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CATERPILLARS FOR LOADS OF UP TO 80 TONS

by

A. Achermann

G E N E V E

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- I INTRODUCTION
- II DESIGN PRINCIPLES OF THE CATERPILLARS
- III THE PRACTICAL USE OF THE CATERPILLARS

I. INTRODUCTION

In order to assemble the Beam Transport System for the CERN PS, we need mechanical handling devices to transport, place and adjust bending magnets, quadrupole magnets, and, eventually, separator tanks and other heavy pieces of apparatus at places where there might be no overhead-travelling crane or other mechanized handling equipment available.

A large bending magnet together with its concrete base may weigh up to 40 and more tons. These magnets must be moved, turned round, lifted up and lowered down onto their feet, quite frequently in places where there is very little space available around the apparatus.

One can think of many possible ways of transporting heavy loads on an even floor in the absence of cranes : compressed air cushions, a walking hydraulic ram on compressed oil film, a ball carpet etc... All these methods have been tried out and can work. However, the aim of the present study and of the design principles applied to the carriages hereunder described, in this note, has been : to provide a self propelled means of transportation for moving loads up to 80 tons on floors which are rather uneven (rough finished concrete floor) and which shall be capable of overcoming slight unevenness of the floor. It shall also provide us the possibility of turning the load on the spot, or of displacing it in a straight motion under any angle.

It shall be self propelled and push-button controlled in order to provide the operator with an easy method of operation and to dispense him from working with winches or lifting tackles to pull the load around.

The carriages should be as small as possible in order to be placed easily on magnets, even if the latter are placed near to each other, leaving little space between them.

The simple caterpillars of the type shown in Fig. 1 are frequently used on concrete floors in workshops, to place machine tools. They may carry quite heavy loads. We have measured their rolling resistance on high carbon, hot rolled steel plates, put on the concrete floor, to be 1,4 to 1,8 %. This means that, in order to pull a load of 80 tons around, one would need to install winches of min. 2 tons capacity. This difficulty is overcome by motorising the caterpillars, of which the design principles are explained hereafter.

II. THE DESIGN OF THE CATERPILLAR

Fig. 2 shows the caterpillar carriages consisting of the caterpillar, the worm gear, the electric motor and the console by which it is clamped to the chassis of the bending magnet or any other apparatus to be moved.

Its main characteristics are :

- Nominal load	20 tons
- Weight of a caterpillar carriage	200 kg
- Max. dimensions (height, width, length)	69 x 50 x 40 cm
- Speed at full load, on level floor	7,4 m/min
- Motor (threephase, squirrel cage) nominal rating	0,7 PS
- Voltage	380 V, 50 c/s
- Starting torque	190 %
- Nominal speed	670 rpm
- Nominal current	1,6 A
- Starting current	5,6 A
- Worm gear ratio	1 : 58
- Worm gear efficiency	56 %
- Nominal pull of the carriage	200 kg
- Maximum pull of the carriage on starting	400 kg

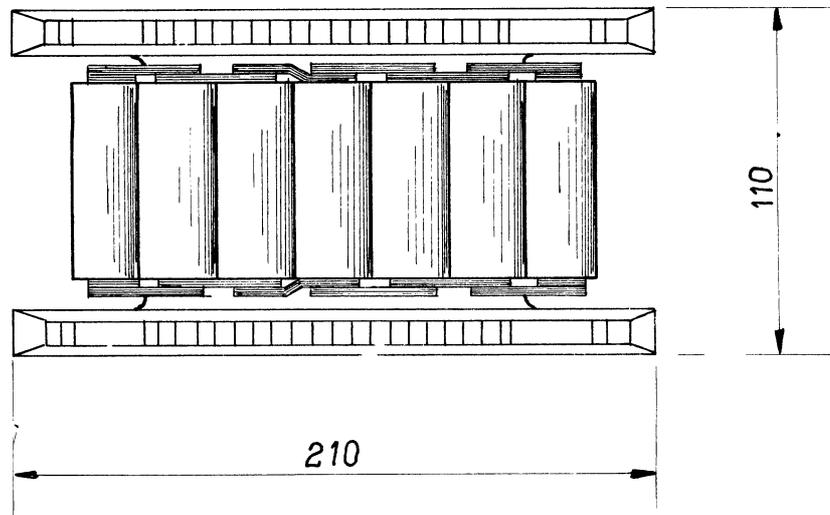
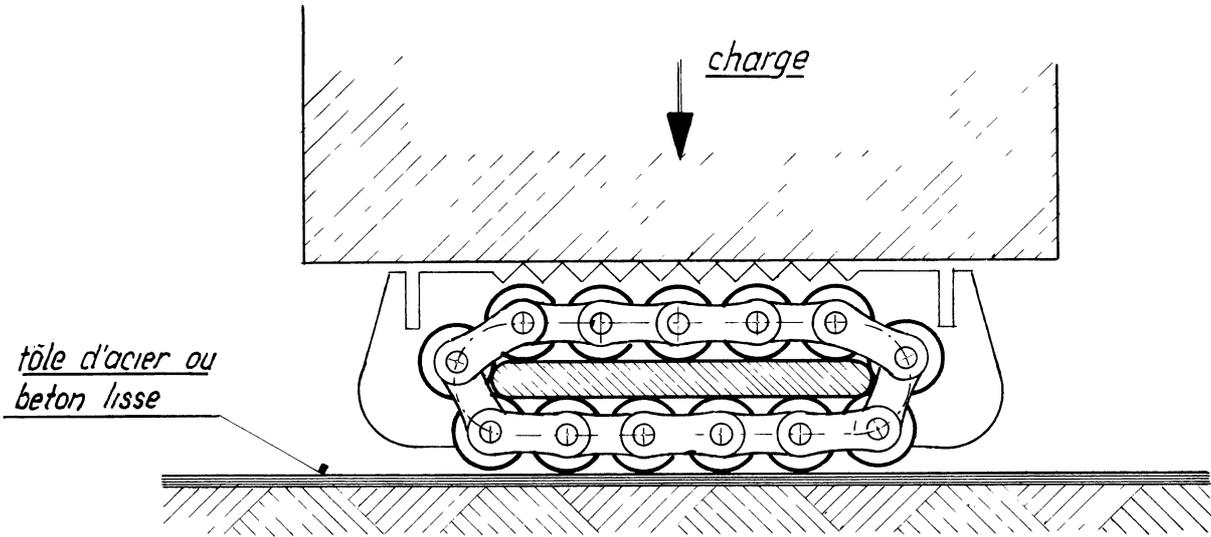


Fig. 1

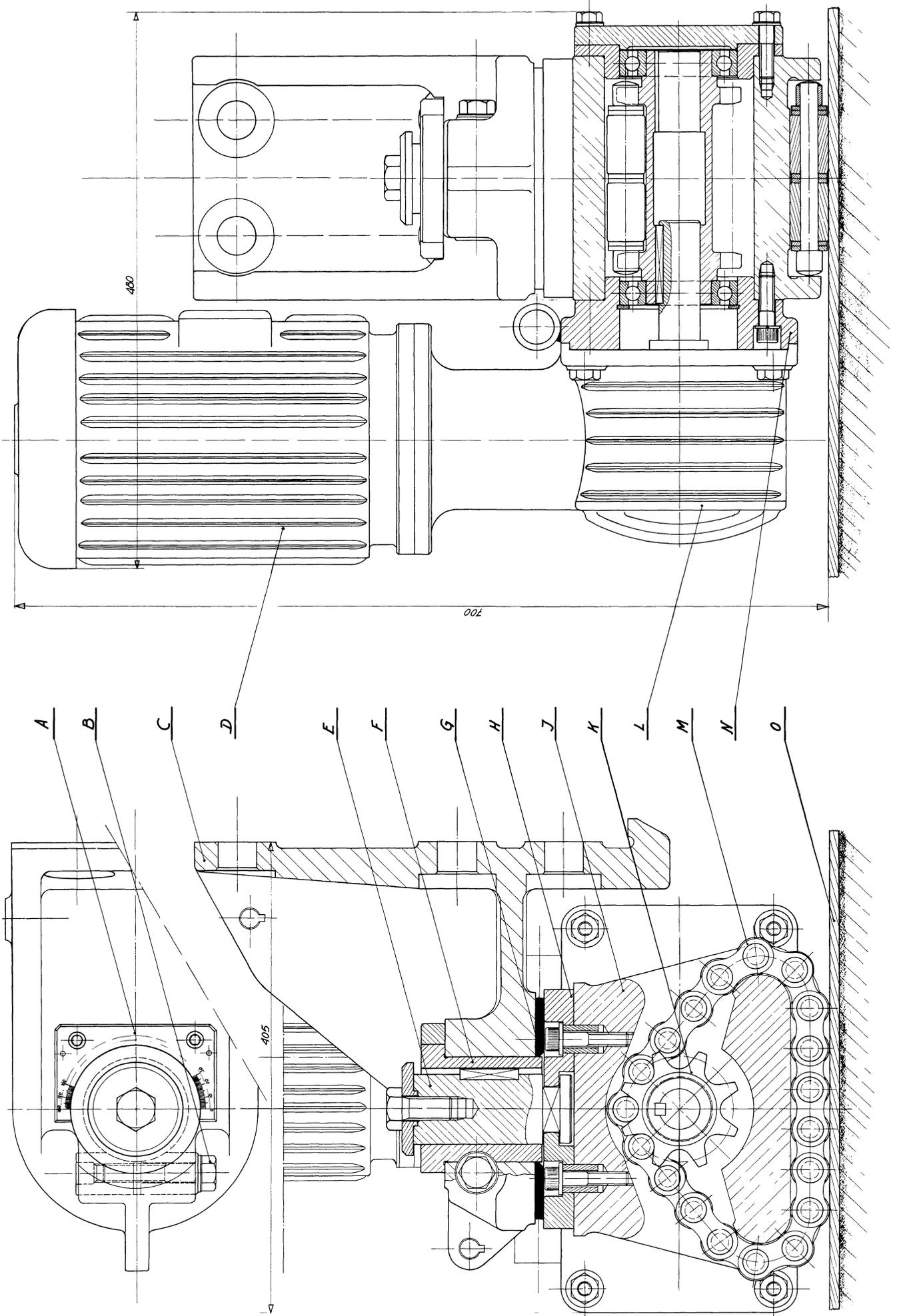


Fig. 2

- Floor needed concrete floor rated 20 t/m^2
- Floor covers hot rolled, high tensile steel sheet of 100 kg/mm^2 breaking strength and min. 6 mm thickness
- Hardness of metal cover 310 Brinell
- Dimensions of the rollers ($\phi \times l$) 32 x 47 mm
- Number of rollers in contact with the floor 12
- Minimum number of rollers bearing the load 4
- Maximum load per roller 5 tons

The electric motor D is directly mounted on the worm gear box L and coupled to the worm by means of a flexible coupling

The worm wheel shaft drives the main double chain wheel K.

The specially made, Gall type roller chain M rides around the driving chain wheel K and through the gap between the machined, lower face of the cast steel chassis J of the carriage and the steel cover plate of the floor O.

The carriage is fitted to the body or chassis of the apparatus to be moved by means of the cast steel console L. The load is transmitted from the console to the carriages, by means of a rubber cushion of 80 ° Shore hardness G.

This rubber cushion acts as a flexible support and ensures good contact of the rollers with the floor even if it is not level or flat. Thus we have a good distribution of the load on the rollers.

The central pivot E is kept locked in any wanted position by means of two screw-clamps B of the types used on machine tools. An indicator plate A facilitates the exact positioning of the carriages in order that all four of them move well aligned on a straight axis or on a circle.

III. THE PRACTICAL USE OF THE CATERPILLARS

A flexible cable brings the necessary electric power to a central distribution box. Its front panel shows the push buttons for the preselection of the carriages to be mobilized, and of the direction of their motion, see figure 3.

The top of the panel of the box is equipped with sockets for the small flexible cables feeding the four motors of the carriages.

We can also see three screw jacks on which the magnet and its base will finally sit.

Other consoles of cast steel are fitted to the side faces of the magnet base. They will be used to jack up the Magnet and its base, as is shown on figure 4.

The magnet and its base are lifted up by means of small, light weight hydraulic jacks

- a) for mounting the caterpillar carriages,
- b) for discharging them if one needs to turn them into another direction,
- c) for dismounting the caterpillar carriages.

Figure 5 shows a phase of a magnet transport where the direction of motion is to be changed.

The front carriages are discharged by means of a hydraulic jack and have already been turned round. The rear carriages are still in the old position.

The steel floor cover plates are only 50 cm wide and 2 m long and are put on the floor and subsequently advanced by two men.

Figure 6 shows a subsequent phase of the same transport : all four carriages point in the same direction some steel plates are laid down on the concrete floor.

The operator pushes the control button, and the 40 ton weight moves in the selected direction

It is possible to turn on the spot, as the schematic drawing, figure 7 shows. The magnet can be positioned with a precision of 2 mm.

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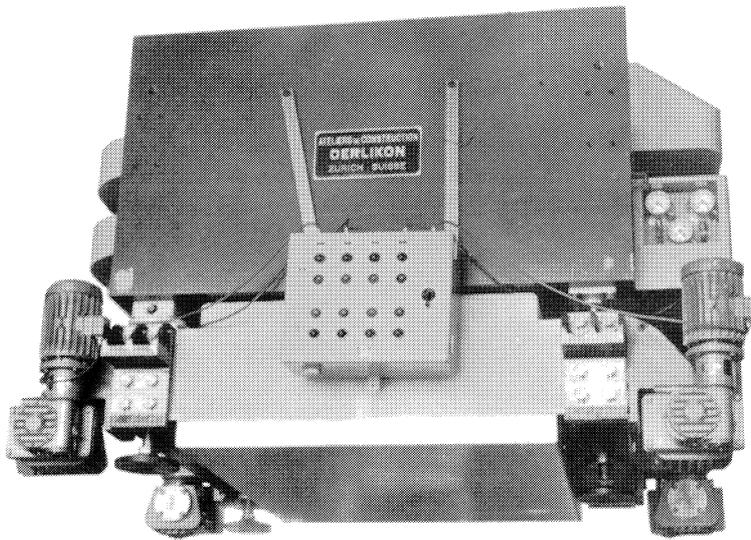


Fig 3

Bending Magnet of 2 m length together with its base, a baryte concrete block Total weight is about 40 tons

4 Caterpillars are fixed to the four corners of the magnet base

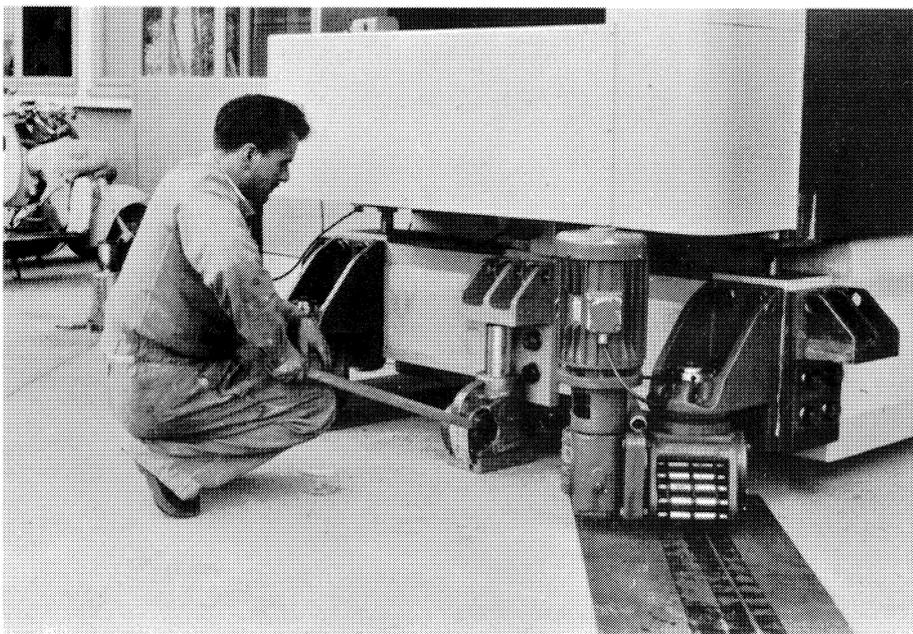


Fig 4

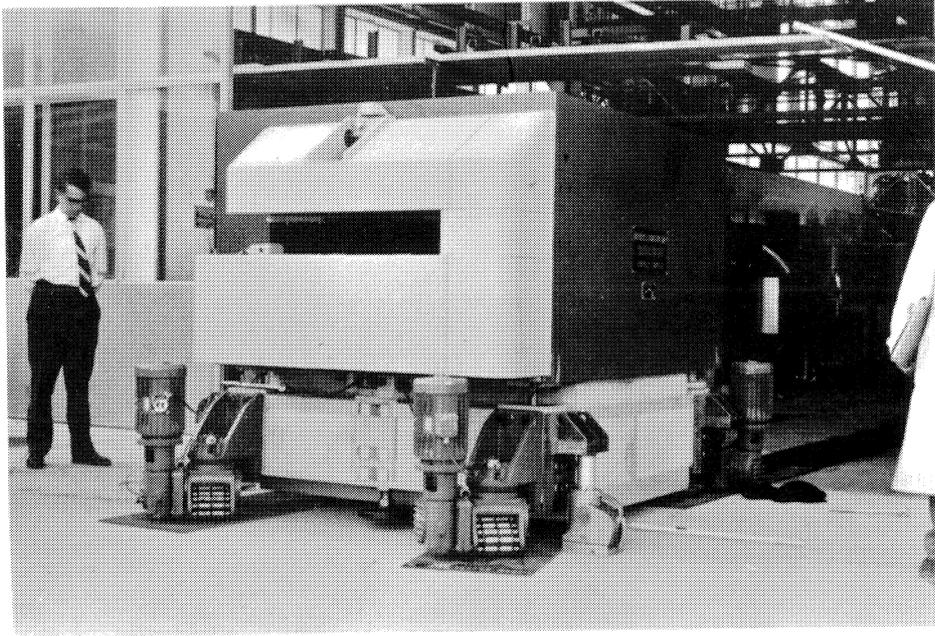


Fig. 5

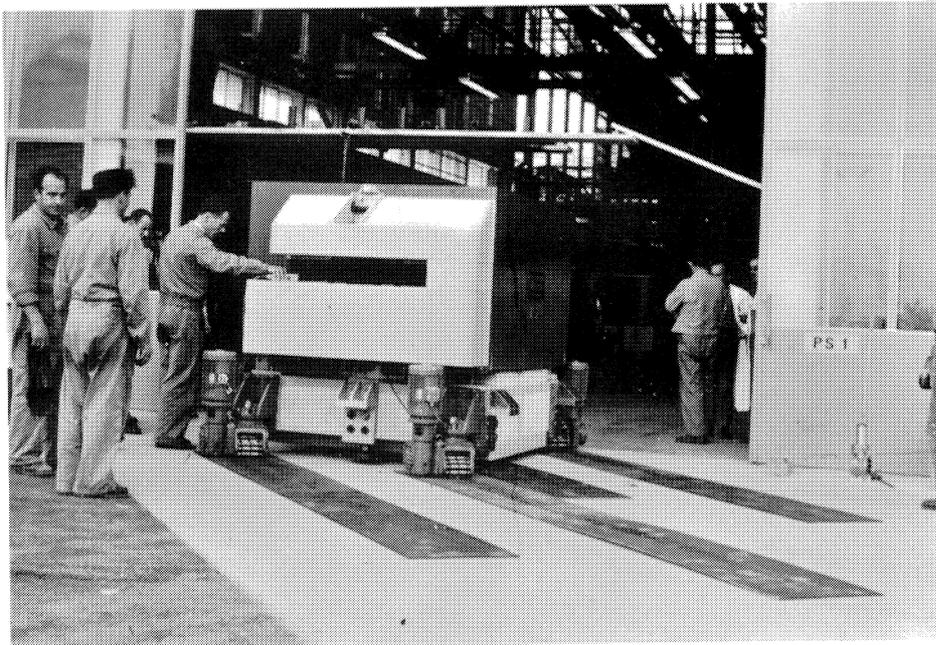


Fig 6

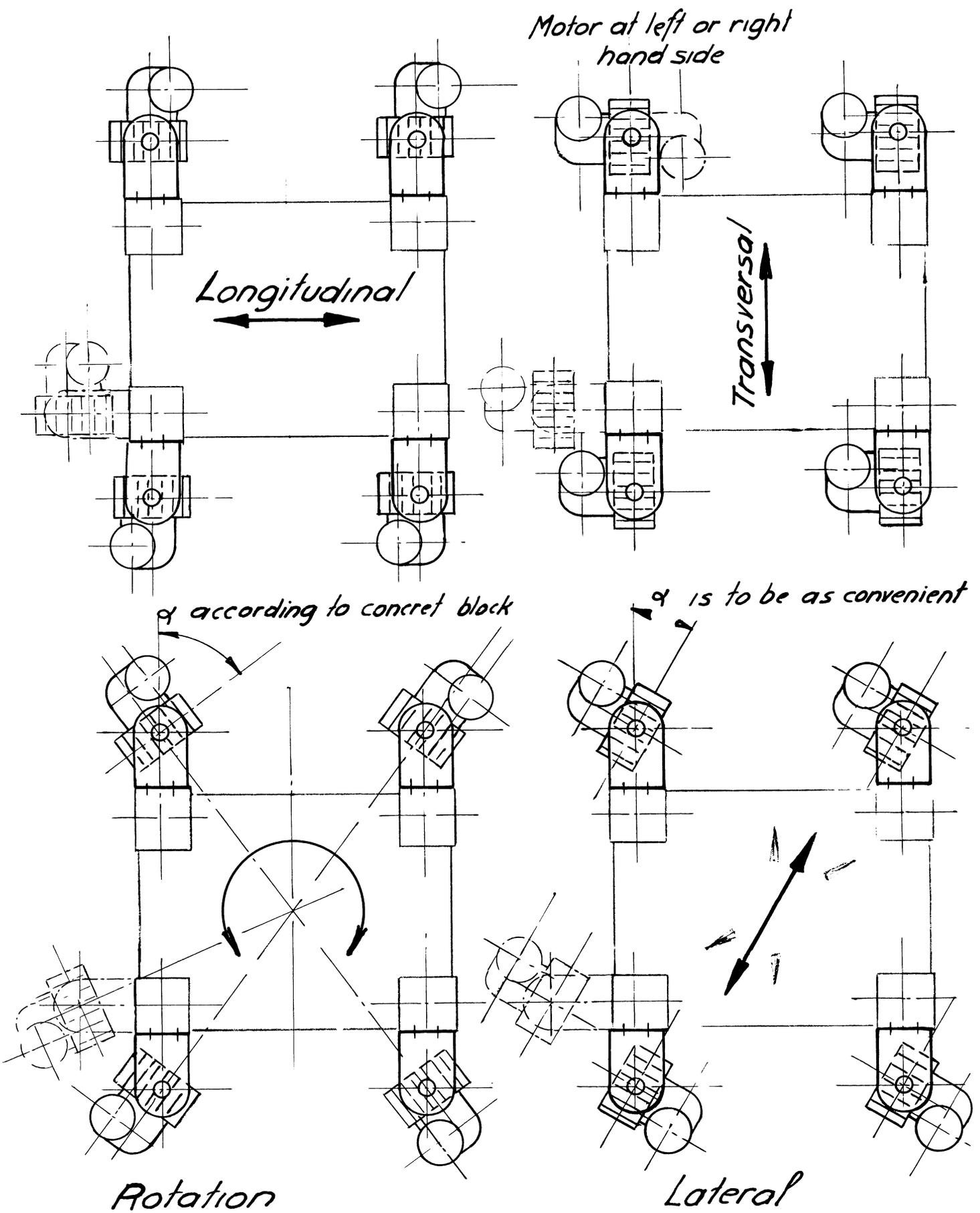


Fig. 7