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PRESURRE REGULATION OF TYRES

GUMIABRONCSOK NYOMÁSSZABÁLYOZÁSA

The pressure the of tyres greatly influences the motion characteristics of vehicles and also the most common failure of tyres is caused by the insufficient airpressure in the tire. Because it is impossible to set a correct pressure value for both road and off-road use it is practical to vary the pressure according to the desired circumstances. This paper summarises the different setting possibilities and deals not only with their working principles but also compares their advantages and disadvantages. Key-words: tyres, pressure regulation, tyre pressure, motion characteristics

A gumiabroncs levegőnyomása a gépjármű menettulajdonságait jelentősen befolyásolja, ezen túlmenően a legtöbb gumiabroncs meghibásodás a helytelen levegőnyomásból ered. Nem lehet köztes gumiabroncsnyomást beállítani, ami jó lenne közúton és talajon egyaránt, ezért célszerű a gumiabroncs nyomását változtatni, az aktuális körülményeknek megfelelően. A cikk összefoglalja a különböző állítási lehetőségeket, és az alapvető működésen túlmenően ismertetésre kerülnek a különböző állítási módok előnyei és hátrányai is.

1. Requirements to be fulfilled by vehicle tyres

The wheels contact the ground via the tyres; they bear the weight of the vehicle, transmit the traction and breaking force to the ground. The flexibility of the tyres provide the comfort of the voyage. [1] [2]

Requirements to be fulfilled by vehicle tyre:

- decrease noise,
- good spring qualities,
- smooth rolling (properly balanced wheel, circularity),
- adequate rolling safety (tyre stays on the wheel, good traction),
- running stability (straight line behaviour, turning stability),
- steerability (adequate steering torque),
- durability (strength, speed bearing),
- resistance against wear,

- decrease rolling resistance,
- little possibility for damage,
- easy repair,
- renewalability. [3]

2. The affect of tyre pressure [1] [2] [3] [4]

The pressure of the tyres greatly affects the rolling resistance and the life-span of the tyres. Using the prescribed pressure for the tyres the entire rolling surface of the tyre contacts the road:

- the side of the tyre does not crease more than it is necessary,
- it springs adequately,
- reaches its normal lifespan.

If the pressure is too high the contact surface of the tyre bulges out, the flexibility of the tyre reduces:

- reduces the comfort of the voyage, shakes violently
- the shaking damages other parts and integral structure of the car,
- the surface pressure increases,
- the centre of the tyre wears more rapidly,
- more likely to skid on wet and muddy roads,
- road handling becomes less reliable.

If the pressure is too small the side of the tyres creases greatly, the contact surface arches inward:

- the outer rim of the running surface wears rapidly,
- crack sappear and break out on the side of the tyre because of the creasing,
- the centrifugal force in a sharp turn causes larger deformation.

Advantages of using proper tyre pressure off-road:

- the ground pressure reduces,
- less rolling resistance,
- more traction,
- less skidding,
- better self cleaning of the tyre ribs,
- fuel-saving,
- better voyage comfort.

Advantages of using proper tyre pressure on roads:

- less rolling resistance,

- less wear
- less fuel consumption ,
- better voyage safety.

3. Reasons for controlling tyre pressure [4] [5]

By the reduction of the pressure inside the tyres, the tyres become flat this way their running surfaces can increase by twofold. This way the weight of the vehicle is distributed on the ground on a greater surface.

The ground pressure is greatly affected by the tyre pressure. If instead of reducing the tyre pressure, the load on the wheels is reduced, then the smaller load acts on a smaller tyre surface this way the ground pressure is only reduced by a small amount.

Using smaller loads has a good effect only if smaller tyre pressure is used with it.

By returning the vehicle to public roads the tyre pressure has to be raised in order to gain the proper stability and traffic safety.

In practice, the tyre pressure is usually not reduced when the vehicle is going off-road.

The drivers usually chose a pressure setting between the adequate variations that is neither good for road or off-road use.

The advantages of regulating tyre pressure:

- setting the tyre pressure quickly and flexibly in accordance with the terrain during motion,
- no need to get out of the vehicle, the regulation is easy and comfortable,
- the pressure can be checked from the driving seat,
- saving time,
- the pressure valves are not liable to dirt,
- the accidental loss of pressure can be equalized by re-pumping during motion,
- the indicator gives greater safety during pressure loss,
- during a puncture the system enables the vehicle to leave the danger zone,
- the circumference of the front and back wheels can be compensated,
- the different axel loads can be taken into consideration.

4. Tyre pressure regulating systems

The pressure regulations of the tyres can be done on a stationary vehicle or in motion, manually, semi-automatically and fully automatically.

4.1 Pressure regulation in stationary mode (AIRBOOSTER)

Usually a filler and a quick tyre deflating kit is available (Fig.: 4.1), for the setting of the tyre pressure individually and in succession. [4] [6]



Fig.: 4.1. Manual tyre inflator and deflator set (AIRBOOSTER).

4.2 Pressure regulation in stationary mode (AIRBOX)

A semi-automatic system that independently regulates the pressure in every connected tyre according to preset values. (Fig.: 4.2). [4] [6]



Fig.: 4.2. Manual tyre inflating system (AIRBOX).

4.3 Pressure regulation during motion (AIRBOX/drive 2L)

The system characteristically has a rotating air pipe with a quick connection outside the wheelbase that is led through the mud guard. (Fig.: 4.3). [4] [6]



Fig.: 4.3. Semi-automatic inflation system (AIRBOX/drive 2L).

4.4 The tyre pressure regulation system of the BTR-80 infantry fighting vehicle

The central pressure regulation system automatically keeps the preset pressure values of the tyres and also enables the driver to check and regulate the pressure of the tyres individually.

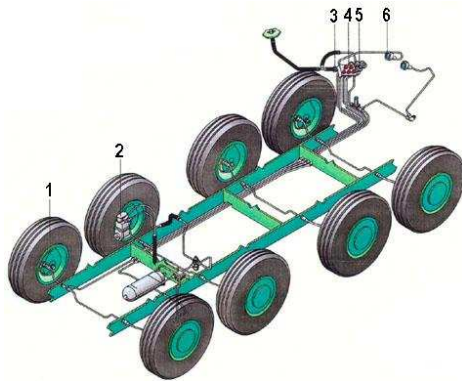


Fig.: 4.4. Tyre pressure regulation system of the BTR-80.

The tyre pressure regulation system of the vehicle consists of: (1) wheel drives, (2) compressor, (3) quick deflation valve, (4) tyre inflation valve, (5) inflation regulation valve, (6) tyre pressure sensor, tubing and rubber pipes, the air pipes of the wheel drives and the wheel valves (Fig.: 4.4).

The tyre inflator regulator valve (reductor) enables the correct setting and maintaining of the pressure during the whole operation according to road conditions (Fig.:4.5). If the the tyre pressure needs to be increased then by turning the hand wheel “FILLING” counter clockwise the has to be adjusted to the desired pressure. If air is escaping from the tyres then the redactor is able to hold the preset pressure until the compressor is capable for the refilling.

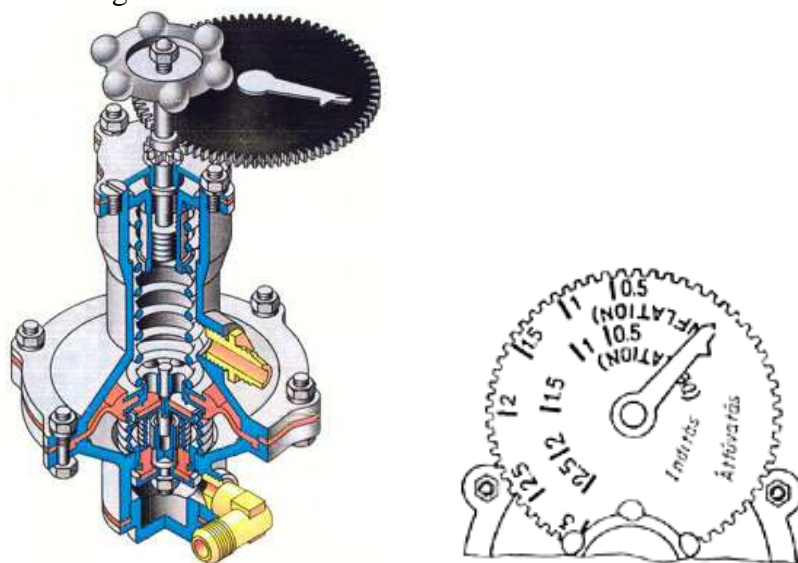


Fig.: 4.5. Tyre-inflating regulation valve

The role of the tyre filling valve is to switch of the inflation of the tyres from the central pressure regulation system. (Fig.: 4.6.). Four tyre switch off valve and a drain valve (for other use of air pressure) can be found in the tyre filling valve.

All four valves and tyres are interconnected via the tyre filling valve when the tyre valves are open; this way every tyre will have equal pressure. The pressure can be regulated in all tyres at the same time. When the pressure of the tyres needs to be reduced without the tyre-inflating regulation valve the quick pressure drop valve can be used.

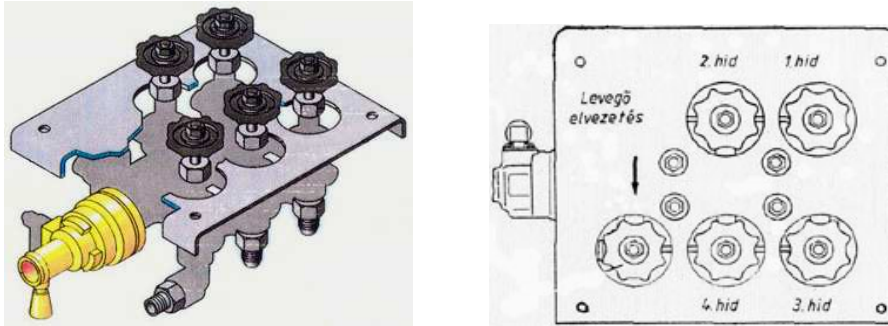


Fig.: 4.6. Tyre filling valve

The tyre valve prevents air escaping from the tyres: when the vehicle is stationary for a long time, when the pressure system is damaged, or when the wheel is removed. When the fighting vehicle is used the tyre valves have to be open in order to refill the escaping pressure if the tyre is punctured or damaged. [7]

4.5 Tyre pressure regulation system of the MB UNIMOG-4000 off-road lorry

The installed electro pneumatic tyre pressure regulation system is capable of automatically inflating and deflating the tyres of the front and back axel wheels. The occasional loss of pressure can be compensated in this way. The pressure of the tyres of the front and back axel wheels can be adjusted separately or together. The regulation can be performed with the switches built into the left dashboard (Fig.: 4.7)



Fig.: 4.7. Pressure regulator switches

The functions that can be selected by the left switch are: inflation, pressure maintaining and deflation. The functions that can be selected with the right hand switch are the selection of the 1.1. axel and the 2. and 2. axels. The pressures of the tyres are indicated on the driver information system installed in the dashboard. (Fig.: 4.8). [5] [8]



Fig.: 4.8. The indication of the tyre filling valve and tyre pressure values

4.6 Tyre pressure regulation system of the Rába H-series off-road lorry (Dana central tyre filling equipment) [9]

The Dana central tyre filling equipment (CTIS) is integrated in the vehicle system and enables the manual and automatic regulation of the tyre pressure. The system enables the driver to select four off-road and three different road settings, this way the correct pressure can be selected according to road conditions and load. The control station is found on the right side of the driver seat with a two way switch that is used to switch on the system. The indicator lamps on the control station show the road conditions and loads selected by the driver (Fig.: 4.9).

During the time of setting the switches the indicator lamp blinks, and after selecting the proper pressure it lights up continuously, after this the automatic operation can be switched off and the indicator lamps will go out. The electronics continuously control and warn the driver if the speed exceeds the value of the speed set for the road conditions and loads. If the speed of the vehicle is too high for the selected pressure the speed of the vehicle has to be reduced or higher tyre pressure has to be selected. If the driver does not reduce the speed within one minute then the system automatically increases the tyre pressure.



Fig.: 4.9 ábra. Control station with the selecting switches

In every mode at any time by pressing the switch the system first performs a check after it sets the desired tyre pressure on every axel. The pressure of the tyres increase due to the heat produced by their normal operation, but the system does not compensate this effect.

5. Conclusion

Tyres are simple parts of the vehicle that consist of very few parts, but their role is ever more important. The tyres bear the weight of the vehicle and the load, they transmit the traction to the ground in both acceleration and braking and also provide proper road holding in bends and in different road conditions. Because they operate in different road conditions and with different loads the air pressure in them cannot be set generally to be suitable in every condition. For military use and also for safety consideration the setting of ideal tyre pressure is more important than for a normal road vehicle. This paper tried to show the necessity of tyre pressure regulations and also some realised systems –without showing all of them in full extent.

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