A terminal of a pipe of the kind used for the evacuation of a motor fluid used to lubricate and/or cool the auxiliary systems of an internal combustion engine, for example a turbocharger. The purpose of the invention is to obtain an easily manufactured and assembled return pipe terminal with which it is possible to carry out the return of fluids at the outlet of the car’s engine block auxiliary devices (turbochargers, displacement compressors, etc.) in a more secure and watertight fashion. The pipe terminal includes improved means for the axial positioning thereof in the engine cylinder block or crankcase, which mainly comprises an abutment, a transition portion, and a coupling portion that connects the two parts.
PIECE FOR MOTOR FLUID RETURN AND ENTRY TO THE CRANKCASE

OBJECT OF THE INVENTION

[0001] More specifically, the invention relates to the terminal of a pipe of the kind used for the evacuation of a motor fluid used to lubricate and/or cool the auxiliary systems of the internal combustion engine (for example, a turbocharger), managing the output thereof from the auxiliary elements to the cylinder block of the internal combustion engine.

[0002] This pipe terminal, preferably metallic although it can be made of other materials, is coupled axially in a hole provided in the crankcase or engine block, so that once mounted part of the pipe lies on the outside of the engine block while another part remains on the inside of the engine block.

STATE OF THE ART

[0003] There are on the market, and can therefore be considered state-of-the-art of this invention, automobile components whose purpose is to establish a return system for motor fluid such as oil, between a turbocharger and the oil reservoir or crankcase of the car.

[0004] Usually, this motor fluid return system comprises two or more parts, whose purpose is to establish a sealed flow conduit between the outlet of the turbocharger and the inlet to the crankcase of the car. Turbochargers are attached solidly to the engine by appropriate means and the blades of their turbines and compressors can reach very high rotation speeds not necessarily synchronous with the alternative movements of the piston/crankshaft system. This mechanical decoupling subjects the return system to movements and vibrations, so the flexibility of this system is very important to prevent possible breakages.

[0005] European Patent no. 1,512,901 refers to a "Connection of a turbocharger evacuation channel to an engine crankcase by a flexible conduit and tubular rim", with the essential feature that this conduit is made of flexible material, and the rim incorporates means so that when the hole provided in the crankcase it remains axially stable.

[0006] European Patent no. 662,581 for "Conduit of a drainage pipe and a combination comprising an engine block, a turbocharger and a connection pipe", describes the essential feature of being formed by a flexible tubular member which is incorporated between a first member and a second member, with means of insertion at the end of this tubular member provided to prevent leakage.

[0007] French Patent no. 2,908,154, for "Lubricating device for turbocharger and assembly procedure for a lubrication pipe", also describes a device with the essential feature that the end of the coupling of at least one lubricating pipe on the turbocharger body should have a cylindrical funnel locked axially by a snap ring.

SCOPE OF THE INVENTION

[0008] The purpose of the invention is to obtain a tube for motor fluid return and entry to the crankcase with a simpler and more economic manufacturing and assembly system than existing systems or devices, and which facilitates the return of fluids (for example, oil or coolant) to the outlets of the engine block auxiliary devices (turbochargers, displacement compressors, etc.) of the car, in a more secure and watertight fashion.

[0009] Another purpose of the invention is to manufacture a pipe that includes the aforementioned pipe terminal, with a simpler and more economic manufacturing and assembly system than existing systems or devices.

[0010] Finally, another additional purpose of the invention is the provision of an element for supporting or retaining the external pipe on the cylinder block, which can be coupled with no possibility of rotation on the outer surface of the pipe terminal and adapted to stop against the front surface of the cylinder block.

DESCRIPTION OF THE INVENTION

[0011] The terminal of the pipe for motor fluid return and entry into the crankcase of this invention is characterized as defined in claim 1.

[0012] The invention describes an improved configuration of the terminal of the motor-block side of a pipe for motor fluid return and entry into the crankcase, which hereinafter we shall refer too simply as "pipe", which is preferably metallic, although it could possibly made from other materials with similar or equivalent properties, even flexible materials.

[0013] The pipe terminal is coupled to the aforementioned motor cylinder block or crankcase by partial insertion and axial coupling in a hole provided in the motor cylinder block by means of axial positioning means arranged on the outer surface of the pipe, while the inner part is formed or mechnized to achieve radial stabilization, thereby achieving optimal sealing of the upper surface of the pipe with the inner surface of the crankcase hole and also with the assistance of a sealing gasket.

[0014] The invention lies mainly in the particular and advantageous configuration of the means for the axial positioning of the pipe terminal in the motor cylinder block or crankcase, which are arranged on the outer surface of the tubular member and whose purpose is to ensure the coaxiality between the axis of the inner part of the tube and the crankcase housing.

[0015] According to the preferred embodiment of the invention, the axial positioning means comprise:

[0016] an abutment geometry with a larger diameter than that of the motor cylinder block hole, so that it rests on and makes contact with the front supporting plane of the motor cylinder block;

[0017] a transition portion with decreasing generatrix (with a decreasing angle α, with respect to the axial axis of the pipe) in direction towards the abutment geometry; this transition extends from the abutment geometry to the groove or housing for the gasket; and

[0018] a coupling portion with a curvature radius of R, which connects the aforementioned abutment geometry to the aforementioned transition portion.

[0019] Coaxiality is ensured by the presence of a flat area substantially perpendicular to the pipe axis and located in the abutment geometry profile, so that the flat contact against the front support plane of the motor cylinder block ensures coaxiality between the pipe axis and the axis of the housing in the block, the contact being large enough to maximize the bearing surface on the front face of the crankcase. However, since the wave of the abutment geometry is achieved by a process of deformation of the tubular member, its height is limited by the material used to make the pipe, such material being taken to the maximum of its capabilities, thus leaving a high level of residual stress in this wave. According to a
preferred embodiment of the invention, the flat perpendicular area has a an “X2” height of between 0.01 and 3 mm. [0020] The aforementioned abutment geometry need not necessarily be of revolution and presents a contact portion comparable to a substantially circular diameter revolution crown.

[0021] This contact portion by way of a crown, which is manufactured with a low level of residual stress, is achieved by providing the wave transition area with a very gentle radius, which we shall call R1, which is why it is necessary to have the presence of a negative angle α1 that generates a zone of decreasing generatrix in the direction of the wave, preferably frustoconical, between the abutment surface (i.e. the wave) and the innermost area of the seal housing.

[0022] The aforementioned decreasing angle α1 is preferably between 1 and 30 degrees.

[0023] Meanwhile, the R2 curvature radius of the coupling portion bordering with the wave is preferably between 0.1 and 5 mm, and its presence advantageously minimizes the risk of breakage by reducing local residual stress in this area and eliminating the stress concentrator effect.

[0024] On the other hand, in one of the possible embodiments of the invention, the transition portion with decreasing generatrix (with a decreasing angle α2 with respect to the axial axis of the pipe) in direction towards the contact portion or abutment, is substantially frustoconical.

[0025] Furthermore, according to a solution known on the market, the pipe terminal also comprises sealing means, such as a gasket to be placed in the corresponding groove or circumferential housing made at a point of the outer surface of the pipe terminal, so that said gasket is seated in said circumferential housing between the outer surface of the pipe terminal and the inner surface of the cylinder block or crankcase.

[0026] According to one option of the invention, the pipe terminal comprises at least one “X1” width guiding portion which performs the functions of guiding the inner area of the pipe in relation to its housing, limiting the compression or excessive distension of the gasket when in working condition (i.e. compressed). Because of the dispersions in mounting the rest of the pipe, this gasket may tend to be more compressed, or not uniformly compressed, and it will be this guiding portion that prevents compressions or distensions that may compromise water tightness or durability.

[0027] This guiding portion is preferably substantially straight and is adapted to make direct contact with the inner surface of the hole, which extends from the groove or housing of the gasket towards the end of the pipe, and this guiding portion extends towards the end of the pipe forming an end portion with a smaller diameter, the guiding portion being connected to the end portion (by a centring portion with decreasing generatrix angle α2).

[0028] This angle α2 is preferably between 10 and 45 degrees.

[0029] The purpose of this final substantially frustoconical centring portion is threefold:

- [0030] a). On the one hand, it facilitates the process of insertion of the pipe in its housing by serving to centre the insertion.

- [0031] b). Secondly, it facilitates the preassembly of the gasket in its housing groove, with no need for any special tool for assembly, allowing fully manual assembly. For this purpose the diameter of area X3 is planned to be smaller than the nominal inner diameter of the gasket, in order to avoid risk of contact between the gasket and the cutting edge of the termination of X3; therefore, the diameter is smaller and the angle α3 ensures that the process of mounting the gasket to the pipe can be done manually with no risk of damage by contact.

- [0032] c). Thirdly, the angle α3 acts as an anti-error system, so that if the gasket position is not completely correct throughout the 360° of its housing groove, the process of inserting the pipe in the crankcase housing would position the gasket completely in its groove (correct position), avoiding system seal failure.

[0033] Optionally, the pipe terminal can also comprise a second substantially straight guiding portion, which extends from the transition portion towards the groove or housing of the gasket, the second guiding portion being arranged between the transition portion and the groove or housing of the gasket.

[0034] The pipe terminal can also optionally incorporate an outer retainer bracket, which allows the attachment of said pipe to a fixed external point located on the cylinder block, relatively close to the connection point of the pipe.

[0035] Said outer retainer bracket consists of a single plate provided with a hole designed to surround the outer part of the pipe member, immobilized by one or more waves provided by way of projections in the so-called outer part of the pipe and of a larger diameter than the latter. Alternatively, this pipe-bracket attachment can be made by expanding the pipe against said internal diameter of the bracket hole, or by using known means of attachment, such as welding or adhesives.

[0036] According to a first solution, the pipe has a prolongation of the contact portion or abutment towards the end of the tube where a Groove is provided to receive the support piece which serves to secure the pipe to an external point located in the engine department.

[0037] According to one possible solution of the invention, the aforementioned contact hole has a non-circular perimeter, so that the pipe-support contact interface is not circular and prevents rotation of the support piece relative to the pipe terminal. It preferably comprises two opposing tangential lateral planes, so when the pipe terminal surface is surrounded (substantially cylindrical or elliptical) they prevent the rotation of the support piece relative to the pipe terminal.

[0038] On the other hand, according to a possible solution of the invention, the surface of the Groove of the pipe and that of the support hole have concordant lateral coupling geometries allowing maximum contact between the pipe surface and the support piece. To maximize contact between the surface of the pipe and that of the support piece, the radii of curvature R1 and R2 have the same or very similar value, as seen in detail "Z2".

[0039] The end portion or terminal of said pipe is obtained from the pipe itself, deforming it by cold deformation, using, but not exclusively, the manufacturing technique of “hydroforming”, or the axial or rotary forming technique (known as rolling in technical jargon).

[0040] Another purpose of the invention is to protect the assembly formed by the pipe with a pipe terminal with the characteristics described above, and the support piece with the characteristics described above.

[0041] Other details and characteristics shall be shown throughout the description below referring to drawings attached to this report which are shown for illustrative but not limiting purposes only in a drawing of the invention.
DESCRIPTION OF THE DRAWINGS

[0042] FIG. 1 is a longitudinal section elevation of a first embodiment of the pipe terminal (10) of the invention in which there is no support (11), which comprises the pipe terminal (10), whose end is inserted in the cylinder block or motor block (12) through the corresponding longitudinal hole (18), and with a single XI’ width guiding portion (20) between the pipe terminal (10) and the inner surface (31) of the aforementioned hole (18).

[0043] Detail “1” is a detailed view of FIG. 1, where you can clearly see the configuration of the abutment geometry (16).

[0044] FIG. 2 is a second embodiment of the invention also without any support (11), but in this case additionally incorporating a second XI’ width contact portion (28) between the pipe terminal (10) and the inner surface (31) of the aforementioned hole (18).

[0045] FIG. 3 is a longitudinal section elevation of a third embodiment of the invention, in which a retaining bracket (11) is incorporated as a separated piece to be coupled to said terminal (10), and with a single guiding portion (20) between the pipe (10) and the inner surface (31) of the hole (18) in the cylinder block (12).

[0046] Detail “2” is a detailed view of FIG. 3, where you can clearly see the configuration of the matching rounded edges of the bracket (11) hole (29) and the groove (23) of the pipe (10) terminal, with respective similar radii R₀ and R₁.

[0047] FIG. 4 is a view of the retaining bracket (11) S’-sectioned in FIG. 3, where the configuration of the bracket (11) hole (29) is clearly detailed, provided with flat lateral edges (30a, 30b).

[0048] Below is a list of the different parts of the invention, which are indicated in the above drawings with their respective numbers: (10) pipe terminal, (11) retaining bracket, (12) motor cylinder block, (14) groove or housing for the gasket, (15) cylindrical area, (16) abutment geometry against the front plan (25), (16) abutment geometry against the retaining bracket (11), (17) transition area, (18) hole of the cylinder block (12), (19) gasket, (20) “XI” width guiding portion, (21) centring portion, (22) end portion, (23) groove, (25) front support plan of the motor cylinder block (12), (26) coupling portion, (27) flat area perpendicular to the pipe axis in the abutment geometry (16), (28) second “XI” width guiding portion, (29) contact hole of the retaining bracket (11), (30a, 30b) opposing tangential lateral planes of the retaining bracket (11), (31) inner surface of the aforementioned hole (18).

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

[0049] In one of the preferred embodiments of the invention, and as can be seen in FIG. 1, the pipe terminal (10) has different areas or parts, whose configuration is described below, but which have been designed to be consistent with the goal pursued for each one.

[0050] The pipe terminal (10) is obtained by cold deformation machining by “hydroforming” or by rolling of the pipe itself, the whole thing therefore being a single piece.

[0051] According to FIG. 1, which corresponds to the first of the possible embodiments of the invention, the pipe terminal (10) has a portion “A” which we will call “the outer part”, which is the part which is located outside the hole (18) of the cylinder block (12) when the pipe is mounted in the cylinder block (12), and a portion “B” which we will call “the inner part”, which is the part that is inserted into the longitudinal hole (18) of said block (12). This outer part “A” and inner part “B”, as can be seen in detail “1-1” of FIG. 1, have axial positioning means formed by

[0052] an abutment geometry (16) that stops against the front plane (25) by way of a wave, and a larger diameter than the nominal diameter of the pipe (10).

[0053] a substantially frustoconical transition area or portion (17) that extends towards the inner area in a groove (14) of smaller diameter, as a means of housing aasket (19) to ensure sealing between part “B” and the hole (18) for the entry of the pipe (10) in said block (12); and

[0054] between said abutment geometry (16) and the transition portion (17), a curved coupling portion (26) with an R₂ curvature radius.

[0055] This substantially frustoconical transition portion (17) can be a totally frustoconical configuration area (i.e. a body of revolution, as shown in the attached figures), or with a substantially frustoconical configuration without total symmetry (a non-revolution body).

[0056] After the aforementioned groove (14) the pipe (10) extends at least for a substantially straight (i.e. cylindrical) guide portion (20) with a width of “XI”, which is adapted, in the case of decentering, to make direct contact with the inner surface of the hole (18), this guiding portion (20) extending towards the end of the pipe in a centring portion (21) with a decreasing frustoconical configuration with a decreasing generatrix angle α₀, which, in turn, extends towards a end cylindrical portion (22) with a smaller diameter than the hole (18) and a width of “X3”.

[0057] According to the second embodiment of the invention shown in FIG. 2, a second “XI” width cylindrical guiding portion (28) can also be included between the transition portion (17) and the groove (14).

[0058] Finally, according to a third embodiment of the invention, there is a retaining bracket (11) against which the aforementioned wave (16) abuts, this retaining bracket (11) being arranged with the inner part resting against the front plane (25).

[0059] As shown in FIG. 4, this retaining bracket (11) has a hole (29), for incorporation in a groove (23) present in the pipe terminal (10) between the wave (16) and the transition portion (17).

[0060] To improve retention against rotation between the bracket (11) and the pipe (10), the hole (29) and the contact area between pipe and bracket (23), the hole (29) preferably has a non-cylindrical geometry, which could be oval or trap- ezoidal among other possibilities. Especially advantageous is the configuration shown in FIG. 4, in which the hole (23) comprises two opposing lateral planes (30a, 30b) tangential to the nominal diameter of the pipe. In this case, for oval or elliptical geometries of the pipe (deliberately produced or resulting from a deformation process adjacent to a curve), the interference is maximized between the distance defined by the two tangential planes and the major axis of the quasi-elliptical geometry.

[0061] Moreover, to reduce the gap between the wave retaining elements (16) and the bracket (11), the bracket (11) hole (29) can present both surfaces in the rounded edges coinciding with the radius of the groove (23)—i.e. radii R₂ and R₃, respectively; these radii, R₂ and R₃ being substantially
the same size—, thereby ensuring the axial location and embedding of the bracket on the pipe, see detail “2” of FIG. 3.

[0062] Having sufficiently described this invention using the Figures attached, it is easy to understand that any changes judged to be suitable may be made, whenever these changes do not alter of the essence of the invention summarised in the following claims.

1. A pipe for motor fluid return and entry to a crankcase which connects an outlet of a lubricant or coolant circuit of an auxiliary device of an engine cylinder block to the cylinder block or crankcase, the return pipe comprising:
   at one of its ends a terminal (10) which is coupled to the engine cylinder block or crankcase (12) by its partial insertion and coupling in a hole (18) provided in the engine cylinder block (12), said pipe terminal (10) incl. and a positioning means for axial positioning thereof in the engine cylinder block or crankcase (12), said positioning means including
   an abutment geometry (16) with a larger diameter than that of said hole (18) in the motor cylinder block (12) so that it rests on and makes contact with a front supporting plane (25) of the motor cylinder block (12);
   a transition portion (17) with decreasing generatrix (with a decreasing angle \( \alpha \), with respect to the axial axis of the pipe) in a direction towards said abutment geometry (16); said transition portion (17) extending from said abutment geometry (16) to a groove or housing for a gasket (14); and,
   a coupling portion (26) with a curvature radius of \( R \), which connects said abutment geometry (16) to said transition portion (17).

2. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said abutment geometry (16) is a non-revolution crown.

3. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said abutment geometry (16) is a substantially circular diameter revolution crown.

4. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said abutment geometry (16) has a flat area substantially perpendicular to the pipe axis (27) which makes flat contact against the front support plane (25) of the engine cylinder block (12).

5. The pipe for motor fluid return and entry to a crankcase according to the claim 4, wherein said flat vertical area (27) has a height of X2 ranging from 0.01 to 3 mm.

6. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said transition portion (17) is substantially frustoconical.

7. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said decreasing angle \( \alpha \), is between 1 and 30 degrees 1 and 30 degrees.

8. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said \( R \), curvature radius of the coupling portion (26) is between 0.1 and 5 mm.

9. The pipe for motor fluid return and entry to a crankcase according to the claim 1, further comprising at least a substantially straight guiding portion (20) adapted, in the case of decentering, to make direct contact with an inner surface of said hole (18), which extends from said groove or housing of the gasket (14) towards the end of the pipe, said guiding portion (20) extending towards the end of the pipe forming an end portion (22) with a smaller diameter, said guiding portion (20) being connected to said end portion (22) by a centring portion (21) with decreasing generatrix angle \( \alpha \).

10. The pipe for motor fluid return and entry to a crankcase according to the claim 9, wherein said angle \( \alpha \), is between 10 and 45 degrees.

11. The pipe for motor fluid return and entry to a crankcase according to the claim 9, further comprising a second substantially straight guiding portion (28), which extends from said transition portion (17) towards said groove or housing of the gasket (14), said second guiding portion (28) being arranged between said transition portion (17) and said groove or housing of the gasket (14).

12. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein an extension of said abutment geometry (16) towards the end of the pipe a groove (24) is provided adapted to receive a support piece (11) for securing the pipe (10) to an external point located in the engine compartment, said support piece (11) being provided with a contact hole (29) within which said groove (24) is provided.

13. The pipe for motor fluid return and entry to a crankcase according to the claim 12, wherein a surface of said groove (24) in the pipe (10) and of said hole (29) in said support piece (11) have respective concordant lateral coupling geometries whose configuration is such that that contact between the pipe surface and said support piece (11) is maximized.

14. The pipe for motor fluid return and entry to a crankcase according to the claim 1, wherein said pipe terminal (10) is mechanized by cold deformation using (a) a “hydroforming” technique or (b) an axial or rotary (rolling) shaping technique.

15. A support piece adapted to be coupled to said pipe terminal (10) of the claim 1, wherein said support piece has a non-circular contact hole (29), so that the pipe-support contact interface is not circular.

16. The support piece according to the claim 15, wherein the non-circular perimeter of said contact hole (29) includes two opposing tangential lateral planes (30a, 30b), which prevent rotation of said support piece (11) relative to said pipe terminal (10).

17. A kit of pipe for motor fluid return and entry to a crankcase with support piece, the kit comprising a pipe with a pipe terminal (10) defined in the claim 1, and a support piece (11).

18. A kit of pipe for motor fluid return and entry to a crankcase with support piece, the kit comprising a pipe with a pipe terminal (10) defined in the claim 1, and a support piece (11) defined in the claim 15.

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