

A Review of Log Grapples Used in China

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ABSTRACT

The history and development of log grapples used in China and their working parameters are given. An analysis is made of the main technical features. Results show that the electro-mechanical log grapple, driven by an electric drum, is the most suitable for the special working conditions found in Chinese forestry at the present time.

Keywords: *log grapple, logging operations.*

INTRODUCTION

Many kinds of log grapples are used in China, and can be classified as either radial or axial. Radial log grapples are used widely, and may be electro-mechanical, electro-hydraulic or cable operated. The electro-mechanical types can be further divided into electric drum, electric hoist and electric screw-rod driven.

LOG GRAPPLES USED IN FOREST OPERATIONS

Log grapples used in forest operations are mounted on forest cranes to facilitate tree-length unloading, log piling, and for loading in log yards.

The first log grapple was introduced into forestry in 1967, and is still in use. It is a cable-operated type, used in the Zhuangzhi log yard of the Daxinganling Forest area. Its closing mechanism is mounted on the hoisting trolley, as part of the hoisting mechanism of the crane. This grapple has a large grabbing force, which results in a highly efficient operation when loading or piling. This efficiency is affected, to some extent, because it cannot rotate, and therefore it also makes it difficult to mount on forest cranes.

In 1978, a log grapple was designed and used in the Wangqing Forest Bureau, Jilin Province. The power source of the closing mechanism was an electric hoist of 7.5 Kw capacity. Experiments showed that this type of grapple was unreliable, and it is not now used.

In 1980, a log grapple (Model ZMZ-50LF) was designed by the Northeast Forestry University. This was also of the electric hoist type, with the addition of a vibrating device on one jaw of the grapple. This took the form of an eccentric mechanism driven by a 2.2 Kw motor. The vibrating device is used to destroy the static state of balance of the logs, so as to reduce the frictional forces among logs, and between the jaws and logs. However, the vibration device makes the grapple complicated, and so it was not put into use.

In June 1980, the first tree-length grapple was used in Chaihe Forest Bureau, Heilong Jiang Province. This was an electro-hydraulic model also designed by the Northeast Forestry University. Its main use was for unloading tree-length logs from railway cars. It was a very simple design, but the hydraulic components proved to be unreliable, and this grapple is not now used.

In 1982, a new log grapple was designed by the South-Central Forestry College. It was designed specifically to load railway cars. One jaw of the grapple can move on the ground, while the other can rotate.

In 1987, the first electric drum grapple (Model DZ), was designed by the Northeast Forestry University. The grabbing force is much larger, and the

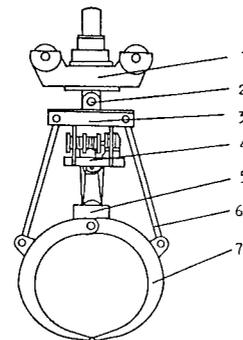


Figure 1. The Model DZ log grapple: 1) rotor, 2) hinging shaft, 3) upper crossbeam, 4) closing mechanism, 5) lower crossbeam, 6) bracing rod, 7) jaws.

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Table 1 Parameters of some log grapples used in forests of China.

	Model U42 rope grapple	Electric Hoist log grapple	Model ZMZ- SDLJ log grapple	Electro- Hydraulic log grapple	Electro- Hydraulic log grapple	Loading log grapple	Model DZ log grapple
Year of Use	1967	1978	1980	1980	1980	1982	1988
Sites Used	Zhuangzi	Wangging	Harbin	Guangxi	Chaihe	Hunan	Alihe
Grabbed logs weight (Kg)	3000	5000	4000	5000	20000	3500	5000
Jaws closed area (m²)	-	1.75	1.0	-	3.65	1.8	1.5
Grapple weight (Kg)	1924	3210	1000	850	2945	1000	2300
Open jaws max spread (mm)	3000	3500	1750	3000	2650	-	3000
Grapple height (mm)	3406	5060	2500	3100	3500	-	4393
Grapple width (mm)	1800	2200	1200	1800	4300	-	1746
Jaws closed time (s)	4	20	10.5	18	27	40	15
Rotor velocity (r/min)	-	1.15	-	0.9	-	-	1.15
Closing mechanism (Kw)	17.5	7.5	7.5	8.1	13	7.5	13
Hydraulic syst pressure (Kg/cm²)	-	-	-	160	70	-	-

Table 2 Parameters of some log grapples used in harbours of China.

	MD5 Double log grapple	7.ST Single cable grapple	15T Single cable grapple	MCA-1.5 hydraulic grapple	15T Single cable grapple
Year of Use	1978	1981	1981	1982	1984
Harbour	Dalian	Shanghai	Shanghai	Shanghai	Shanghai
Weight of logs grabbed (Kg)	5000	7500	15000	7000	15000
Weight of log grapple (Kg)	1383	3200	4900	1750	4800
Area of jaws held (M²)	1.5	1.34	2.0	1.5	1.9
Max spread of open jaws (mm)	2800	3000	3500	2600	3500
Log grapple width (mm)	1650	1800	2000	1400	2000
Log grapple height (mm)	2900	4300	5000	2500	4880
Time of jaws closed (s)	-	-	-	13	-
Velocity of rotor (r/min)	-	-	-	1.15	-
Hydraulic system pressure (Kg/cm²)	-	-	-	140	-

unit has been in use in the Alihe Forest Bureau since June 1988. It has proved to be very reliable, and there have been no serious breakdowns. The main components of this grapple (Fig 1) consist of the jaws, a lower crossbeam, an upper crossbeam, a bracing rod, closing mechanism and rotor. A special characteristic of this model is that the body of the grapple is connected to the rotor by a hinged shaft. In the event the grapple is out of order, the hinged shaft can be disconnected, and a lifting hook substituted for the grapple, so that operations may continue.

It can be seen from Table 1, that during the 1960's and 1970's, the design and application of log grapples to forest operations was still in the early stages, and grapple development was slow. In the 1980's, greater attention was focused on grapple design and testing by universities, institutes and forest bureaus. Consequently, many new types of grapples were developed, particularly the electro-mechanical and electro-hydraulic types. However, only a few proved effective, and met the needs of Chinese forestry.

LOG GRAPPLES USED IN HARBOURS

With the increase in log imports and exports, more and more grapples were used in harbour operations.

In the 1970's, cable log grapples were used in Dalian Harbour for unloading railway cars, and for loading ships. Since their introduction, they have worked well.

Following a conference held by the Ministry of Communications in Shanghai harbour in July 1984, it was concluded that the use of log grapples could increase the efficiency of unloading ships, and at the same time reduce accidents.

In the 1980's, the Shanghai harbour designed log grapples on the basis of information obtained both at home, and from abroad, taking into account the special conditions of log loading and unloading operations in the harbour.

In 1981, a 10-tonne double-cable log grapple was designed and put into use in the harbour for unloading 4 m and 8 m imported logs from ships, and was the first time grapples were used for this purpose. The 10-tonne double-cable grapple was a simple design, and after five months of use, a 7.5-tonne and a 15-tonne single-cable grapple were also put into use in Shanghai harbour.

In 1983, an electro-hydraulic log grapple was used in Shanghai harbour. It was mounted on a 10-tonne, 30-metre gantry crane. Because the hydraulic system was unreliable, designs reverted to electro-mechanical again, and in 1984 another 15-tonne single-cable unit was placed in service.

It can be seen from Table 2 that log grapples used in harbours were limited before the 1980's, but developed quickly. Their main characteristics were that they were of the cable type, simple in design, with a large grabbing force, and were safe to operate. They were used in conjunction with rotating cranes, thereby overcoming the inability of cable grapples to rotate.

CONCLUSION

From the preceding review, the following summary can be made:

1. The main areas of use for log grapples are log yards, forest operations, harbours and railway yards. Log grapples used in harbours are of the cable type. Although many grapples have been designed for use in forest operations, only a few have been successful.
2. Given the special conditions of forest operations in China, the electro-mechanical grapples (i.e., electric drum; electric hoist) are the most suitable. However, consideration should continue to be given to the electro-hydraulic type, the main problem being the determination of the appropriate hydraulic system pressure. It is thought this should exceed 150 Kg/cm².
3. Currently, cable grapples driven by two inclined electric screw rods are the best design for use with tree-length logs.