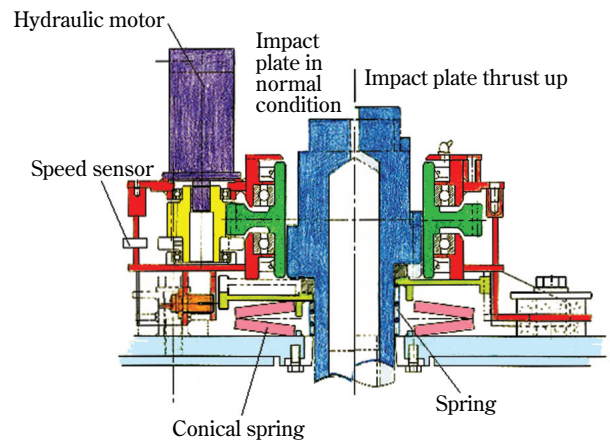


Fig. 10 Nut runner system

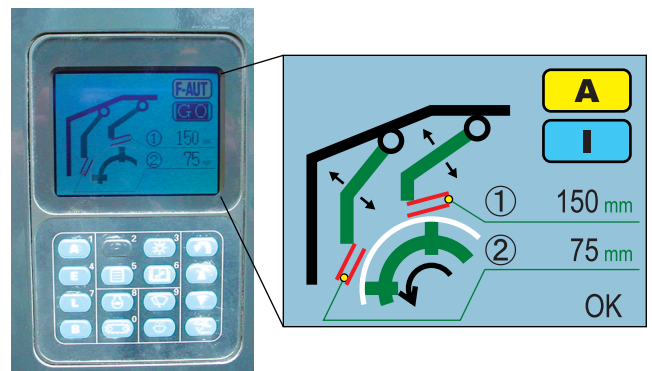


Fig. 11 Screen for input of data for automatic gap adjustment

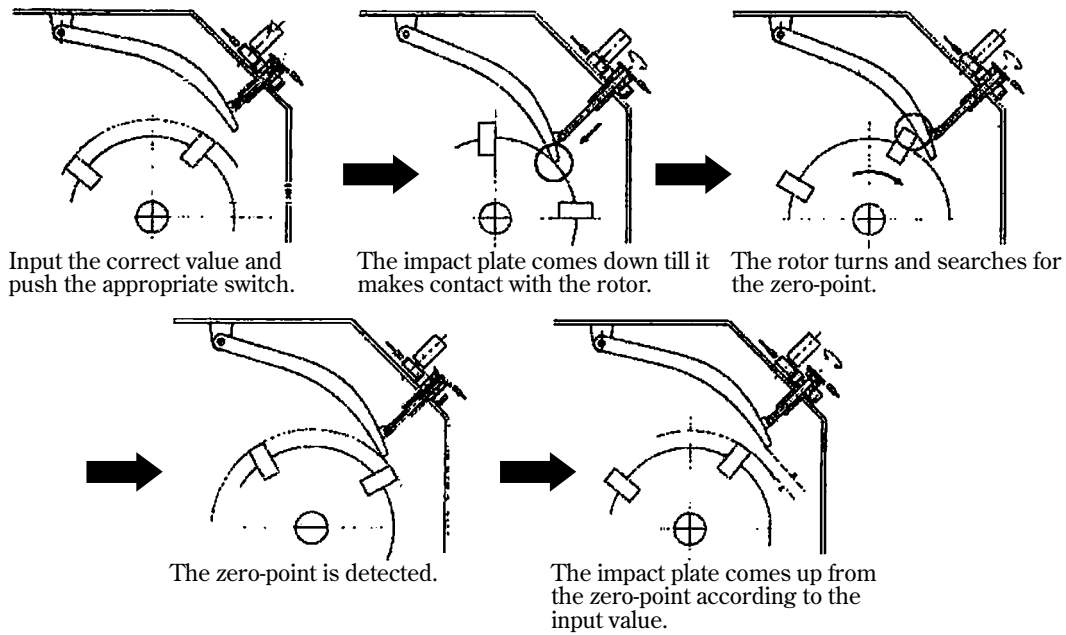


Fig. 12 Outline of control in automatic gap adjustment

In addition to the automatic gap adjustment, ‘semi-automatic mode’ and ‘manual mode’ are available for gap adjustment. The optimum mode of gap adjustment can be selected by the selector switch on the control panel (Table 2).

Table 2 Modes of gap adjustment

Adjustment mode	Description
<b>Automatic</b>	It is possible to adjust the gap automatically simply by inputting a setting value
<b>Semi-automatic</b>	The gap is adjusted by specifying a suitable amount of movement of the impact plate.
<b>Manual</b>	The gap is adjusted manually by remote-controlling the upper and lower switches of the impact plate while checking the amount of plate movement.

(3) Adoption of large inspection window

Even if some trouble (e.g., a clogged crusher) occurs during crushing operation, the operator can confirm the conditions of the crusher interior through a large inspection window provided in the side of the crusher (Photo 3). This has eliminated the need to open the crusher casing for inspection, thereby minimizing the crusher downtime and improving the crusher maintainability.



Photo 3 Large inspection window

(4) Blow bars that can be removed and refitted easily

The maintenance item that is important next only to the crusher gap adjustment is reversing/replacing the blow bars that are always subject to a strong impact. Therefore, they must be fixed in the following manner.

- ① They are fixed so securely that they do not become loose even under large impact loads.
- ② They can be removed easily during replacement.

For the BR480RG, a spacer block system is employed to fix the blow bars. Namely, a spacer is inserted in-between the rotor and each blow bar to fix the bar. Since no fixing bolts are used, the blow bars can be removed easily (Fig. 13).

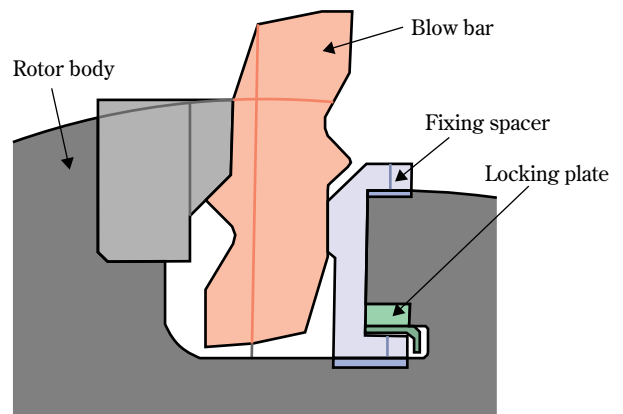


Fig. 13 Method of fixing blow bars

(4) Adoption of crane for crusher maintenance

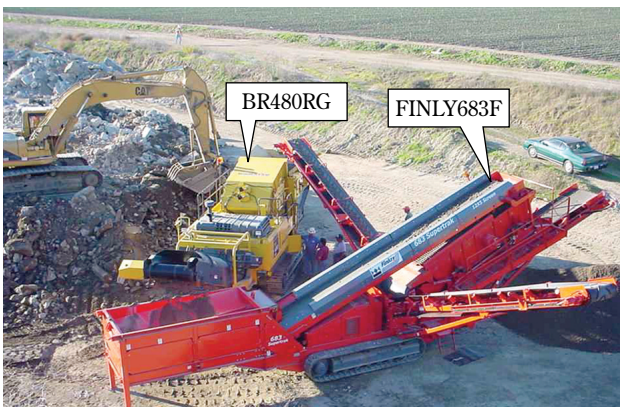
Since the impact crusher has many parts which are subject to wear, it is effective to use a crane when servicing the crusher. The conventional impact crushers require a base for the crane used for their maintenance. The BR480RG permits installing a hydraulic crane to the machine side for the convenience of the maintenance personnel. This hydraulic crane, which is driven by an electric motor, is provided with safety devices which prevent the work equipment from getting into action suddenly during maintenance work. The newly-developed crane has greatly facilitated replacing worn parts inside the crusher (**Photo 4**).



**Photo 4** Crane used for maintenance

(5) Combination with screening equipment

In order to recycle crushed debris into aggregates, it is necessary to meet the applicable standards. In this connection, it is effective to use screening equipment to treat crushed debris. The conventional crushing plants employ a closed system in which oversize debris can be transported on a conveyor and re-input to the screening equipment. In order to implement the same function with the BR480RG too, connection of a mobile screen with the BR480RG has been made possible to configure a closed system (**Photo 5**). This in turn has significantly expanded the scope of application of the BR480RG since it permits readily building a simple plant at a site where crushing and screening debris is necessary.



**Photo 5** Closed system configuration

4. Consideration for the environment

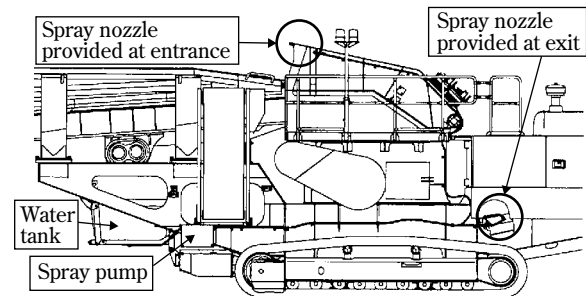
- (1) The BR480RG employs a Komatsu SAA6D125E-2 engine – a clean, low-vibration engine that has cleared the Tier II emission regulations of the United States. The noise produced by the engine is also controlled to a low level (**Table 3**). All this helps to reduce the environmental impact during operation of the BR480RG.

**Table 3** Levels of noise and vibration caused by BR480RG

Working condition (engine in HI mode)		Noise (measured at points 7m from machine) dB	Ground vibration (measured at points 7m from machine sides) dB
Work equipment 'OFF'	No load	80.0	Max. 65
	Under load (reference)	92.0	Max. 65

- (2) Installation of water spray

The occurrence of fine dust during crushing work often poses a problem, especially when an impact crusher is used. In order to restrain the occurrence of dust, the crusher discharging port and conveyor system of the BR480RG are completely enclosed to prevent the dust from coming out. In addition, spray nozzles are provided at the crusher entrance and exit to prevent the dust from scattering about during operation of the BR480RG (**Fig. 14**).



**Fig. 14** Water spray system



## 5. Conclusion

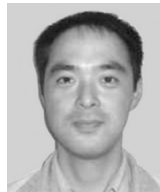
In Japan, the Construction Recycling Law was promulgated in May 2000 and put into effect in May 2002. Since it is expected that the volume of concrete debris will continue increasing and the recycling of such debris will be further promoted in the future, the scope of application of mobile crushers is supposed to continue expanding. As a matter of fact, the mobile crushers of Komatsu are highly rated by many of the customers specializing in the demolition of concrete structures. The history of mobile crushers is still short, and we consider it necessary to foster the development of mobile crushers by meeting individual needs of the market.

### Introduction of the writers



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### [A few words from the writers]

The present development was carried out with the target set not only at the domestic market but also at overseas markets. Therefore, we took several new steps of development, including a preliminary survey of the U.S. market and demonstrations of the prototype model. In those processes, we felt that the market for Komatsu's mobile crushers was expanding on a global basis and that the customer needs were becoming increasingly complicated. In order to further expand the market for our mobile crushers and offer better products that fully meet the customer needs, we intend to continue making improvements on the existing products.