DEVICE FOR THE TRANSMISSION OF ROTARY MOTION TO VIBRATING MEMBERS WITH SIMULTANEOUS DAMPING OF THE VIBRATIONS

Filed Aug. 25, 1959 2 Sheets-Sheet 1

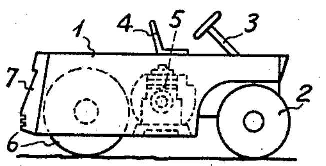


FIG. 1

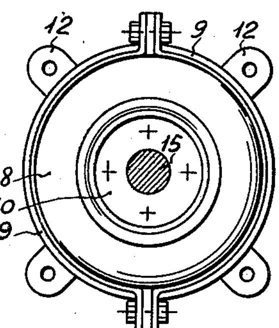


FIG. 2A

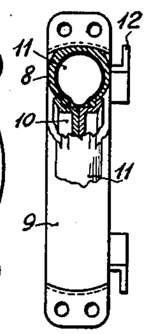
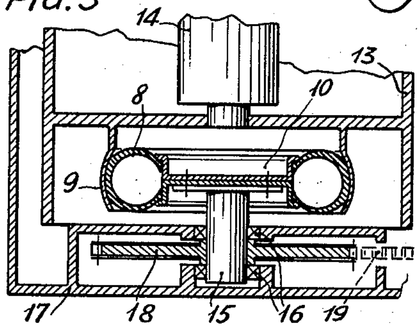


FIG. 2B

FIG. 3



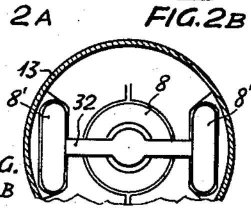


FIG. 10B

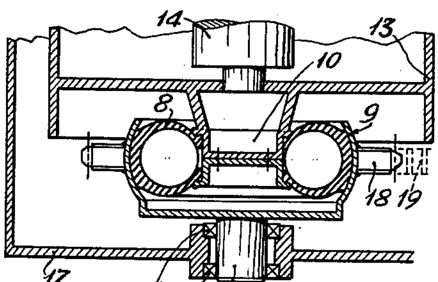


FIG. 4

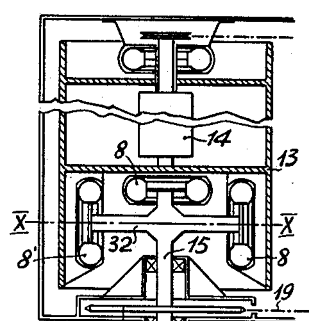


FIG. 10A

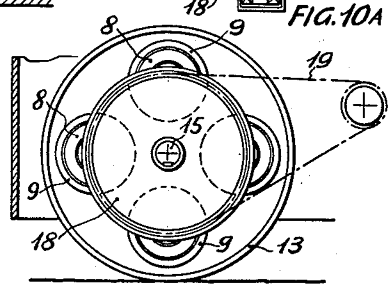
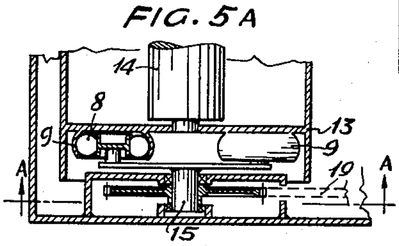


FIG. 5B

FIG. 5A



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DEVICE FOR THE TRANSMISSION OF ROTARY MOTION TO VIBRATING MEMBERS WITH SIMULTANEOUS DAMPING OF THE VIBRATIONS

Filed Aug. 25, 1959 2 Sheets-Sheet 2

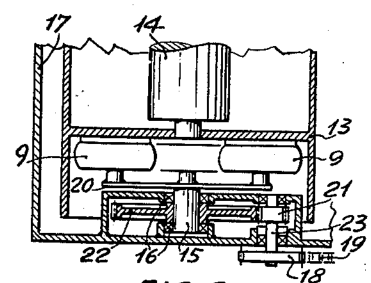

FIG. 6

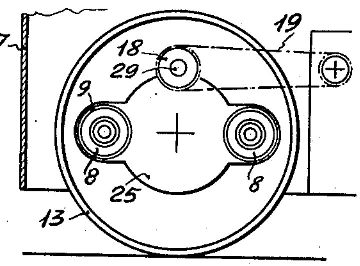

FIG. 8B

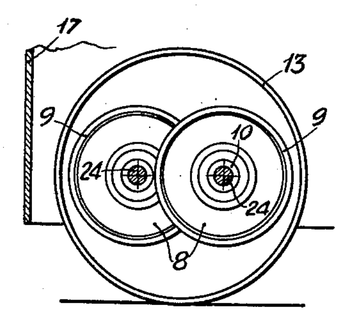

FIG. 7B

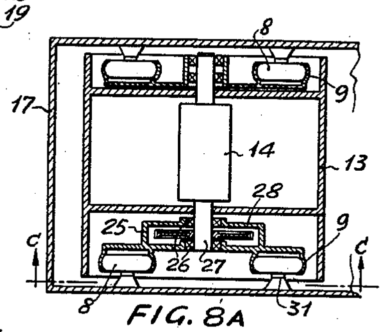

FIG. 8A

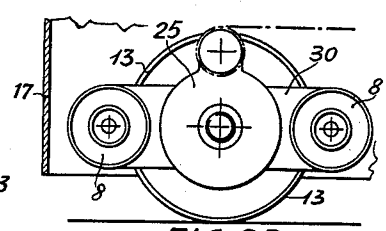

FIG. 9B

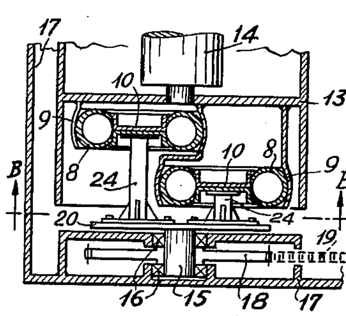

FIG. 7A

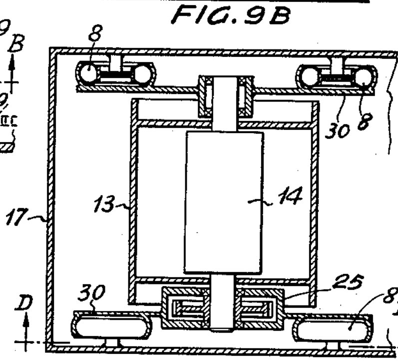

FIG. 9A

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3,108,519

DEVICE FOR THE TRANSMISSION OF ROTARY MOTION TO VIBRATING MEMBERS WITH SIMULTANEOUS DAMPING OF THE VIBRATIONS

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2 Claims. (Cl. 94—50)

The considerable advantages obtained by using the vibration by the tamping and compacting of ballasts, macadams and of all those layers of granular materials used in the road- and dam-construction as well as for other purposes are well known to everybody skilled in the art.

Many machines already have been studied to transmit an adequate vibrating effect to the layers to be tamped. One of the more modern and rational machines for this purpose is the vibrating self-moving compressing roller. This type of machine consists in a body or frame, the fore part of which supports the guiding wheel or wheels, the steering group, the seat for the driver, the engine and at one end of said frame the vibrating mechanism. This vibrating mechanism generally consists of a metallic cylinder set into vibration by a suitable exciter generating the vibrations which cylinder transmits the vibrations to the ground on which it rests.

In order to obtain the maximum vibrating effect and simultaneously the maximum economy of the whole machine it is convenient that the major part of the total weight of the machine be discharged on the ground through the vibrating mechanism.

To this extent a counterweight is sometimes provided in such a position as to displace the center of gravity of the whole machine as close as possible to the vibrating mechanism. A vibrating self-propelled compressing roller must obviously carry out a transition which results in an independent displacement during the working phase as well as during the travel from one place of work to the next besides vibrating the ground upon which it rests.

It is obvious for the purpose of proper distribution of the weight, as mentioned above, that it is necessary to impart simultaneously the function of a driving wheel to the vibrating drum in order to obtain a maximum tangential force on the drum and therefore a maximum forward pull (or push) since the machine is designed for working and moving on steep inclines as well as on even ground. In other words, the drum, acting as a driving wheel, is transmitting the tangential forces to the ground which cause the forward or reverse movement of the whole machine.

A twofold problem arises in this connection, that is namely:

(1) Avoiding that the vibrations of the vibrating drum be transmitted to the frame as well as to all the other members and elements connected to the latter;
(2) Transmitting the torque to the vibrating member.

It is well known that this double problem has been solved up to now either by employing resilient metallic elements or solid rubber elements. The latter, consisting of circular or prismatic bodies, have been subjected to torsion, bending, compression as the various cases may be. The device forming the object of the present invention, designed to transmit a rotary movement to vibrating members in such manner that the vibration be not transmitted to the main frame and to all the elements connected to the latter, is characterized by at least one resilient, toroidally shaped ring provided with an internal cavity filled with a fluid, said ring being engaged by at least two rigid bodies, each of which is subdivided into

portions which, after being assembled approximately assume the geometric form of bodies of rotation surrounding the ring filled with the fluid, compressing same at the same time. The portions of one of said rigid bodies are mounted on the non-vibrating elements of the machine, while the portions of the other rigid body are mounted on the vibrating elements, to which latter the torque applied to the portions of the first rigid body is transmitted by way of the said fluid-filled ring.

The object of the device according to the present invention is to solve both the above mentioned problems by using hollow rings of elastic material containing more or less compressed gases or fluids. In particular these pneumatic rings may be similar to those used in the car industry. In some cases it will be even convenient to use the pneumatic tires actually used on cars and motorcycles. This fact renders the devices, forming the object of the present invention, very economic and easy to maintain.

As far as the resilient, steel elements previously used for the damping of the vibration are concerned, it should be noted that they have been long since replaced by solid rubber elements since said steel elements had been very unsatisfactory and insufficient from the point of view of their poor elastic characteristics and their resistance to fatigue. The use of solid rubber elements has many disadvantages compared with the use of fluid-filled rings according to the present invention. The most important of these disadvantages are:

(*a*) The solid rubber elements used for the damping of vibrations have a high elastic hysteresis as well as a considerable internal viscosity so that they absorb a large part of the existing vibrating energies. This is proven by the fact that these solid rubber supports or elements very rapidly reach high temperatures during the working of the machine and radiate very much heat.

(*b*) If the quality of the rubber used for said solid rubber elements is not particularly good, the temperatures reached are so high that they cause a decrease of the elastic coefficient with consequent vulcanisation and rupture, what requires that these elastic elements be often replaced.

(*c*) The cost of these elastic solid rubber elements is very high as they usually must be vulcanised with a very complex and expensive chemical process on steel discs or plates, which are necessary for effecting the fixing of said solid rubber elements to the vibrating as well as to the non-vibrating metallic bodies.

The advantages of the fluid-filled rings according to the invention over the solid rubber elements are:

(*d*) The fluid-filled rings as used in the devices according to the present invention take advantage of the elasticity of the air or of other gases.

As these gases are rapidly subjected to compressions and successive decompressions they practically undergo adiabatic changes of state with consequent minimum, if not zero, heat loss, and therefore minimum, if not zero, dissipation of vibrating energy. Hence, the vibrating power generated by the exciter is entirely transmitted to the ground, without a substantial loss in the damping system.

(*e*) The pneumatic or fluid-filled rings used in the device forming the object of the present invention always keep a very low temperature and therefore have a much longer life than the corresponding solid rubber elements.

(*f*) It is made possible to use pneumatic tires of the type found in the trade for cars and motor-cycles, thereby utilising low cost elements which are everywhere available.

The accompanying drawings diagrammatically show, by way of example only, some embodiments of the device according to the invention.

FIG. 1 is a diagrammatic side view of a self-propelled vibrating road roller according to the present invention.

FIG. 2A is a side view of a pneumatic ring.

FIG. 2B is a section through a portion of a pneumatic damping ring.

FIG. 3 is an axial horizontal section through a portion of the self-propelled vibrating roller.

FIG. 4 is an axial horizontal section through a portion of a self-propelled vibrating roller showing a different fastening system of the vibrating drum and of the rigid frame to the rigid elements surrounding the pneumatic ring.

FIG. 5A is an axial horizontal section through a portion of the self-propelled vibrating roller provided with a vibration damping system allowing the transmission of a torque without producing tangential friction forces at the contact surfaces between each pneumatic ring and the rigid elements surrounding it.

FIG. 5B is a vertical section along the line A—A of FIG. 5A.

FIG. 6 is an axial horizontal section (similar to the one of FIG. 5A) of an embodiment showing a different solution for the transmission of the torque.

FIG. 7A is an axial horizontal section of the vibrating self-propelled roller wherein the pneumatic rings are disposed on different vertical plans.

FIG. 7B is a vertical section along the line B—B of FIG. 7A.

FIG. 8A is an axial horizontal section through a portion of the vibrating roller provided with a damping device for the transmission of the torque wherein a part of the transmission gears is mounted on the vibrating drum and vibrates with the latter.

FIG. 8B is a vertical section along the line C—C of FIG. 8A.

FIG. 9A is an axial horizontal section through a device similar to the one of FIG. 8A, having the pneumatic rings disposed outside of the vibrating drum.

FIG. 9B is a vertical section along the line D—D of FIG. 9A.

FIGS. 10A and 10B respectively show a horizontal and a vertical section along the line X—X of another embodiment wherein some pneumatic rings are mounted parallel to the axis of the vibrating drum.

The vibrating self-propelled road roller shown in FIG. 1 comprises a rigid body or frame **1**, one or two guiding wheels **2**, a steering group **3**, a seat **4** for the driver, an engine **5**, a vibrating tamping mechanism **6**, a counterweight **7**. The device for the damping of vibrations and the transmission of rotary motion to a vibrating member according to the present invention comprises as basic elements (FIGS. 2A and 2B) one or more toroidally shaped pneumatic rings **8** suitably mounted on rigid elements **9** and **10** generally of metal having the geometric shape of so-called bodies of rotation. These rigid elements **9** and **10** consist of portions or sectors, designed for positively fastening and gripping after assembly, the pneumatic ring **8**, thus preventing any sliding or slipping between the surface of the ring **8** and the surface (usually of metal) of each of the rigid elements **9** and **10**, said rigid elements being distinct and separate and only connected to each other by way of the pneumatic ring intermediately placed between them.

According to this particular arrangement, when one of the rigid elements, for example element **10**, is subjected to a vibratory motion, the other one (**9**) "feels" the vibrations only through the pneumatic ring **8**, which for the reasons mentioned above is capable of damping most of the said vibrations.

FIGURES 2A and 2B diagrammatically show a pneumatic ring **8** and the relatively rigid members **9** and **10** applied to the said ring which in this case is a conventional car-tire containing an inner tube **11**. According to the present invention it also is possible to use pneumatic rings of other shape, consisting of other elastic material than rubber. The rigid member **10** consists in this case of a normal tire-rim of the type used on cars and motor-cycles.

Obviously, by mounting the rim **10** on a vibrating member and fixing the rigid element **9** (for example by means of one or more projections **12**) to a stationary member, it is possible to obtain the positioning of the vibrating member without impairing its vibration and at the same time avoiding to the utmost extent that the said vibrations be transmitted to the stationary member.

FIG. 3 shows a most simple device according to the present invention for the damping of vibrations and simultaneous transmission of rotary motion to a vibrating member, said device being designed to solve this double problem in the case of a self-propelled vibrating compressing road roller. FIG. 3 diagrammatically shows a section taken along the horizontal plane comprising the geometrical axis of the vibrating drum. The vibrating drum **13** rigidly bears the exciter **14**, generating the vibrations. The said vibrating drum **13** is fixed to the rigid member **9** surrounding the pneumatic ring **8**. The rim **10** surrounded by the inner part of the pneumatic ring **8** is rigidly mounted on the shaft **15** rotatably supported by means of bearings **16** on the main frame **17** of the machine. A gear **18** also is keyed to the shaft **15**, said gear **18** engaging the chain **19** driven by the engine.

This particular arrangement obviously gives the drum **13** the chance of carrying-out its vibratory motion impairing however to the utmost extent the vibrations to be transmitted to the frame and to the other members of the machine. Furthermore it permits the transmission of the torque from the frame **17** to the vibrating drum **13** in order to provide for the desired rotation of the said drum and consequent forward motion or movement of the whole machine.

FIG. 4 shows a similar device for the damping of the vibrations and transmission of the torque from a vibrating member to a non-vibrating element except for the fact that in this case the vibrating drum **13** is fixed to the rigid body **10** (rim), while the shaft **15** is fixed to the rigid body **9** externally surrounding the pneumatic ring **8**. This second solution shown in FIG. 4 is practically equivalent to the one shown in FIG. 3 and the choice between these two solutions is generally determined by the practical constructive requirements of the various members.

The description of the following devices forming the object of the present invention, has been limited merely to the illustration of one possible embodiment. The other embodiments however which may be obtained by analogy from the described one are certainly also to be considered as comprised within the scope of the present invention.

FIGS. 3 and 4 and sequ. do not show the other side of the vibrating drum nor the way this end is held in position. Various solutions are possible in this case and can be taken from the devices shown in the figures. It is sufficient to think that at the non-represented end the problem of transmitting the torque does not exist and it is therefore sufficient to solve the problem of the damping of the vibrations. One possible solution is to realize at the non represented end of the drum a device identical to the one shown in FIG. 3 except for the gear **18** and the chain **19** which can be omitted.

According to the arrangements shown in FIGURES 3 and 4 the transmission of the torque is effected by means of the tangential friction forces arising between the pneumatic ring **8** and the rigid members **9** and **10** surrounding and compressing the said ring.

The said tangential friction forces may be substantially increased by conveniently profiling the contact surfaces i.e. by providing the latter with ridges, facets, notchings and so on.

According to the present invention it also is possible to provide devices for the transmission of the torque without having tangential friction forces between the pneumatic rings **8** and the rigid elements **9** and **10** mounted thereon.

One of these devices is represented in FIGS. 5A and 5B wherein a portion of a self-propelled vibrating compressing roller is shown having a vibrating drum 13, an exciter 14, a shaft 15, bearings 16, a frame 17, a gear 18 and a chain 19 driving said gear. In this case the shaft 15 is fixed to a plate 20 on which four penumatic rings 8 are mounted (the number of these pneumatic rings could be chosen at will to be two, three or more than four). The rims 10 of said penumatic rings 8 are rigidly mounted on the plate 20, while the rigid outer element 9 is rigidly fixed to the vibrating drum 13. By applying a torque to the shaft 15 by a chain 19, the pneumatic rings 8 are not submitted to tangential forces but exclusively to radial forces as desired.

FIG. 6 shows a solution similar to the one of FIG. 5A except for the fact that a speed reduction group with consequent multiplication of the torque is provided on the frame 17 in close proximity to the vibrating drum 13. According to this arrangement the shaft 15 bears a gear 22 keyed thereon engaging a wheel pinion 21 mounted on a countershaft 23. The gear 18, driven by the chain 19, is keyed on said countershaft 23 and transmits the torque generated by the engine.

FIGS. 7A and 7B respectively show in horizontal and vertical section a device similar to the one shown in FIGS. 5 and 6 except for the fact that the pneumatic rings 8 are arranged on different planes so as to have a more compact group which may be placed within the inner part of a vibrating drum having a small diameter. In this case the plate 20 carries small studs 24 of different lengths for fixing the said plate 20 to the rims 10 of the pneumatic rings 8. In this case the transmission of the torque is effected through the studs 24 without having tangential friction forces on the contact surfaces between the pneumatic rings 8 and the rigid bodies 9 and 10 surrounding them.

According to the present invention the damping of vibration and the simultaneous transmission of the torque to a vibrating member is effected by a device shown in horizontal and vertical section in FIGS. 8A and 8B, wherein all the elements having similar functions are indicated by the same reference numerals used in the preceding figures. The vibrating drum 13 is in this case set into vibration by an exciter 14 which may be driven by the main engine of the machine in various ways (not shown) as for example by V belts or by electric means. A box 25 is arranged for keeping the bearings 26 mounted on the end of the vibrating drum 13 for the transmission of the torque, the said bearings 26 forming a rotating connection and engaging a projection 27 of the vibrating drum. A gear 18 contained in the box 25 is keyed on said projection 27, and engages a pinion keyed on the counter shaft 29, which is rotatably arranged in the box 25.

The gear 18, driven by the chain 19, is mounted on the outside of the box 25 but it is also keyed on the countershaft 29. The box 25 is kept in its position by the pneumatic rings 8, the rigid elements 9 of which are fixed to the plate 30 solidly connected with the box 25. The latter is therefore capable to vibrate together with the drum, while its rotation is impaired by the pneumatic rings 8. The countershaft 29 and the gear 18 on it also vibrate since they are mounted on the box 25. However since they are in an eccentric position with respect to the geometric axis of the vibrating drum they transmit to the chain 19 a very much reduced vibrational power, which is of an allowable magnitude. During the application of the torque to the vibrating drum, the box 25 is subjected to twisting reactions, which are counteracted by the pneumatic rings 8 in the form of forces which are directed radially with respect to them. The rims 10 of the rings 8 are fixed by means of studs 31 to the main frame 17.

In order to submit the said penumatic rings 8 to smaller radial stresses, whereby the torque remains equal, it is possible to realise an arrangement as shown in figures 9A and 9B which is similar to the preceding one, except for the fact that the plate 30 fixed to the box 25 is elongated so that the pneumatic rings 8 are at a greater distance from the geometric axis of the vibrating drum 13 and from the gear 8, thus projecting beyond the profile of said drum 13.

FIGS. 10A and 10B show a further embodiment wherein several pneumatic rings 8' are disposed in planes parallel to the axis of the vibrating drum 13 and are mounted as idlers on a transversal axis 32.

This arrangement has the advantage of better resisting to the axial displacement of the drum. The penumatic rings 8 and 8' also could be arranged on inclined planes forming any angle with the axis of the drum 13. Obviously in the devices shown in figs. 8A–8B; 9A and 9B; 10A and 10B a plurality of pneumatic rings may be provided without departing from the spirit of the present invention.

I claim:

1. A roller structure comprising a vehicle body; a vibrating roller; and a connection at each end of the roller mounting the roller for rotation with respect to the vehicle body and for limiting the transmission of vibration from the roller to the body; one of said connections comprising a pair of pneumatic toroidal rings each having an outer peripheral face and an inner peripheral face spaced apart perpendicularly with respect to the center axis of the toroidal ring, the axes of the toroidal rings being parallel with the axis of rotation of the roller and spaced-apart therefrom; a first member for each toroidal ring operatively connecting one peripheral face of the toroidal ring with the body; a second member operatively connecting the other peripheral face of each toroidal ring with plate means located between the body and roller; said first and second members being overlapped in spaced-apart relationship with a toroidal ring therebetween; a shaft connected to the roller extending outwardly therefrom and rotatably mounted on said plate means; and means for rotating said shaft and said roller.

2. A roller structure comprising a vehicle body; a vibrating roller; and a connection mounting the roller for rotation with respect to the vehicle body and for limiting the transmission of vibration from the roller to the body; said connection comprising three pneumatic toroidal rings each having an outer peripheral face and an inner peripheral face spaced apart perpendicularly with respect to the center axis of the toroidal ring; the axes of two of the toroidal rings being coaxially aligned and generally perpendicular to the axis of rotation of the roller; the axis of the other toroidal ring being coaxially aligned with the axis rotation of the roller; first means for operatively connecting one of the peripheral faces of each toroidal ring to the roller; second means for operatively connecting the other peripheral face of each toroidal ring with the body and rotatable about an axis coaxial with the axis of rotation of the roller; said first and second means having portions overlapped in spaced-apart relationship with the toroidal rings therebetween; and means for rotating the second means to in turn rotate the toroidal rings, the first means, and the roller.

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