

Introduction of Products

HM400-1 Articulated Dump Truck

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The market had strongly requested Komatsu to develop articulated dump trucks by itself. We developed the first model, the HM400-1, and put it on the Japanese market in May 2001 and on the USA market (which was the main market) in June 2001.

In this paper, we will introduce the main features of the HM400-1 which has outstanding performance and durability as a construction machine based on our technologies.

Key words: Articulated Dump Truck, Outstanding Productivity, Outstanding Reliability, Differential Lock, Interaxle Differential Lock

1. Introduction

The world demand for articulated dump trucks increased rapidly and has stayed as high as 4,200 to 4,700 units/year in recent years (Fig. 1). We judged that it was the time to put a Komatsu articulated dump truck on the market and developed the HM400-1 (Photo 1).



Photo 1 HM400-1

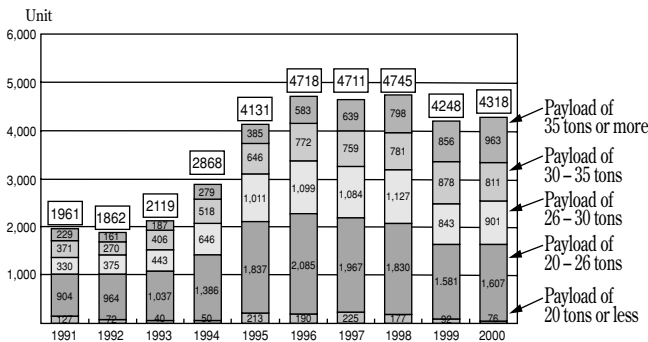


Fig. 1 Demands for articulated dump trucks of each class

2. Development concept

We basically decided to develop the HM400-1 by using our components and technologies developed for wheel loaders and dump trucks, then take the necessary measures to attain the features and the development concept as shown below (Tables 1 and 2).

[Basic concept]

- ① Attainment of outstanding productivity and reliability
- ② Attainment of comfortable operating environment which is a feature of our construction machines
- ③ Sufficient safety measures
- ④ Facilitation of maintenance
- ⑤ Dump truck gentle to the environment

Table 1 Measures to attain features and target industries

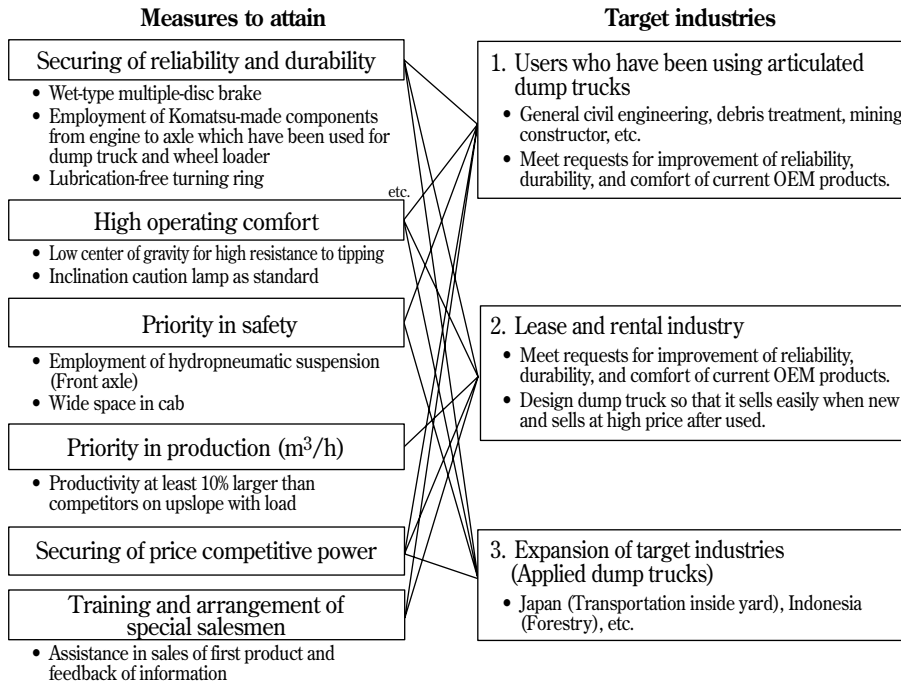
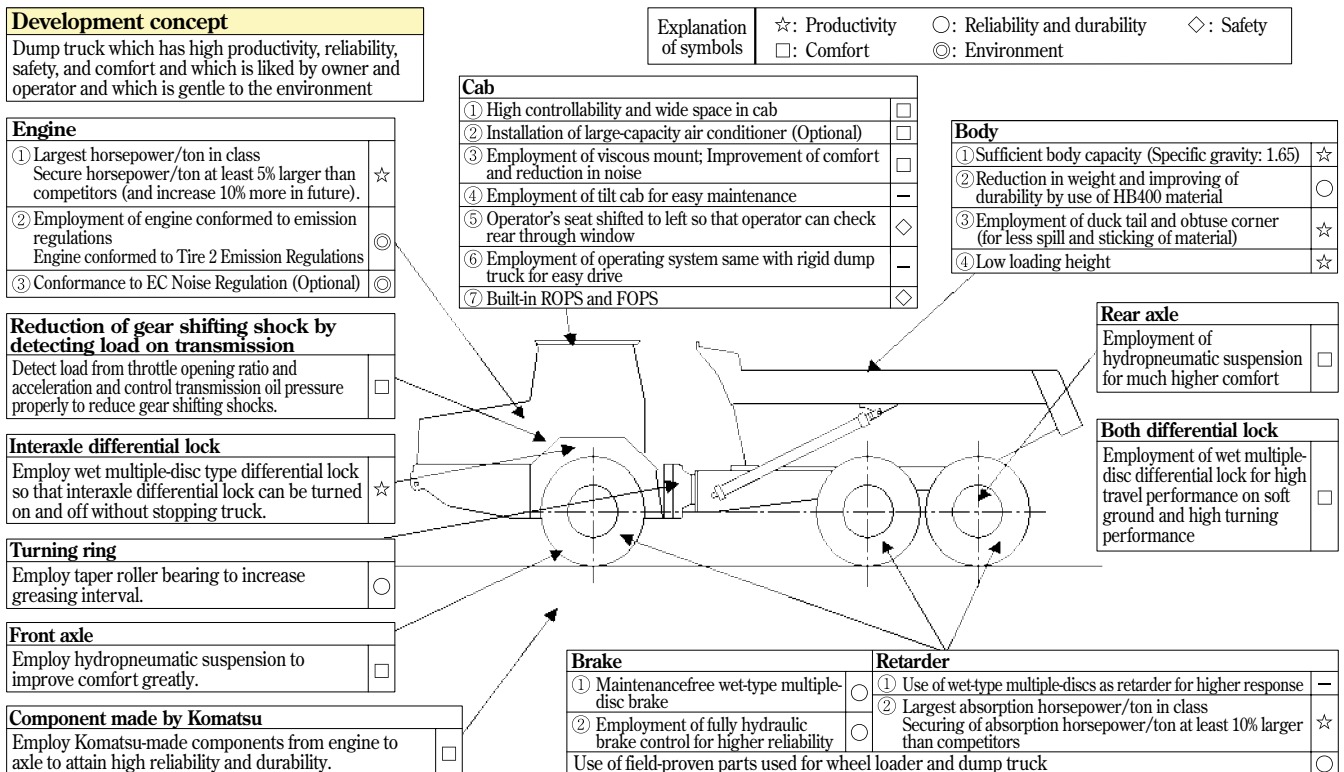


Table 2 Development concept

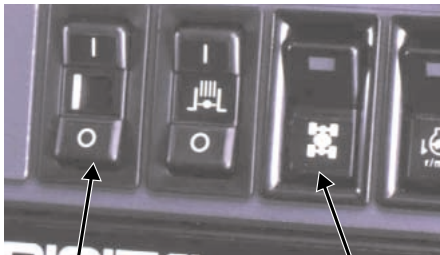


3. Measures to attain

(1) Attainment of outstanding productivity and reliability

- ① Largest horsepower/ton in the class
 Since a powerful and clean Komatsu SAA6D140E-3 engine is used, the largest horsepower/ton in the class and powerful and high-speed travel are attained.
- ② Employment of differential lock and interaxle differential lock
 Since the full-time six-wheel drive system is employed, the tires do not slip easily and the travel performance is stabilized. Both differential lock and interaxle differential lock are wet multiple-disc type and they provide large driving power under any condition. Since the differential lock can be turned on and off without stopping the dump truck, the working efficiency is increased (Photos 2 and 3).
- ③ Employment of electronically controlled transmission
 The counter-shaft type transmission which has been used for wheel loaders, etc. is employed. The gear is shifted smoothly by the all-gear speed electronic control modulation system “K-ATOMiCS” and the engine-interlocked control which have been used for rigid dump trucks and evaluated high (Photo 4).

- ④ Employment of fully hydraulic wet-type multiple-disc brake
 The fully hydraulic brake has high reliability and response. It is an enclosed wet-type multiple-disc brake which is reliable during travel on soft ground. The dump truck can drive down slopes at high speed by using the wet-type multiple-disc brake as a retarder similarly to a rigid dump truck. Consequently, the operating performance is improved (Photo 5).
- ⑤ Employment of hydropneumatic suspension
 The hydropneumatic suspension which has been used for the rigid dump trucks is employed. The front axle suspension employs “De Dion” type design using a long trailing arm, allowing the machine to ride more smoothly over bumps. Since the rear axle is also equipped with the hydropneumatic suspension, the wheels follow up changes of the road surface and the operator can drive on even bad roads comfortably (Figs. 2 and 3).



Differential lock switch
 (If this switch and the differential lock are pressed, the differential lock is turned on.)
 Interaxle differential lock switch

Photo 2 Differential lock switch

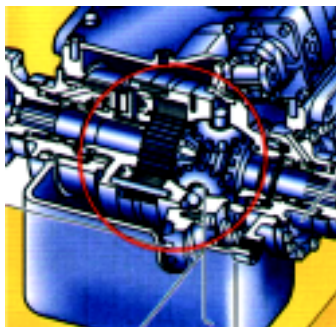


Photo 3 Interaxle differential lock

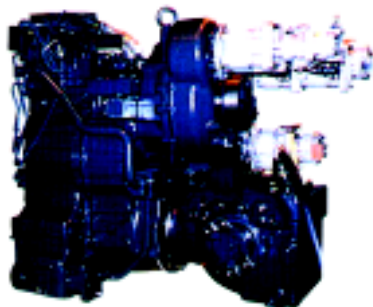


Photo 4 Transmission

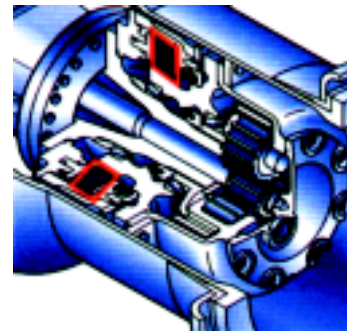


Photo 5 Wet-type multiple-disc brake

Front suspension type	<p>Hydropneumatic suspension Long trailing arm</p>
Rear axle suspension	Hydropneumatic suspension
Damping performance	Superior
Riding comfort	Superior

Fig. 2 Front suspension

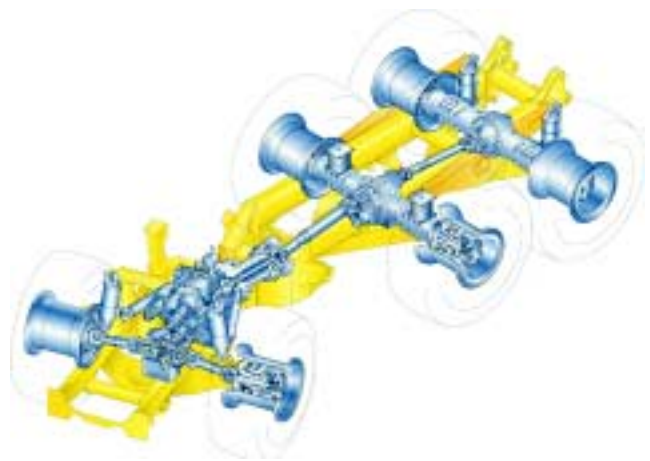


Fig. 3 Suspension

- ⑥ Reliable electric parts and hydraulic piping
All the wiring harnesses are connected by DT-type (Deutsche) connectors which have high reliability for the use in construction machinery. Flat face-to-face O-ring seals are used for the hydraulic piping to reduce oil leakage (Photo 6).



Photo 6 DT-type (Deutsche) connector

- ⑦ Employment of frames having box-section structures
Both front and rear frames have highly rigid box-section structures. They are designed on the know-how of the rigid dump trucks used for long years in severe jobsites. The important parts are made of cast steel to secure high durability (Fig. 4).



Fig. 4 Front and rear frames

(2) Attainment of comfortable operating environment

- ① Comfortable wide cab
The wide cab equipped with the power windows and cool box is employed to secure a comfortable space. The large window area is secured and the operator's seat is shifted to the left so that the operator can check the rear easily (Photo 7).



Photo 7 Inside of cab

[Main interior parts of cab]

- Air suspension seat
 - Instructor's seat
 - Tilt/Telescopic steering wheel
 - Air conditioner
 - Cool box
 - Power window
 - Cup holder
- ② Employment of air suspension seat
The soft air suspension seat is employed as standard. The headrest, longitudinal position, height, reclining angle, and hardness of the cushion can be adjusted to take the best position. The 3-inch retractable seat belt is installed as standard (Photo 8).



Photo 8 Operator's seat

- ③ Low vibration and low noise
The cab is mounted on the viscous mounts which use "rubber" and "silicone oil". The mechanical vibration and noise from the truck body are reduced to fatigue the operator less and improve the operating performance (Fig. 5).

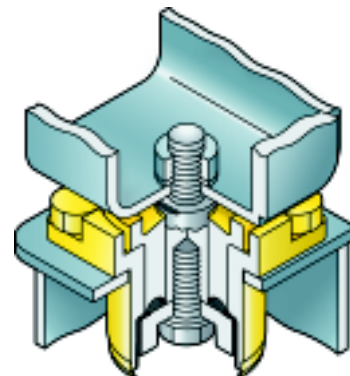


Fig. 5 Viscous mount

- ④ Refined operation feeling
The control levers, switches, and panels are so arranged that the operator can operate them easily. The operator can drive the truck as if he (she) drives a car. Since the steering wheel, accelerator pedal, and brake pedal are light to operate, the operator is fatigued less and the operating performance is improved (Photo 9).
- ⑤ Air conditioner
The operator can select the five air outlet modes and four air flow rates of the air conditioner with push buttons (Standard for Japanese market and optional for foreign market). The air outlets are arranged in front of the operator's seat so that the cool air will circulate all over the cab (Figs. 6 and 7).
- ⑥ Smooth dumping control
An electric body dump control system is employed. The operator can control dumping lightly and easily. Since the dumping speed is controlled according to the sensed dump body position (angle), fewer shocks are made when the dump body is seated (Photo 10).
- ⑦ Instruments panel easy to check
Various meters and caution lamps are so arranged that the operator can check the condition of the truck at a glance. If any trouble occurs, the operator is notified by displaying a message. Then, the operator can take proper actions (Photo 11).



Photo 9 Front of operator's seat

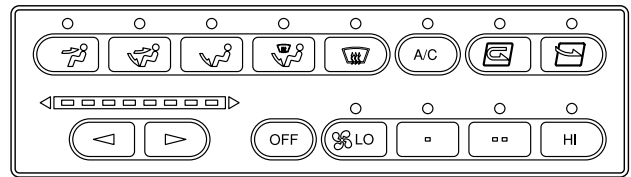


Fig. 6 Air conditioner controller

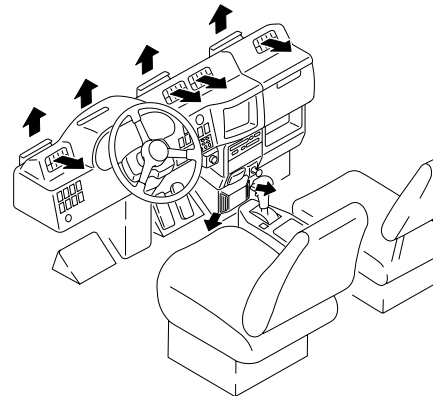
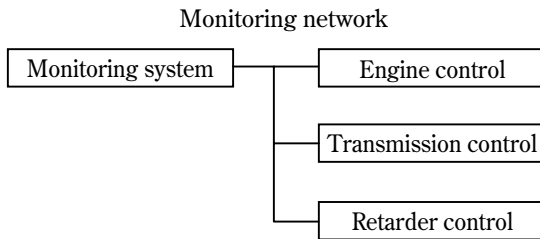


Fig. 7 Air outlets

(3) Sufficient safety measures

- ① Employment of cab with built-in ROPS/FOPS
The cab with built-in ROPS/FOPS is installed against an emergency (Fig. 8).



Fig. 8 ROPS cab



Photo 10 Dump control lever



Photo 11 Instruments panel

- ② Safe three independent brake systems
The front, rear, and parking brakes are independent structurally from each other. The front and rear service brakes have two independent circuits respectively.
- ③ Secondary brake
Should the brake circuit oil pressure lowers for some reason, the parking brake is operated by spring force to stop the dump truck.
- ④ Supplementary steering
If the steering circuit oil pressure drops for some reason, the electric pump works automatically and the supplementary steering system operates. The supplementary steering system can be operated manually with the switch in the cab, too.
- ⑤ Full safety devices
 - Down-shift inhibitor
 - Overrun inhibitor
 - Reverse inhibitor
 - Forward-Reverse shift inhibitor
 - Anti-hunting system
 - Neutral safety
 - Rear frame inclination sensor
 - Maximum gear speed limiter (Optional)
- ⑥ Full safety equipment
Various guards to protect the operator and truck are installed as standard (Figs. 9, 10 and 11).
 - Protective guard for rear window
 - Engine underguard (Fig. 9)
 - Transmission underguard (Fig. 9)
 - Drive shaft guard (Fig. 10)
 - Exhaust thermal guard
 - Fire prevention cover
 - Large-sized rear view mirror (Fig. 11)
 - Front undermirror (Fig. 11)

(4) Facilitation of maintenance

- ① Employment of fully opening hood and tiltable cab
Since the fully opening hood (which can be set to 45° and 60°) is employed, the operator can check the engine and transmission easily. The cab can be tilted hydraulically (or with a crane). Since it can be tilted easily, the operator can maintain it easily in a shorter time (Fig. 12).

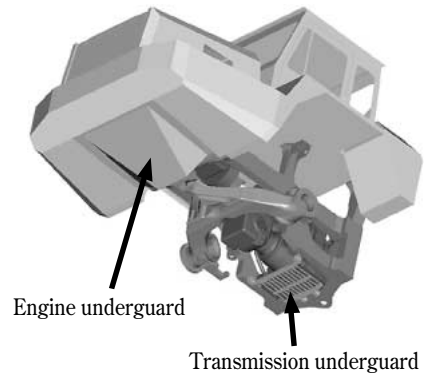


Fig. 9 Underguards

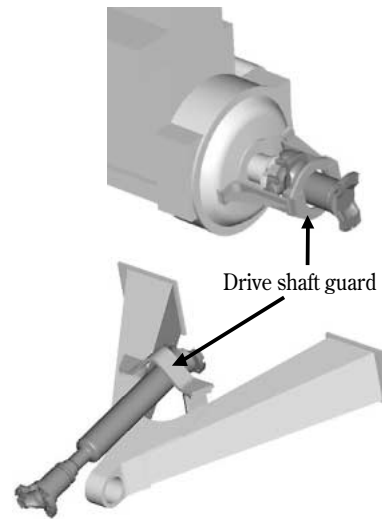


Fig. 10 Underguard

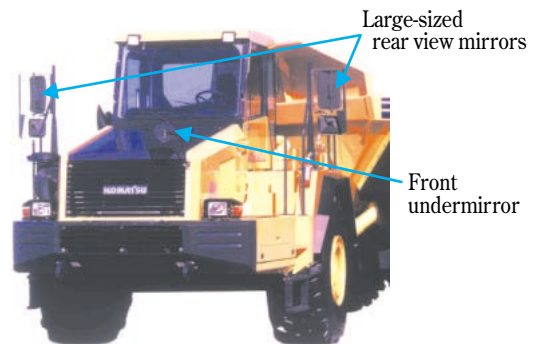


Fig. 11 Various mirrors



Fig. 12 Fully opening hood and tiltable cab

② Employment of lubrication-free hitch frame and rubber bushings

Taper roller bearings filled with grease are used as the oscillation bearings of the hitch frame. They do not need to be supplied with grease until the overhaul time (Fig. 13). The arms and rods are supported on rubber bushings to reduce the number of parts which need to be supplied with grease.

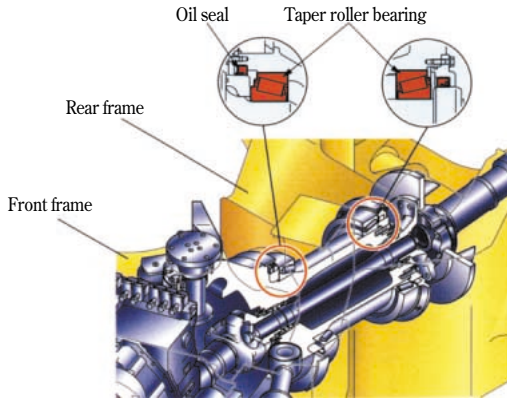


Fig. 13 Hitch frame



Photo 12 Centralized filter elements

③ Centralized filter elements

All the filter elements are centralized on the left side of the engine hood so that they can be replaced easily (Photo 12).

④ Employment of remote greasing

The remote greasing is employed for the parts difficult to grease. The operator can supply grease to the all parts to be greased from the ground (Photo 13).



Photo 13 Remote greasing

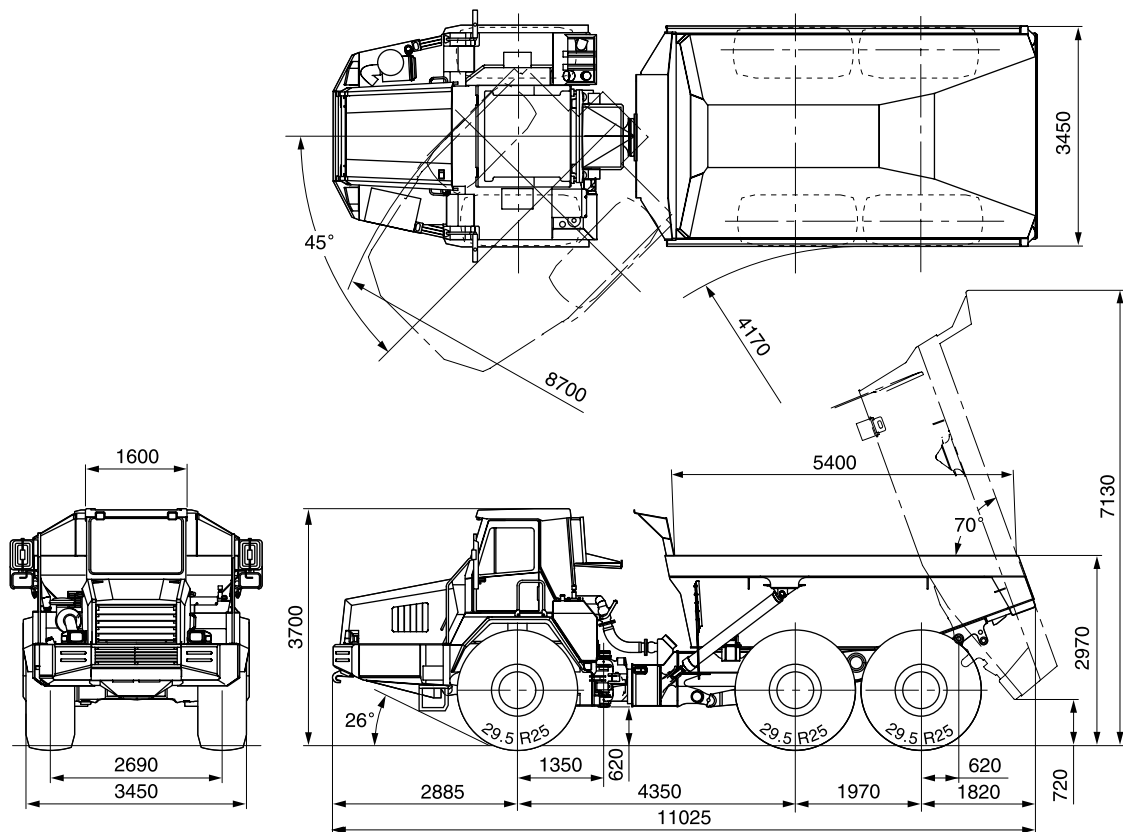


Fig. 14 Outside view of HM400-1

4. Closing remarks

The HM400-1 which is the first model of the articulated dump truck series made by Komatsu was put on the market as planned and the second model HM350-1 and the third model HM300-1 are to be put on the market in February and April 2002 respectively.

The HM400-1 was introduced first in Chattanooga Field Day Exhibition, then demonstrated and evaluated by many distributors and users.

In Japan, the HM400-1 was introduced first on the 80th anniversary held in May 2001, then demonstrated.

The distributors and users evaluate the following items very high.

- ① Productivity is very high.
- ② Very comfortable. The operator is not fatigued even after driving all day.
- ③ Noise is low inside and out of the cab.
- ④ The gear is shifted smoothly without large shocks.
- ⑤ The frames, hitch, drive shafts, etc. seem to be very strong.

The durability and reliability cannot be evaluated in a short period. The performance is evaluated very high, however, as we expected.

Introduction of the writer



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[A few words from the writer]

While I was in charge of design of the articulated dump trucks which were new products, many unexpected problems related to performance and durability occurred. The fact that the whole staff worked together to solve those troubles showed the large latent power of Komatsu. It is now a happy memory that we executed the performance test in the daytime and tuned the transmission in the nighttime on night and day shifts for about three months in cold winter.