

## AN ENCLOSED PNEUMATIC HALF-TRACK

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WHEELED vehicles equipped with pneumatic tyres are best suited for use on paved roads, whereas tracked vehicles have a better performance on soft and uneven ground. However, since more tracks are made of steel, tracked vehicles are unsuitable for general use on paved roads. Many vehicles are required to operate both on and off the road, and with this requirement in mind the tubular rubber track as developed by Bonmartini of Rome, Italy, offers good possibilities for use on small tractors.

There are several drawbacks associated with the design and operation of tracked vehicles, chief amongst these being the problem of excessive weight, short track and sprocket life, difficulties in adaptations for traversing paved roads and high production costs. In conventional wheeled vehicles the moving components of the transmission and final drive operate in enclosed spaces under good lubricating conditions, thus ensuring low wear rates and long component life. In contrast the track mechanism (drive and idler sprockets, track rollers and tracks) generally operate under unlubricated conditions and is continually exposed to dirt and grit. To keep wear to reasonable limits under these arduous conditions it is necessary to use high grade materials and heat treat the components, thus increasing production costs. The outstanding advantage of the track is, no doubt, its ability to secure traction under conditions which will not permit a wheel to operate with any degree of success. Not only can a tracked vehicle secure good footing under very adverse conditions but it can also operate with smaller slip losses under normal operating conditions. The magnitude of the "slip" or "loss of travel" is an important factor governing the efficiency of locomotion of a vehicle.

The reduction of ground contact pressure is also of importance in improving vehicle efficiency. This may be achieved by reducing vehicle weight. However, since this requirement imposes limitations on the designer, an increase in contact area could give the desired effect. This can be done either by increasing the width of the tracks or wheels or by increasing the length of the contact patch. The latter course would also be more effective in increasing the coefficient of traction and reducing the resistance due to soil compaction. This concept is explained by Bekker in his book *Off-the-road Locomotion*. Thus to obtain maximum travel efficiency it is necessary to orientate the contact area lengthwise and not crosswise in relation to the direction of travel. To increase the contact length of a wheel it is necessary to increase wheel diameter. Thus a track cannot be replaced by a wheel without recourse to choosing unacceptably large diameters. Since there is a practical limit to the diameter of tyre that can be used in a vehicle it follows that the application of tyres in heavy duty hauling operations is a matter of some difficulty.

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To overcome this a new type of tracked vehicle using an endless rubber track has been devised. The sides of this track are sealed by flexible diaphragms to exclude dirt from the track and sprocket contact faces and to contain suitable lubricants. This concept is illustrated in Fig. 1. The sealed track consists of a main frame (1), which carries the two driving sprockets (2) and an idler sprocket (3).

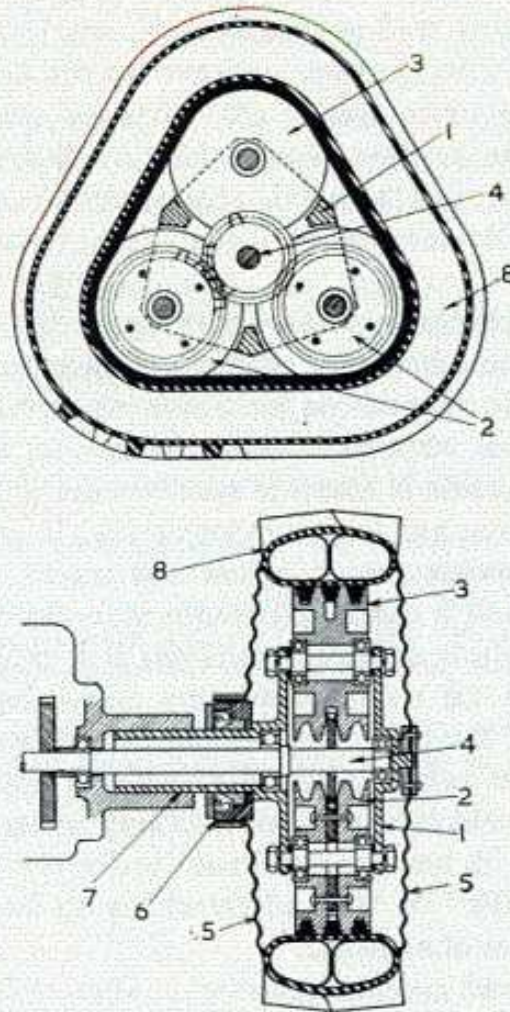


FIG. 1. Details of the sealed pneumatic half-track.  
 (1) Main frame. (2) Drive sprocket. (3) Idler. (4) Drive shaft. (5) Sealing diaphragms.  
 (6) Shaft seal. (7) Shaft housing. (8) Pneumatic track.

The drive is transmitted to the track (8) from the drive shaft (4), which is located in the housing (7), through a reduction gearing on the drive sprockets. All moving components are sealed in by the diaphragms (5) and the shaft housing seal (6), which is similar in construction to a standard oil seal. The inner diaphragm is strong enough to rotate the outer part of the seal as the track moves round. Due to the configuration of the supporting wheels, which are arranged at the apices of a triangle with the seal located centrally, a high degree of flexibility is not required of the diaphragm.

A vehicle equipped with this sealed pneumatic half-track is shown in Fig. 2. Such a vehicle is capable of being operated on paved roads as a normal wheeled vehicle and also has good performance over soft and uneven ground. Since all



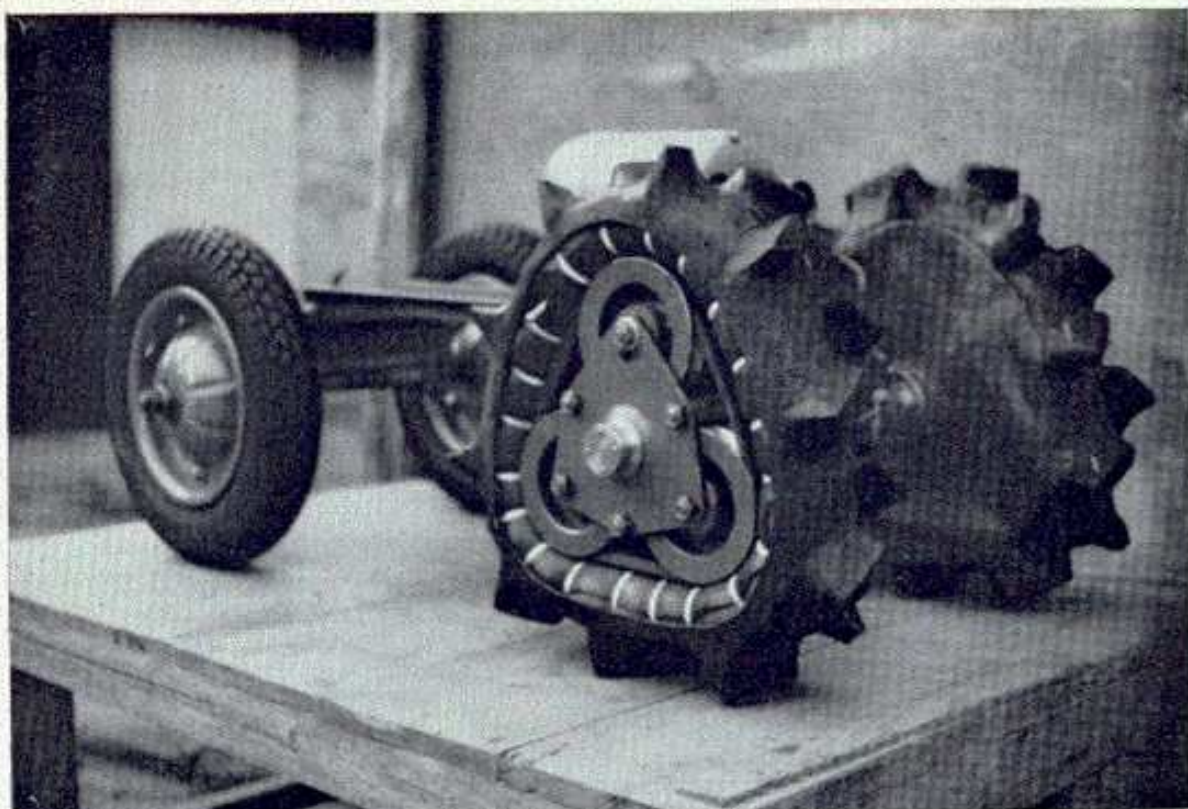


FIG. 2. A test vehicle equipped with the half-track.

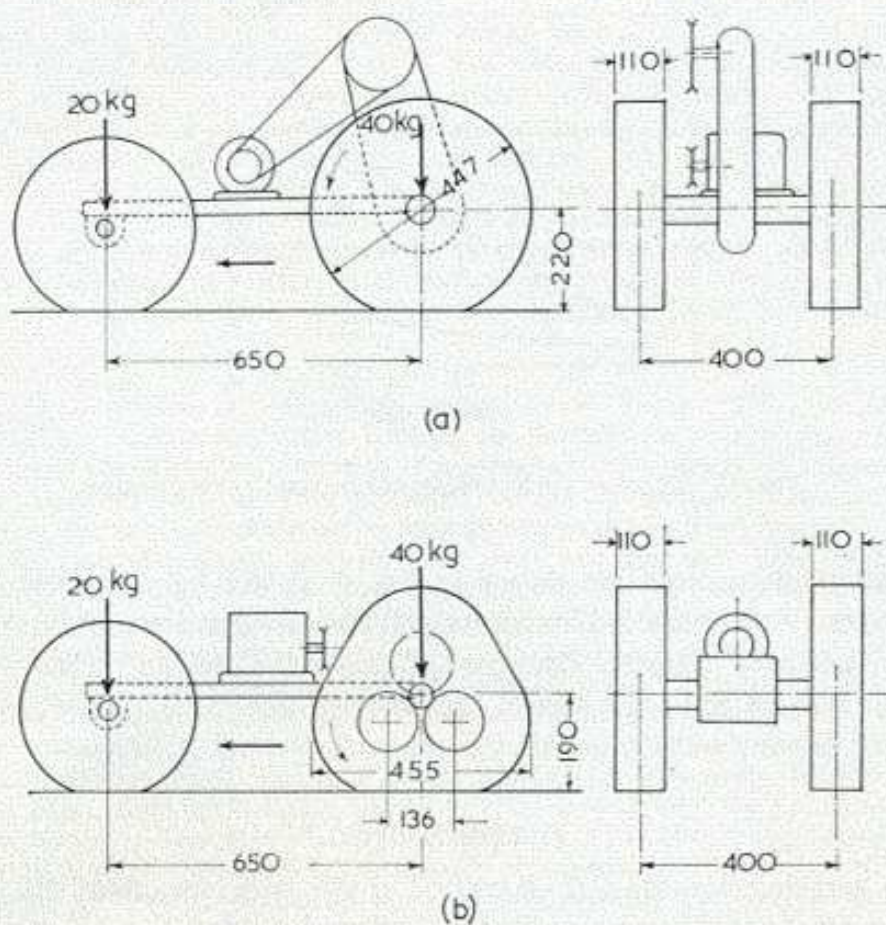


FIG. 3. Specifications of the two test vehicles.  
 (a) The wheel-type vehicle. (b) The pneumatic half-track vehicle.  
 (Dimensions are in mm)



the moving parts are sealed, this track has a longer working life as compared with a conventional track. The sealing also makes it possible to design the components in a manner similar to that of conventional transmission equipment, thus ensuring the use of lighter components resulting in lower contact pressures. Since the weight of the final drive is concentrated within the track itself it is also possible to achieve a low vehicle centre of gravity.

Tests were carried out to compare the performance of a conventional wheeled vehicle and one equipped with the sealed pneumatic track described. Figure 3 gives the dimensions of the two models used in the test. Both vehicles are of the same weight and have identical non-driven front wheels. The driving wheels of the wheeled vehicle consists of standard  $4.00 \times 8$  tyres as used on small power cultivators, and have a standard tread pattern. The pneumatic half-track utilizes the carcass of a similar tyre and hence has an identical tread pattern. The weight distribution of both vehicles was 20 kg on the front wheels and 40 kg on the rear. The free running speed of the wheeled vehicle over the test ground was 0.232 m/sec. whilst that of the half-track was 0.242 m/sec. The tests were conducted on a clay soil at a moisture content of 32 per cent.

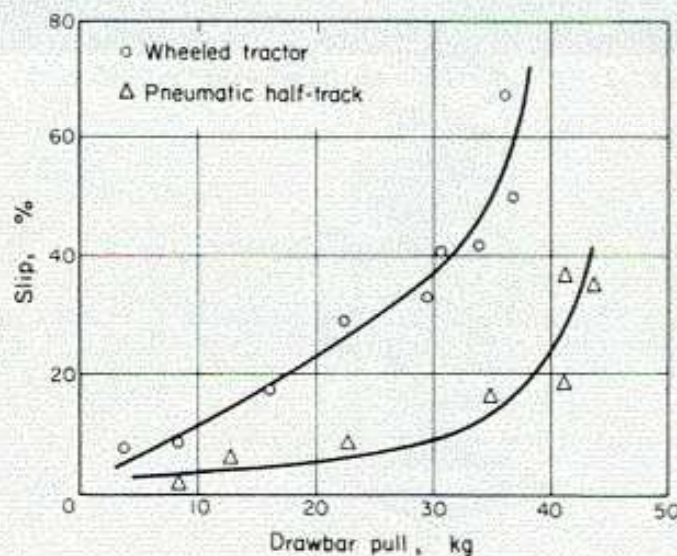


FIG. 4. Tractive performance curves for the two tractors.

The results of these tests are shown in Fig. 4. It will be seen from these curves that the drawbar pull of the half-track on soft clay is superior to that of the wheeled vehicle and indicates a higher drawbar efficiency for the half-track. For example at a drawbar pull of 30 kg the slip of the wheeled vehicle is as high as 37 per cent whilst the half-tracked vehicle is only 9.5 per cent.

#### Editor's Note

The pneumatic half-track described in this paper has been designed and developed as an individual effort by Mr. Okada, without support from any organization. Patents for this device has been applied for by Mr. Okada.