A rapid coupling (1) for threaded or profiled terminals (T), comprising: a central body (2) extending between an upper end (3) removably sealably connectable with the terminal (T), and a lower end (4), connectable with a fluid circuit, which enables, when the coupling is connected to a terminal, passage of the fluid between the circuit and the terminal; an engaging clamp (5) operatively associated to the central body (2) and operable at least between a first configuration, in which it is not engaged to the terminal and enables the coupling or decoupling of the central body to and from the terminal, and a second configuration, in which it is engaged, internally or externally, to the terminal and connects the central body thereto; activating means (30) movably active on the central body (2) and/or on the engaging clamp (5) such as to enable passing of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal. The engaging clamp (5) externally surrounds the central body and is made in a single piece, the engaging clamp (5) comprising a base collar (6) and a plurality of flexible elements (7) which extend axially on a same side as the collar in circumferentially flanked positions, the flexible elements being separated from one another by longitudinal slits (9).
“A RAPID COUPLING FOR THREADED OR PROFILED TERMINALS”

DESCRIPTION

Technical Field
The present invention relates to a rapid coupling for threaded or profiled terminals. In greater detail, the invention relates to a device for rapid coupling of an internally or externally threaded or profiled terminal to a utilizing circuit, such as a testing circuit or a supply circuit (typically a pneumatic, oil-dynamic, hydraulic circuit, etc.) or an apparatus. The rapid coupling is thus configured as a connecting end of the circuit or the apparatus which is to be connected to the threaded end.

Prior art
Numerous devices and machinery, such as motors, pumps, boilers, cylinders, are provided with inlet/outlet terminals by means of which they can be connected to supply or discharge circuits (parts of apparatus or plants), in which typically fluids are supplied and discharged such as gases (for example air or gas at certain pressures) or liquids (water, oil, fuel etc.). In some operating configurations, the devices and machinery require the respective terminals to be connected to and/or disconnected from the circuits: for example, during the operations of testing and/or setting up of a machine, the terminals of the machine have to be connected to determined circuits (for gases or fluids) of control and analytical apparatus which verify correct functioning thereof.

The connection of the terminals of the device or machinery to be tested is typically done by means of a thread or profiling of the terminal, able to couple with a counter-thread or counter-profile of a respective terminal of the circuit or apparatus to which the terminal of the machinery has to be connected. The terminals can be provided with a thread or a profile of a male or female type, destined to be connected to inlets/outlets of the circuit of a respectively female or male type. In substance, the terminals typically have the shape of a connector or nipple or threaded portion of tube, widely known in the hydraulic and plant sectors.

The connecting of the terminals is typically manually done, by an operator using spanners or other tools.
Note that the connection of the terminal must satisfy precise mechanical and structural requisites (stability, resistance to stress and vibrations, etc.) and, in numerous applications, it is further crucial for the connection to ensure the fluid seal (for example either pneumatic, hydraulic or oil-dynamic).

Also known are devices and components for connecting-up, specially designed to make the coupling of terminals to a circuit or machinery rapid. The function of these devices and components, known in the sector as rapid couplings, is to avoid the complex and laborious steps of traditional mounting, such as the screwing of the threaded parts or the predisposing of engaging elements. The couplings enable reducing the mounting and demounting operations to simple and rapid pushing or pulling actions of the connector in the terminal. Further, the attaching and demounting to and from the terminal are done selectively and guarantee a stable connection when the coupling is inserted in the terminal and an easy release of the coupling when it is to be de-connected from the terminal.

European patent EP 1186822 describes a rapid coupling comprising a tubular body defining an engaging mouth and an assembly of gripping jaws of the terminal to be connected, in which the tubular body has at least two identical incisions, on a same perpendicular plane to the axis of the body, defining at least two distinct windows of identical angular extension in the cylindrical wall of the tubular body, in proximity of the mouth; each of the jaws is shaped as a sector of a circular crown having an angular extension having complementary dimensions to the extension of the windows, so as to translate radially through a respective window, and has a profile that can operatively engage a certain profile of the terminal of the tube to be connected. The connector further comprises a circular containing spring of the distinct jaws partially housed in the circular grooves of the jaws, a seal gasket against which the end of the terminal abuts, an internal cylindrical body - supporting the gasket - axially sealedly slidable internally of the tubular body and compressing an internal spring when forcedly retracted from the terminal pushed against the gasket, and an external activating sleeve, pushed by a spring towards the mouth, having a conical terminal surface abutted against the external conical circular surface of the jaws.

A further type of rapid coupling is known from European patent EP 1876381, which describes a rapid coupling for threaded terminals comprising a connection for supplying a hydraulic or pneumatic fluid under pressure which passes through
a tubular chamber extending over a whole length of the rapid coupling. In this solution, at the end of the coupling facing towards the connection destined to receive the connector, an annular connecting body is provided composed of annular segment elements elastically joined with the aid of an elastic ring and presenting, internally or externally according to the type of terminal to be connected, a connecting thread or profiling of the terminal. The segments making up the connecting ring of the coupling are interchangeable, such as to realise rings suitable for different threads or profilings of the terminal to be connected.

In both the above-described solutions, the coupling necessarily comprises special engaging elements of the thread of the terminal, respectively represented by the jaws described in patent EP 1186822 and the annular body of the coupling of patent EP 1876381. The engaging elements are structured such as to pass between an inserting/deinserting configuration, in which the insertion or de-insertion of the end of the coupling in the terminal is allowed, and an engaged configuration, in which they grip on the thread or the profiling of the terminal such as to realize a stable connection between the coupling and the terminal. The Applicant has found that the solutions disclosed in the above patents exhibit drawbacks and are liable to improvement in various ways. Primarily, the rapid couplings described are, overall, structurally complex and characterised by a high manufacturing cost. In particular, the engaging elements of the rapid coupling to the thread of the terminal, respectively the jaws described in patent EP 1186822 and the annular body of patent EP 1876381, are complex and/or expensive to realize and/or difficult to assemble in the relative connector and/or can be affected by faults or malfunctions.

Further, in order to pass between the above-mentioned configurations of insertion/de-insertion and engaging the known engaging elements require appropriate elastic elements, such as recall springs or O-rings, which make the structure complex and/or susceptible to breakage and/or can cause losses of fluid. Additionally, the known rapid couplings, due to how the respective engaging elements are realized, exhibit the drawback of making the operations necessary for making the coupling suitable for a different terminal slow and/or complex; in other words the interoperability of the rapid coupling is made difficult and/or limited. Many of the known rapid couplings are also characterised by a poor grip of
the respective engaging elements on the thread or profiling of the terminal, as the engaging elements act only on a circumferentially smaller portion of the terminal.

A further drawback of the rapid couplings of known type is that the engaging elements to the thread of the terminal, i.e. the jaws of the patent EP 1186822 and the element in the shape of the annular segment which make up the annular body of patent EP 1876381, can, in use, displace circumferentially as they are maintained in position only - respectively - by the seatings and by an elastic ring; the displacements can near or distance two or more adjacent engaging elements to and from one another, along the circumference on which they are arranged.

However, a correct and stable circumferential positioning of the engaging elements is of fundamental importance for an optimal functioning of the rapid coupling with the threaded terminals, since each of the engaging elements exhibits a respective threaded portion such that overall the coupling exhibits a complementarily-shaped thread to the thread of the terminal to which the coupling is to be connected; thus, a displacement of the various engaging elements is translated into an imprecise conformation of the overall threading of the coupling, which for this reason will not be able to couple perfectly to the terminal, causing problems of mechanical seal of the connection and/or leakage of fluid.

In substance, the engaging elements of the rapid couplings of known type cannot guarantee the absence of leakage of fluid during the engaging and disengaging steps of the coupling and/or are not able to provide mechanical and seal performances necessary for special applications, for example applications in which the fluid passing between the connector and the terminal is high-pressure. The rapid coupling of known type can sometimes be subject to a drop in performance over time and/or mechanical wear phenomena. In addition, the rapid couplings of the prior art are characterised by a large overall volume.

A further drawback of the known couplings is represented by the difficulties of the connecting and/or disconnecting operations of the rapid coupling to and from the terminal, for example due to the high force to be applied to the connector to engage and/or disengage the threaded elements of the connector to and from terminal thread.

Aim of the invention

In this situation the objective at the base of the present invention, in its various aspects and/or embodiments, is to disclose a rapid coupling for threaded or profiled terminals which can obviate one or more of the cited drawbacks.

A further aim of the present invention is to provide a rapid coupling for threaded or profiled terminals characterised by a simple structure, which is rational and/or resistant to faults and/or is characterised by a modest manufacturing cost.

A further aim of the present invention is to provide a rapid coupling which enables performing the connecting and disconnecting operations to and from the terminal in a simple way, using only small forces and without the aid of spanners or special tools and/or without the need for specialised personnel.

A further aim of the present invention to provide a rapid coupling able to be used effectively also for applications which include passage between the coupling and the connected terminal of fluids having a high flow rate and/or pressure.

A further aim of the present invention is to provide a rapid coupling able to guarantee a connection - to a terminal - which is without fluid leakage in any working condition, both during the coupling step and for the whole duration of the fluid transit between the coupling and the connected terminal.

A further aim of the present invention is to realise a rapid coupling able to make the testing operations, including of a machine provided with a terminal for a passage of a fluid more rapid and/or characterised by a high level of precision and/or repeatability.

A further aim of the present invention is to provide a rapid coupling characterised by engaging means to the thread or profiling of the terminal that are structurally and functionally original.

Summary of the invention

These aims, and others besides, which will more fully emerge during the course of the following description, are substantially attained by a rapid coupling for threaded or profiled terminals according to one or more of the accompanying claims, each of which taken alone (without the relative dependencies) or in any combination with the other claims, as well as according to the following aspects and/or embodiments, variously combined, including with the above claims.
In a first aspect, the invention relates to a rapid coupling for threaded or profiled terminals, the rapid coupling comprising:
a central body having a longitudinal axis and extending between an upper end, destined to be removably sealedly connectable with the terminal, and a lower end, opposite the upper end, destined to be connected with a fluid circuit, the central body being configured such as to enable, when the coupling is connected to the terminal, passage of the fluid between the circuit and the terminal;
an engaging clamp operatively associated to the central body and operable at least between a first configuration, in which it is not engaged to the terminal and enables the coupling or decoupling of the central body to and from the terminal, and a second configuration, in which it is engaged, internally or externally, to the terminal and connects the central body thereto;
activating means movably active on the central body and/or on the engaging clamp such as to enable passage of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal.
In an aspect the engaging clamp externally surrounds the central body and is made in a single piece, the engaging clamp comprising a base collar and a plurality of flexible elements which extend axially on a same side as the collar in circumferentially flanked positions, the flexible elements being separated from one another by longitudinal slits.
In an aspect the engaging clamp is mounted above the central body in such a way as to freely rotate about the central body. The upper ends of the flexible elements of the engaging clamp can rotated together about the central body while maintaining the reciprocal position thereof. The solution guarantees the two connected tubes (terminal and circuit) can rotate one with respect to another while in any case guaranteeing the correct position of the ends and the grip and hold on the terminal.
In an aspect each flexible element is provided with a lower end, solidly constrained to the collar, and an upper end opposite the lower end and provided with an externally or internally threaded or profiled operating portion, destined to cooperate with a portion of a thread or a profiling of the terminal, the upper ends of the flexible elements realising overall a thread or profiling of the engaging clamp.
In an aspect the rapid coupling is provided with a main axis along which the coupling or decoupling of the rapid coupling in and from the terminal occurs, the terminal having a respective axis, when coupled, that coincides with the main axis. In an aspect, the engaging clamp has an overall shape which is substantially cylindrical and provided with a central axis coinciding with the main axis of the coupling.

In an aspect the longitudinal slits are realised by means of spark erosion or blade cutting of a single cylindrical body, or using other working methods that are more appropriate and/or advantageous.

In an aspect, the flexible elements are configured such as to flex radially with respect to the central axis of the engaging clamp by means of inclination of the respective upper end with respect to the respective lower end, solidly constrained to the collar, in such a way as to be orientated transversally with respect to the central axis.

In an aspect, the flexible elements are orientated transversally to the central axis of the engaging clamp when it is in the first configuration and are orientated substantially parallel to the central axis of the clamp when it is in the second configuration.

In an aspect, the flexible elements being configured so that the action of the activating means causes flexion thereof, and a consequent passage of the engaging clamps between the first and the second configurations.

In an aspect, the second configuration of the engaging clamp corresponds to a rest condition of the flexible elements, which are structured such as to be normally arranged parallel to the central axis of the clamp, and the first configuration of the engaging clamp corresponds to a stressed condition of the flexible elements, which are structured such as to generate, when arranged transversally to the central axis, an elastic force tending to cause a return to the rest condition. This means that, according to the geometry thereof, the flexible elements are normally maintained in flexion by the activating means of the rapid coupling, while when the flexible elements, by means of an appropriate action of the activating means, they are free to flex radially, and the automatically return into the axially aligned position, i.e. into the second configuration; this enables the "snap" insertion of the upper ends of the flexible elements into the thread or profiling of the terminal, and further enables a rapid deinsertion of the engaging clamp by means of a new
flexion of the flexible elements. Alternatively, in a different geometry realization, the flexible elements can be normally maintained in an aligned position by the activating means of the rapid coupling, such as to enable the insertion or deinsertion of the rapid coupling, and be brought into a radial flexion by means of an appropriate action of the activating means, into the second configuration.

In an aspect, each flexible element of the engaging clamp has a respective width calculated as a distance between two respective sides of the flexible element open on the two longitudinal slits adjacent to the element, the distance being preferably equal for each element of the plurality of flexible elements.

In an aspect, each flexible element occupies an angular sector of the collar equal to a first angle identified by the flexible element on a perpendicular plane to the central axis of the engaging clamp with respect to the central axis. In this way the flexible elements are angularly equally distributed along the circumference identified by the base collar.

The first angle is preferably less than 60°, more preferably less than 45°, by way of example about 30°. The selection of the first angle determines the number of longitudinal slits (and correspondingly cuts - or other operations - necessary for the realization thereof); the angle of 30° (by way of example) enables performing a limited number of cutting operations and, at the same time, realizing a sufficient number of flexible elements, able to guarantee an appropriate flexibility of the engaging clamp between the first and second configuration and an ease of use thereof. In some applications it can be appropriate to select a smaller value for the first angle, for example about 20°, with the aim of increasing the number of flexible elements.

In an aspect, the longitudinal extension of the flexible elements, from the respective lower end to the respective upper end, i.e. the extension of the longitudinal slits, is such as to enable the upper end to flex by a second angle, with respect to the central axis of the engaging clamp, sufficient to enable the engaging clamp, in the first configuration, to insert in or be extracted from the terminal without interfering with the threading or the profiling of the terminal. The second angle is preferably less than 10°, more preferably less than 6°, still more preferably less than 2°, so as to guarantee constant elastic return into the rest condition, i.e. into the second configuration of the engaging clamp.
In an aspect the flexible elements have a thickness, along the longitudinal development with the exception of the operating portion, such as to guarantee the necessary structural resistance of the engaging clamp and, at the same time, enable each flexible element to elastically flex, between the rest and stressed conditions, at least by the second angle.

In an aspect, the width of the flexible elements, and thus the angular sector occupied by each thereof, is such as to guarantee the flexible element an elasticity that is sufficient to enable a flexion by at least the same angle.

In an aspect, the operating portion of each flexible element projects, externally or internally with respect to the body of the respective flexible element, by an operating distance at least equal to the difference in diameter between a bottom surface and a crest surface of the terminal to be connected.

In this way during the step of inserting or de-inserting the flexible elements are radially broadened in an external direction or bent inwardly such that the operating portions do not interfere with the crest surface of the terminal; when the clamp passes into the second configuration, the flexible elements return into the rest condition and the operating portions engage the thread or profiling of the terminal.

In an aspect the operating portions of the flexible elements realize a thread or a profiling of dimensionally the same type as the profiling present on the terminal to be connected.

In an aspect, in the case of a rapid coupling for externally threaded or profiled terminals, the longitudinal slits between the flexible elements of the engaging clamp have a minimum width, preferably comprised between 0.05mm and 0.5mm, such that the flexible elements, when the engaging clamp is in the second configuration, are substantially laterally in contact with one another.

In an alternative aspect, in the case of a rapid coupling for internally threaded or profiled terminals, the longitudinal slits between the flexible elements of the engaging clamp have a minimum width, preferably comprised between 0.5mm and 2mm, such that the flexible elements, when the engaging clamp is in the second configuration, are laterally distanced from one another.

In an aspect, the single piece of the engaging clamp exhibits an incision which develops over the whole axial length of the clamp such as to enable a radial deformation of the single piece during the assembly.
In an aspect, the incision is defined by one of the slits which extends into the base collar.
The radial deformation of the incision enables radially dilating or contracting the clamp such as to house it in an annular incision fashioned in a body of the rapid coupling.

In an aspect, the activating means comprise an obturator slidably associated to the central body and mobile at least between a first position, in which it acts on the upper ends of the flexible elements of the engaging clamp, maintaining the engaging clamp in the first configuration (i.e. it presses on the flexible elements such as to maintain them in the stressed condition) and enabling the insertion and extraction of the central body into and from the terminal to be connected, and a second position, in which it does not act on the flexible elements of the engaging clamp, enabling passage into the second configuration (i.e. it enables the flexible elements to elastically return into the rest condition) and determining the engaging of the operating portions of the flexible elements to the threading or the profiling of the terminal.

In an aspect the passage of the obturator from the first to the second position undergoing by effect of the thrust exerted by an edge of the terminal on the obturator during the inserting of the rapid coupling into the terminal and corresponding to a lowering, along a parallel direction to the longitudinal axis of the central body of the obturator with respect to the central body.

In an aspect the central body or obturator, when the obturator is brought into the second position, provide a support to the engaging clamp which prevents it from returning into the first configuration.

In an embodiment, the rapid coupling is for internally threaded or profiled terminals. The obturator is positioned externally with respect to the central body and the engaging clamp is mounted such as to rotate freely on an intermediate body located between the central body and the obturator.

In an embodiment, the rapid coupling is for externally threaded or profiled terminals. The obturator is internally positioned with respect to the central body and the engaging claim is mounted such as to rotate freely on the central body and about the obturator.
In an aspect, a washer is operatively active on the upper ends of the flexible elements and axially mobile with respect to an engaging clamp and the central body.

In an aspect, the washer is axially mobile with respect to the obturator.

In an aspect the obturator is provided with a washer, by means of which it acts on the upper ends of the flexible elements of the engaging clamp, the washer being a distinct body slidably mounted on the obturator and retained abuttingly thereon by means of an elastic element, such that a thrust exerted thereon by the terminal on the obturator causes a compression of the elastic element by the washer and a detachment, by axial sliding, thereof by the obturator, the detachment being functional such as to enable complete transfer of pressure from the obturator to the terminal to be connected without the engaging clamp being subjected to traction loads.

The washer further enables more precise and effective opening or closing movements of the upper ends of the flexible elements on the terminal.

In an aspect, an engaging edge of the washer facing towards the upper end exhibits a conical entry able to centre the washer on the terminal during coupling.

In an aspect, the rapid coupling comprises a relief located at the upper end, which opposes head-on the flexible elements engaged on the thread portion or the profile of the terminal. The flexible elements engage the thread of the terminal and are opposed "head-on" by the relief.

In this condition the whole engaging clamp, placed under mechanical stress in working conditions, is only compression-stressed, thus guaranteeing the best mechanical seal results when the rapid coupling transmits a fluid at high-pressure.

In an embodiment, the relief is fashioned in the top of the central body.

In an embodiment, the rapid coupling comprises a body external of the central body and the relief is fashioned on the top of the external body.

In an embodiment, the rapid coupling comprises an auxiliary collar external of the central body and the relief is fashioned on the top of the auxiliary washer.

In an aspect the activating means are configured such that when the coupling is connected to the terminal the fluid pressure crossing the coupling determines a pressurization internally of the coupling which guarantees the hermetic seal between the rapid coupling and the terminal; in particular, this pressurization is directly proportional to the working pressure of the fluid.
In an aspect, the activating means comprise a pin, solidly constrained to the central body, and a slot, the pin being configured such as to cooperate with the slot between an unblocked configuration, in which the pin is inserted in the slot in such a way as to enable sliding of the activating means with respect to the central body in an inserting and de-inserting direction, and a blocked configuration in which the pin is inserted in the slot in such a way as to prevent sliding of the activating means with respect to the central body in the deinserting direction, the passage between the configurations occurring by means of at least a rotation of the central body about the longitudinal axis.

In an aspect, the activating means are configured such as to enable deinsertion of the rapid coupling from the terminal only when the pressure internally of the rapid coupling, due to the fluid passing between the coupling and the terminal, is unloaded.

The Applicant believes that the combination of the above-described technical characteristics enables obtaining numerous advantages. Primarily, the described coupling, in particular the engaging clamp in a single piece, enables reducing the manufacturing costs with respect to the known solutions, providing a simple and extremely functional mechanical structure. Further, the Applicant has found that the conformation of the flexible elements, inferiorly solidly constrained to the base collar and superiorly free, enables having an engaging clamp able to autonomously position, by effect of the elasticity of the flexible elements, in a configuration which guarantees the grip on the thread or profiling of the terminal without any need for further components or operations. The engaging clamp described also does not require further elastic elements (for example O-rings or recall springs), either for assembly thereof or for gripping onto the terminal.

A further advantage of the described solution lies in the rapid interchangeability of the engaging clamp, which enables an easy use of the coupling with terminals of various diameters and/or threads and/or profiling. Further, a same engaging clamp can be advantageously used, without any structural modification, with both threaded terminals and with like profiled terminals. Further, the rapid coupling is characterised by an extreme ease and rapidity of assembly, in particular in relation to the mounting of the engaging clamp internally of the rapid coupling.

An important advantage obtained by the present invention consists in the high precision of the positioning of the engaging clamp with respect to the thread or
profiling of the terminal, which guarantees a high degree of safety of the coupling-terminal connection obtained.

The described solution also enables obtaining a connecting of the coupling to the terminal substantially along the whole threaded or profiled interface of the terminal (i.e. the circumferentially about the whole terminal); in particular in the case of externally-threaded terminals the connection is almost total.

A further advantage of the described solution consists in the high mechanical seal of the coupling/terminal connection and in the absence of losses and/or leaks of fluid, as will be more clearly explained in the detailed description that follows of the functioning of the rapid coupling. A further advantage lies in the dimensions of the engaging clamp, extremely compact, with a consequent overall reduction of the volume of the rapid coupling.

A further advantage obtained by means of the present solution consists in the precise and stable circumferential positioning of the flexible elements (each bearing a portion of thread or profiling); in fact all the flexible elements are inferiorly connected, and in a piece, with the base collar. This prevents possible circumferential displacements between adjacent flexible elements, guaranteeing that the thread or the profiling of the engaging clamp is overall, in any operating condition, perfectly complementarily-shaped to the thread or profiling of the terminal.

The present solution further guarantees a secure grip and a seal of the engaging claim on the terminal even in the presence of relative rotations between the tube of the terminal and the tube of the circuit due to the possibility given the terminal and the engaging clamp closed thereon to rotate with respect to the central body solidly with the tube of the circuit. Differently, the jaws of the prior document EP2439440 cannot rotate as they are guided in respective longitudinal grooves as also are the jaws of document US 2004/0000788. The jaws of the clamps of document US 3,039,794 cannot rotate because the clamp is screwed on the tubular body thereof. Lastly, the gripping element of the clamp of US 5,927,683 do not rotate together because they are distinct elements held together only by an annular spring, so that the circumferential position thereof is variable and does not enable guaranteeing a constantly correct grip on the terminal.

Also worthy of note is the fact that none of the prior documents exhibits a clamp in a single piece with an incision for facilitating the mounting thereof.
Also noteworthy is the fact that none of the prior documents shows a washer acting on the upper ends of the flexible elements of the engaging clamp. Further, note that none of the prior documents exhibits a relief acting head-on on the terminals of the engaging clamps.

In an independent aspect, the present invention relates to a method for realising a rapid coupling for threaded or profiled terminals comprising steps of:
- predisposing a central body extending along a longitudinal axis between an upper end, destined to be removably sealedly connectable with the terminal, and a lower end, opposite the upper end, destined to be connected with a fluid circuit, the central body being configured such as to enable, when the coupling is connected to the terminal, the passage of the fluid between the circuit and the terminal;
- realising an engaging clamp;
- associating the engaging clamp to the central body and operable at least between a first configuration, in which it is not engaged to the terminal and enables the coupling or decoupling of the central body into and out of the terminal, and a second configuration, in which it is engaged, internally or externally, to the terminal and connects the central body thereto;
- predisposing activating means movably active on the central body and/or on the engaging clamp such as to enable passage of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal.

In an aspect according to the preceding aspect, the step of realizing an engaging clamp comprises steps of:
- predisposing a tubular cylindrical body in a single piece;
- realising a base collar of the engaging clamp at a lower end of the cylindrical body;
- threading or profiling an upper end of the cylindrical body;
- longitudinally cutting the cylindrical body starting from the upper end up to inferiorly reaching the base collar, such as to realise a plurality of flexible elements extending axially from the collar in circumferentially flanked positions and separated from one another by longitudinal slits.

In an aspect, the engaging claim is associated to the central body such as to rotate freely about the central body.
In an aspect according to one or more of the preceding aspects, during the step of longitudinally cutting the cut is preferably realised by spark erosion (or by means of other working methods that are more appropriate and/or advantageous).

In an aspect according to one of the three preceding aspects, in the step of realising an engaging clamp, the tubular cylindrical body is made of a material having such properties, and being of such a width, as to enable the flexible elements to flex radially with respect to a central axis of the engaging clamp by means of an inclination of a respective upper end with respect to a respective lower end, solidly with the collar, such as to be orientated transversally with respect to the central axis.

With particular reference to the manufacturing method of a rapid coupling, the Applicant has verified that the steps described in the above aspects of the method enable realising a rapid coupling of the above-described type, and in particular enable realising an engaging claim provided with the technical characteristics as illustrated above.

**Brief description of the drawings**

Further characteristics and advantages will more fully emerge from the detailed description of some embodiments, among which also a preferred embodiment, by way of non-exclusive examples, of a rapid coupling for a threaded or profiled terminal according to the present invention. This description will be set out in the following with reference to the accompanying drawings, provided purely by way of non-limiting example, in which:

- figures 1a-1d illustrate a first example of an engaging clamp which is a part of a possible embodiment of a rapid coupling according to the present invention, for connection to an externally-threaded terminal;
- figures 2a-2b illustrate a second example of an engaging clamp, which is a part of a further possible embodiment of a rapid coupling according to the present invention, for connecting to an internally-threaded terminal;
- figure 3 illustrates three possible embodiments of the engaging claim of figures 2A-2E;
- figures 4a-4d illustrate a third example of an engaging clamp, which is a part of a further possible embodiment of a rapid coupling according to the present invention, for connecting to an externally-threaded terminal;
- figures 5a-5d illustrate a fourth example of a rapid coupling, which is a part of a further possible embodiment of a rapid coupling according to the present invention, for connecting to an internally profiled terminal;
- figure 6 shows three possible embodiments of the engaging clam of figures 5A-5E;
- figures 7-7a, 8-8a, 9-9a, 10 and 11 illustrate a rapid coupling according to the present invention for connecting to an internally threaded or profiled terminal and the functioning thereof;
- figures 12-12a, 13-13a, 14-14a, 15 and 16 illustrate a further rapid coupling according to the present invention for connecting to an externally threaded or profiled terminal, and the functioning thereof;
- figures 17-17a, 18-18a, 19-19a and 20 illustrate a further embodiment of a rapid coupling according to the present invention for connecting to an externally threaded or profiled terminal, and the functioning thereof;
- figures 21a and 21b illustrate a further example of an engaging clamp;
- figure 22 illustrates an embodiment of a rapid coupling element of the invention.

Description of the preferred embodiments of the invention.

With reference to the accompanying figures, a rapid coupling according to the present invention is denoted in its entirety by reference number 1. In general, the same reference number is used for identical or similar elements, possibly in the variants thereof.

The rapid coupling 1 of the present invention is a rapid attachment developed for rapidly realising the connecting and disconnecting operations directly on the terminals T, either threaded or profiled, preventing laborious manual locking operations with spanners or other tools, and guaranteeing both the mechanical seal and the hermetic seal.

The terminal T is a connection, a portion of tube or a sleeve. In the figures reference is made, by way of example, to a tubular connection (exhibiting an internal thread, or female) and a nipple (exhibiting an external thread, or male).

The rapid coupling described is to be connected, at an upper end, to the terminal T and to be connected, at a lower end, to a fluid circuit which is to be connected to the terminal, so that the fluid is injected into the terminal from the circuit and/or exits from the terminal towards the circuit.
The terminal T can belong to a large variety of devices or machinery; for example, it can be an inlet and/or outlet terminal which is a part of a boiler, a radiator, a tank, a motor, a pump, a hydraulic or pneumatic cylinder, a valve, etc. According to the type of machinery, the terminal is destined to be connected to a water, air, oil, gas, fuel terminal, etc.

The rapid coupling 1 enables the circuit-terminal connection rapidly and easily and is advantageously usable for example where it is intended to carry out functional tests on machinery which require the connection to pneumatic/oil-dynamic/hydraulic circuits. This testing can be done for example at the end of the productive cycle of the machinery or during the setting-up thereof; it can also be automated along a production line, internally of which one or more terminals of the machinery are headed by means of the connection to a fluid circuit. In particular, the rapid coupling of the present invention, by way of the adopted constructional choices, is usable for a very broad range of uses in which pressure and fluid flow rate can vary from very modest levels to very high levels.

The rapid coupling 1 comprises a central body 2, having a longitudinal axis 2a and extending between an upper end 3, destined to be removably sealedly connectable with the terminal T, and a lower end 4, opposite the upper end 3, destined to be connected with a fluid circuit, the central body 1 enabling, when the coupling is connected to the terminal, passage of the fluid between the circuit and the terminal. The circuit is not shown in the figures as it is of known type; the lower end 4 of the central body is provided with appropriate means, such as a thread, for connecting the coupling to the circuit. The rapid coupling 1 comprises an engaging clamp 5 operatively associated to the central body 2 and operable at least between a first configuration, in which it is not engaged to the terminal and enables the coupling or decoupling of the central body to and from the terminal, and a second configuration, in which it is engaged to the terminal and connects the central body thereto. The coupling 1 further comprises activating means 30 movably active on the central body 2 and/or on the engaging clamp 5 such as to enable passage of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal.

With reference to figures 1a-1d, 2a-2d, 3, 4a-4d, 5a-5d and 6, the engaging clamp 5 which with the coupling engaged externally surrounds the central body 2 is
made in a single piece, and comprises a base collar 6 and a plurality of flexible elements 7 which extend axially on a same side as the collar in circumferentially flanked positions, the flexible elements being separated from one another by longitudinal slits 9.

Each flexible element 7 is provided with a lower end 7a, solidly constrained to the collar 6, and an upper end 7b opposite the lower end and provided with an threaded or profiled operating portion 8, able to cooperate with a portion of a thread or a profiling of the terminal T, the upper ends 7b of the flexible elements realising overall a thread or profiling of the engaging clamp 5.

The rapid coupling 1 is provided with a main axis P along which the coupling or decoupling of the rapid coupling in and from the terminal occurs, the terminal T having a respective axis, when coupled, that coincides with the main axis P. The engaging clamp, as can be seen in the figures, has an overall shape which is substantially cylindrical and provided with a central axis C coinciding with the main axis P of the coupling.

The flexible elements 7 are structured such as to flex radially with respect to the central axis C of the engaging clamp by means of inclination of the respective upper end 7b with respect to the respective lower end 7, solidly constrained to the collar 6; in this way they are orientated transversally with respect to the central axis C.

In greater detail, the flexible elements 7 are orientated transversally to the central axis C of the engaging clamp 5 when it is in the first configuration and are orientated substantially parallel to the central axis of the clamp when it is in the second configuration. The flexible elements 7 are structured so that the action of the activating means 30 causes flexion thereof, and a consequent passage of the engaging clamps between the first and the second configurations.

With particular reference to figures 1a, 2a, 4a and 5a, the second configuration of the engaging clamp 5 corresponds to a rest condition of the flexible elements 7, which are structured such as to be normally arranged parallel to the central axis C of the clamp, while the first configuration of the engaging clamp corresponds to a stressed condition (i.e. inclined) of the flexible elements, which are structured such as to generate, when arranged transversally to the central axis, an elastic force tending to cause a return to the rest condition. In other words, the flexible elements are inferiorly constrained to the collar 6 and superiorly free: they behave
as slim blades normally vertical (for forming a three-dimensional cylindrical clamp) but at the same time flexible; when bent, the blades behave as a "spring", i.e. - in the absence of means maintaining them bent - autonomously return into a substantially vertical position.

Each flexible element 7 of the engaging clamp 5 has a respective width calculated as a distance between two respective sides of the flexible element open on the two longitudinal slits 9 adjacent to the element; as shown in the figures, the distance is preferably equal for each element of the clamp. Likewise, each flexible element 7 occupies an angular sector of the collar equal to a first angle A identified by the flexible element on a perpendicular plane to the central axis C of the engaging clamp with respect to the central axis. The first angle is preferably the same for each flexible element, such that all the flexible elements are angularly equally distributed along the circumference identified by the base collar. The first angle is for example about 30°.

The longitudinal extension of the flexible elements 7, from the respective lower end 7a to respective upper end 7b, or likewise the extension of the longitudinal slits 9, is such as to enable the upper end to flex by a second angle B, with respect to the central axis C of the engaging clamp 5; this angle is the minimum angle enabling the engaging clamp 5, in the first configuration, to insert in or be extracted from the terminal T without interfering with the threading or the profiling of the terminal. The second angle B is preferably less than 10°, more preferably less than 6°, still more preferably less than 2°, so as to guarantee a constant elastic return into the rest condition, i.e. in the second configuration of the engaging clamp.

The flexible elements 7 have a thickness, along the longitudinal development (with the exception of the operating portion 8, wider as illustrated in the following) such as to guarantee the necessary structural resistance of the engaging clamp and, at the same time, enable each flexible element to elastically flex, between the rest and stressed conditions, at least by the second angle B.

The flexible elements, along the relative longitudinal extension, can have a variable thickness. For example, they can have a lower thickness for a first portion at the respective lower end 7a (solidly constrained to the base collar), such as to facilitate the flexion thereof with respect to the central axis C of the clamp, and a greater thickness (for example double with respect to the smaller thickness) for a
second portion of longitudinal development, extending for example over the
remaining part of longitudinal extension of the flexible element (from the upper
end of the first portion - of smaller thickness - up to the respective upper end 7b),
such as to guarantee a correct mechanical resistance of the flexible element and
preventing it from stripping following a flexion or several successive flexions.
Figures 1a-1d illustrate an example of engaging clamps for connecting to an
externally-threaded terminal. The collar 6, the flexible elements 7 and the terminal
T provided with an external thread F1 can be observed. In particular, figure 1a
shows the clamp 5 in the first configuration (with the flexible elements bent
towards the outside), figures 1b and 1c show the clamp in the second
configuration (with the flexible elements in the rest condition), and figure 1d shows
the clamp connected to the terminal, i.e. with the operating portions of the flexible
elements splined on the external thread F1.
Figures 2a-2b illustrate an example of an engaging clamp for connecting to an
internally-threaded terminal. The collar 6, the flexible elements 7 and the terminal
T provided with an internal thread F2 can be observed. In particular, figure 1a
shows the clamp 5 in the first configuration (with the flexible elements bent
internally), figures 1b and 1c show the clamp in the second configuration (with the
flexible elements in the rest condition) and figure 1d shows the clamp connected to
the terminal, i.e. with the operating portions of the flexible elements splined on the
internal thread F2.
Figure 3 shows three different embodiments of an engaging clamp 5 for an
internally-threaded terminal: on the right side of each clamp the flexible element is
shown in the rest condition, while on the left side it is shown in the stressed
condition (inclination towards the inside). The figure illustrates how the flexion
conditions of the engaging clamp vary on the variation of the length of the
longitudinal slits 9 between the flexible elements 7. It is clearly seen how for each
different length of the slit (and the flexible elements) corresponds to a different
second angle B defined by the flexion to which the single flexible elements are
subjected. The Applicant has verified that on increasing the length of the
longitudinal slits (and the flexible elements separated thereby) diminishes more
than proportionally to the value of the second angle B, and thus the entity of the
flexion of the flexible elements between the engagement and the release of the
rapid coupling; a smaller angle over time better guarantees the following
mechanical characteristics: less effort in the steps of insertion/de-insertion, greater duration over time of the clamp (without breakages or reduction in performance), greater elasticity of the single flexible elements, better self-adaptability of the engaging clamp with respect to the terminal to be connected.

Like considerations can be made for an externally-threaded terminal.

Figures 4a-4d illustrate an example of an engaging clamp for connecting to an externally-profiled terminal; the figures are entirely similar to figures 1a-1d, except for the type of terminal, which is profiled rather than threaded. A terminal T of a profiled type comprises, at the opening thereof which receives the connector, an external profiling S1 which provides at least a gripping surface for the engaging clamp. In this case the profiling consists of an annular connecting protrusion, which realizes an undercut beyond which the operating portions of the flexible elements abut so as to effect the grip of the connector on the terminal. Note that the operating portions do not cooperate at the same level as the profiling (as instead occurred in the case of the threaded terminal) but beyond the profiling; this enables using the clamp for terminals that are either externally threaded or internally threaded.

Figures 5a-5d illustrate an example of an engaging clamp for connecting to an internally-profiled terminal; these figures are entirely similar to figures 2a-2d except for the type of terminal, which is profiled instead of threaded. In this case the internal profiling S2 consists in an annular protrusion internally of the terminal, which realizes an undercut beyond which the operating portions of the flexible elements abut to effect the grip of the connector on the terminal. In this case too, note that the operating portions do not cooperate at the same level as the profiling but beyond it; this enables using the same clamp for terminals that are either internally threaded or internally profiled.

Figure 6 represents three different embodiments of an engaging clamp 5 for an internally-profiled terminal; the figure is alike to figure 3 and shows the variation of the flexion conditions of the engaging clamp on varying the length of the longitudinal slits 9 between the flexible elements 7; for this type of clamp the same considerations are made with reference to the clamps for the threaded terminal are valid.

The operating portion 8 of each flexible element projects, externally or internally (according to the type of terminal to be connected) with respect to the respective
flexible element (i.e. with respect to the minimum thickness of the flexible element along the longitudinal development thereof between the lower and upper ends) by an operating distance at least substantially equal to the difference in diameter between a bottom surface 11 and a crest surface 12 of the terminal to be connected.

In the case of the threaded terminal, the bottom 11 and crest 12 surfaces correspond to the envelopment of the valley and crests of the thread; in the case of the profiled terminal, the bottom surface 11 and crest surface 12 correspond respectively to the terminal surface corresponding to the rated diameter and the protrusion (external or internal) which realizes the shaping of the terminal.

Naturally the operating portions 8 of the flexible elements 7 realise a thread or a profiling dimensionally of the same type as the one present in the terminal to be connected, such that when the flexible elements go into the rest condition, the operating portions perfectly engage the thread or the profiling of the terminal.

Note that figures 4a-4d, 5a-5d and 6 show how, even by considerably modifying the type of the terminals to be connected (passing from threaded terminals to profiled terminals) it is possible to obtain the same results with practically identical engaging clamps to those described in figures 1a-1d, 2a-2d and 3. The only peculiarities to be considered are the following: it is not necessary that the operating portions of the flexible elements are threaded; the operative distance must be specially calculated to enable correctly receiving the profile of the terminal to be connected.

In the case of a rapid coupling for threaded or externally-profiled terminals (see in particular figures 1b, 1d, 4b, 4d), the longitudinal slits 9 between the flexible elements 7 of the engaging clamps have a minimum width, preferably comprised between 0.05mm and 0.5mm, such that the flexible elements, when the engaging clamp is in the second configuration, are substantially laterally in contact therewith. In this case, in fact, the flexion of the flexible elements occurs in a radial opening direction of the engaging clamp (i.e. in an external direction); this opening is allowed by the slits although they have a small width. The small thickness of the slits enables realizing a connection of the engaging clamp to the terminal having an optimal fluid seal, almost total; this is particularly significant in the cases in which the rapid coupling is subjected to very high fluid working pressures and/or in
the case of connection with terminals realized in particularly light materials (for example light alloys or plastics).

Alternatively, in the case of a rapid coupling for internally threaded or profiled terminals (see in particular figures 2b, 2d, 5b, 5d), the longitudinal slits between the flexible elements of the engaging clamps have a minimum width, preferably comprised between 0.5mm and 5mm, so that the flexible elements, when the engaging clamp is in the second configuration, are laterally distanced from one another. In this case, in fact, the flexion of the flexible elements occurs in a radial closing direction of the engaging clamp (i.e. in an internal direction); the closure is allowed by the lateral distance between the flexible elements defined by the slits, which avoids an impact between contiguous flexible elements by reason of dimensional interference. In substance, the minimum width value of the slits must be as small as possible but functional so as to enable flexion in an internal direction, without collisions, of the single flexible elements.

In a possible embodiment, relating to externally-threaded or profiled terminals, the flexible elements of the engaging claim each comprise a blocking portion projecting externally of the flexible element from the opposite side with respect to the operating portion. In this way the flexible elements overall realize an annular protrusion externally of the clamp, which is able to cooperate with a blocking band which externally envelops the claim and, pressing on the blocking portions of the flexible elements, avoids, in the inserting condition of the connector in the terminal, the opening of the flexible elements. The blocking band constitutes a further guarantee of a seal of the connector on the terminal.

The engaging clamp illustrated in figures 21a and 21b is similar to the one of figures 1a-1c but exhibits an incision 100 which develops over a whole axial length thereof, interrupting the circumferential continuity of the collar 6 too.

This discontinuity enables a radial deformation (contraction or expansion) of the clamp 5.

The width of the incision is preferably such as to enable a radial contraction of the clamp 5 with the aim of inserting the collar 6 in an radially internal annular cavity of a rapid coupling 1 and thus eliminate removable blocking elements, such as Seeger rings or the like.

The described engaging clamp is made (for example by means of the above method) preferably starting from a rough tubular element, or a solid piece, by
means of mechanical working on a machine tool. The engaging clamp is preferably made of metal material, for example made of steel, such as steel for springs.

In the following the overall functioning of the rapid coupling 1, in some embodiments according to the present invention.

Primarily, the coupling of the present invention is manually activatable; however it can be activated by means of appropriate coupling/decoupling devices destined to position the rapid connector with respect to the terminal and to act on the activating means; in this way the connecting or de-connecting operations can occur in an automated way (for example along a production/testing line) by servo-assisted activation (for example electrical, pneumatic means etc.).

In general, the activating means 30 comprise an obturator 31 slidably associated to the central body 2 and mobile at least between a first position, in which it acts on the upper ends 7b of the flexible elements 7 of the engaging clamp 5, maintaining it in the first configuration (i.e. it presses on the flexible elements to maintain them in a stressed condition) and enabling insertion of extraction of the central body into and from the terminal to be connected, and a second position in which it does not act on the flexible elements of the engaging clamp enabling passage into the second configuration (i.e. it enables the flexible elements to return elastically into the rest condition) and determining the engaging of the operating portions of the flexible element to the thread or profile of the terminal.

The passage of the obturator 31 from the first to the second position is done by effect of the push exerted by an edge of the terminal T on the obturator during insertion of the rapid coupling 1 into the terminal and corresponds to a lowering, along a parallel direction to the longitudinal axis 2a of the central body of the obturator with respect to the central body. According to the type of coupling (designed for a determined type of terminal), the central body 2 or the obturator 31, when the obturator is brought into the second position, provide a rest for the engaging clamp 5 which prevents it from returning into the first configuration thereof.

Figures 7-7a, 8-8a, 9-9a, 10 and 11 illustrate the functioning of a rapid coupling for internally-threaded or profiled terminals.

Figures 7 and 7a show the rapid coupling 1 in normal rest conditions (i.e. distanced from the terminal); in this case the obturator 31 is positioned externally
of the central body. Observe that the washer 32 forces the flexible elements of the
clamp 5 in the closed position, i.e. subjected to flexion towards the inside of the
clamp. This condition enables inserting thereof without any force in the rapid
coupling internally of the threaded terminal to be inserted. Figures 8 and 8a show
the rapid coupling at the start of the inserting operation, i.e. with the terminal
located in contact with the obturator 31. By forcing the penetration of the coupling
into the terminal there is a sliding downwards of the obturator 31, which in turn
draws with it, downwards, the washer 32. As can be seen in figures 9 and 9a, as
the obturator 31 lowers to a point that the washer 32 slides below the operating
portion (threaded) of the flexible elements 7, two effects occur, practically
simultaneously: the flexible elements 7 are freed, by effect of the elasticity thereof,
to move into the rest position and thus the grip of the thread of the terminal, and
the central body 2, by effect of a first spring 33, slides downwards, providing a safe
and irreversible rest for the flexible element as soon as they encounter the
reciprocal portion of threading of the terminal.

The seal ring 34, destined to effect the hermetic seal between the rapid coupling
and the terminal, is maintained under pressure (between the terminal and the
obturator) and therefore in sealed conditions thanks to the following factors: the
initial elastic force exerted by a second spring 35 (interposed between the
obturator 31 and an intermediate body 36) and a pressurization which occurs
internally of the coupling and which propagates through passage holes 48 which
place the activating means directly in connection with the pressure of the fluid
crossing the coupling.

Note further that the obturator 31, not being rigidly connected to the sleeve 32,
makes possible a sliding downwards of the washer with respect to the obturator,
functional such as to enable complete transfer of pressure from the washer 32
towards the terminal to be connected without the flexible elements being subjected
to damaging traction loads. In substance, the flexible elements 7 engage the
thread of the terminal and are opposed head-on by a relief 3a fashioned in the top
of the central body 4.

In this condition the whole engaging clamp 5, placed under mechanical stress
when working, is only compressively stressed, thus guaranteeing the best
mechanical results even when the rapid coupling transmits a fluid at high pressure.
The overall seal of the rapid coupling 1, which enables propagation internally thereof of the correct fluid working pressure, is guaranteed by the seal rings 37 and 38, respectively between the obturator and the intermediate body and between the intermediate body and the central body. To facilitate a better ease of gripping and manoeuvrability of the coupling, as well as the covering of the second spring 35, the activating means comprise an external washer 40 arranged externally of the coupling and solidly with the intermediate body 36. When the coupling is connected to the terminal, the fluid flow in the circuit can propagate through the central body 2, which has no internal obstruction and can therefore have a large diameter. It is exactly the large dimensions of the diameter of the central body, greater with respect to the internal diameters of the known rapid couplings, make the coupling of the present invention suitable not only for carrying out the operations of pressurization but also for continuous dispensing of fluids from circuits having a high flow rate.

Figure 10 shows the rapid coupling in rest conditions (i.e. as in figure 7); it can be noted that the pin 41, solidly constrained to the central body 2, is in an unblocked configuration with respect to the slot 42 fashioned in the intermediate body 36.

Figure 11 shows the coupling in a connected-up condition (i.e. as in figure 9); note that the pin 41 performs an axial displacement downwards along the slot 42 and then an axial rotation of the central body (typically by a few degrees, for example 20°) displaces the pin into the unblocking configuration.

The pin 41, in this configuration, functions as a safety block for the coupling, which can no longer accidentally disconnect. This detail gives the coupling considerable guarantee of the seal even when subjected to high-frequency pulsating pressure.

The disconnecting step of the rapid coupling from the internally threaded or profiled terminal can happen only when the pressure internally thereof is unloaded; differently, even when trying to activate the rapid coupling, it is not possible to effect disconnection thereof. The disconnecting step occurs - simply - by newly rotating (in an opposite direction with respect to the blocking stage) the central body 2, freeing the pin 41 in such a way that it can slide axially in the slot 42 and then forcing up to the maximum penetration of the central body 2 - in a direction of the depth - into the terminal and contemporaneously retaining the obturator 3 in such a way that the flexible elements 7 are at the median position, with a smaller
diameter, of the central body 2, which enables the operating portions to be extracted from the thread in which they were previously engaged. Figures 12-12a, 13-13a, 14-14a, 15 and 16 illustrate the functioning of a further embodiment of a rapid coupling according to the present invention, for externally threaded or profiled terminals. Figures 12 and 12a show the rapid coupling (in this case the obturator 31 is positioned internally with respect to the central body, such as to enter into contact with the terminal. The activating means further comprise an external body 45 and an auxiliary washer 46, interposed between the external body 45 and the central body 2. Observe that the washer 32 forces the flexible elements of the engaging clamp 5 into the open position, i.e. subjected to flexion externally of the clamp. In this position, the auxiliary washer 46 is maintained in the low position. This condition enables inserting, with no force, the coupling on the externally-threaded terminal. Figures 13 and 13a show the rapid coupling at the start of the inserting operation, i.e. with the terminal placed in contact with the obturator 31. By forcing the penetration of the coupling about the terminal to be connected the downwards axial sliding of the obturator 31 is obtained, which in turn draws the washer 32 downwards with it. As can be seen in figures 13 and 13a, as the obturator 31 lowers to the point that the washer 32 slides below the operating portion (threaded) of the flexible elements 7, two effects occur practically simultaneously: the flexible elements are freed, by effect of the elasticity thereof, to move into the rest position and therefore the grip on the thread of the terminal, and the auxiliary washer, by effect of a first spring 33, slides upwards supplying a safe and irreversible rest for the flexible elements as soon as they encounter the reciprocal threaded portion of the terminal.

The seal ring 34, destined to realise the hermetic seal between the rapid coupling and the terminal, is maintained under pressure (between the terminal and the obturator) and therefore in a sealed condition thanks to the following factors: the elastic force exerted by a second spring 35 (interposed between the obturator 31 and the central body 2) and a pressurisation which occurs internally of the coupling and which propagates inferiorly of the obturator 31 directly in connection (since internal of the central body) with the pressure of the fluid which crosses the coupling.

Note that in this case too that the washer 32 is not rigidly connected to the obturator 31 and can slide downwards with respect to the obturator, the sliding
being functional such as to enable a complete transfer of pressure from the obturator 31 towards the terminal to be connected without the flexible elements being subjected to damaging traction loads. In substance, the flexible elements 7 engage the thread of the terminal and are opposed "head on" by a relief 45a present on the top of the external body 45, while the mechanical opposition to the opening of the flexible elements 7 is supplied by the sliding into the high position by the auxiliary washer. In this condition the whole engaging clamp 5, placed under mechanical stress in working condition, is only subjected to compression, thus guaranteeing the best mechanical seal results even when the rapid coupling is subjected to a high-pressure fluid.

The overall seal of the rapid coupling 1, which enables propagation internally of the correct working pressure of the fluid, is guaranteed by the seal ring 37 between the obturator and the central body. To facilitate a greater ease of grip and manoeuvrability of the central body, the activating means comprise an external washer 40 solidly connected to the auxiliary washer 46 via the fixing of at least one or two pins 41.

Figure 15 shows the coupling in the rest position (i.e. as in figure 12), it can be seen that the pin 41, solidly with the central body 2, is in an unblocked configuration with respect to the slot 42 afforded in the external body 45. Figure 16 shows the coupling in the connected position (i.e. as in figure 14).

Note that the pin 41 performs an axial displacement upwards along the slot 42 and then an axial rotation of an external washer 40 solidly with the auxiliary washer (typically by only a small amount, about 15° for example) displaces the pin 41 into the blocking configuration. In this case too the pin 41 functions as a safety lock for the coupling, which can no longer accidentally decouple.

The step of disconnecting the rapid coupling from the externally threaded or profiled terminal can occur only when the pressure internally thereof is unloaded; differently, even trying to activate the rapid coupling, it is not possible to disconnect it. The step of disconnection is very simple achieved, by newly rotating (in the opposite direction to the previous locking step) the external washer 40, freeing the pin 41 in such a way that it can axially slide in the slot 42 and then forcing the auxiliary washer 4 downwards, such that the flexible elements 7 are freed from the circumferential opposition; at this point the obturator 31, pushed by the second spring 35, acts as an extractor of the terminal.
Figures 17-17a, 18-18a, 19-19a and 20 illustrate the functioning of a further embodiment - alternative to the preceding - of a rapid coupling according to the present invention, for external threaded or profiled terminals. Figures 17 and 17a show the rapid coupling in normal rest conditions (i.e. distanced from the terminal).

In this case too the obturator 31 is positioned internally with respect to the central body, so as to enter into contact with the terminal. Note that the washer 32 forces the flexible elements of the clamp 5 into the open position, i.e. subjected to flexion towards the outside of the clamp. In this position, the auxiliary washer 46 is maintained in a raised position with respect to the upper ends of the flexible elements. This condition enables inserting, with no force, the coupling to the externally threaded terminal to be connected. Figures 18 and 18a show the rapid coupling at the start of the inserting operation, i.e. with the terminal T placed in contact with the obturator 31. By forcing the penetration of the coupling towards the terminal to be connected, acting on the central body 2, the obturator 31 is forced to slide downwards, in turn drawing with it - downwards - the washer 32.

As can be observed in figures 19 and 19a, from when the obturator 31 lowers to the point at which the washer 32 slides below the operating portion (threaded) of the flexible elements 7, two practically simultaneous effects occur: the flexible elements are freed, by effect of the elasticity thereof, to move into the rest position and thus the gripping position on the thread of the terminal, and the auxiliary washer, by effect of a first spring 33, slides downwards providing a safe and irreversible rest for the flexible elements as soon as they encounter the reciprocal threaded portion of the terminal.

The seal ring 34, destined to perform the hermetic seal between the rapid coupling and the terminal, is maintained under pressure (between the terminal and the obturator) and thus in the sealed condition, thanks to the two following factors: the elastic force exerted by a second spring 35 (interposed between the obturator 31 and the central body 2) and a pressurisation which occurs internally of the coupling and which propagates inferiorly of the obturator 31 directly in connection (as it is internal of the central body) with the pressure of the fluid that crosses the coupling.

Note that in this case too the washer 32, not being rigidly connected to the obturator 31, can slide downwards with respect to the obturator, the sliding being functional in enabling the complete transfer of pressure from the obturator 31
toward the terminal to be connected without the flexible elements being subjected to damaging traction loads. In substance, the flexible elements 7 engage the thread of the terminal and are engaged both "head on" by a relief 46a fashioned in the top of the auxiliary washer 46 and circumferentially by a cylindrical portion 46b of the washer 46. In this condition the whole engaging clamp 5, placed under mechanical stress in the working condition, is only subjected to compression stress, thus guaranteeing the best mechanical seal results also when the rapid coupling is subjected to high pressures.

In an embodiment, illustrated in figure 22, the washer 32 exhibits an edge 32a (facing towards the terminal T and situated at the upper end 3 of the coupling 1) shaped such as to engage with the terminal T and centre with respect thereto. For this purpose, the edge 32a exhibits a radially internal truncoconical surface with opens towards the terminal T.

The overall seal of the rapid coupling 1, which enables propagation internally thereof of the fluid working pressure, is guaranteed by the seal rings 37 and 38.

With the aim of ensuring the necessary guarantee that the rapid coupling cannot be accidentally disconnected during the working steps, the working fluid can propagate from the central body into the chamber in which the first spring 33 houses through passage holes 48. This detail enables the auxiliary washer 46 to be blocked downwards in a mechanically sealed condition on the flexible elements, with a supplementary force to the force supplied by the first spring 33 and proportional to the working pressure to which the coupling is subjected.

The step of disconnecting the rapid coupling from the threaded or profiled terminal can occur only when the pressure internally thereof is unloaded; differently, though trying to activate the coupling, it is not possible to disconnect it. The disconnecting step occurs, simply, by upwardly forcing the auxiliary washer 46 such that the flexible elements 7 are free from the circumferential opposition; at this point the obturator 31, pushed by the second spring 35, acts as an extractor of the terminal.

In the three different embodiments of the rapid coupling illustrated respectively in figures 7-11, 12-16 and 17-20, the respective engaging clamps are illustrated, by way of example, with the respective flexible elements having a constant thickness along the whole longitudinal development (this can enable a simplification of the comprehension of the figures and, in particular of the behaviour of the engaging clamp internally of the rapid coupling). However the rapid couplings shown herein
can operate with engaging clamps provided with flexible elements having a longitudinally variable thickness (for example having a smaller thickness for a first portion at the respective lower end 7a and a greater thickness for a second portion of longitudinal development - extending for example for the remaining part of the longitudinal extension of the flexible element - as shown for the remaining part of longitudinal extension of the flexible element - as shown in figures 1-6).
CLAIMS

1. A rapid coupling (1) for threaded or profiled terminals (T), the rapid coupling comprising:
   a central body (2) having a longitudinal axis (2a) and extending between an upper end (3), destined to be removably sealedly connectable with the terminal (T), and a lower end (4), opposite the upper end (3), destined to be connected with a fluid circuit, the central body (1) being configured such as to enable, when the coupling is connected to the terminal, passage of the fluid between the circuit and the terminal;
   an engaging clamp (5) operatively associated to the central body (2) and operable at least between a first configuration, in which it is not engaged to the terminal and enables the coupling or decoupling of the central body to and from the terminal, and a second configuration, in which it is engaged, internally or externally, to the terminal and connects the central body thereto;
   activating means (30) movably active on the central body (2) and/or on the engaging clamp (5) such as to enable passage of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal,
   wherein the engaging clamp (5) externally surrounds the central body, is made in a single piece and is freely rotatable about said central body, the engaging clamp (5) comprising a base collar (6) and a plurality of flexible elements (7) which extend axially on a same side as the collar in circumferentially flanked positions, the flexible elements being separated from one another by longitudinal slits (9).

2. The rapid coupling (1) of claim 1, wherein each flexible element (7) is provided with a lower end (7a), solidly constrained to the collar (6), and an upper end (7b) opposite the lower end and provided with an externally or internally threaded or profiled operating portion (8), destined to cooperate with a portion of a thread (F1, F2) or a profiling (S1, S2) of the terminal (T), the upper ends (7b) of the flexible elements realising overall a thread or profiling of the engaging clamp, and/or wherein the rapid coupling is provided with a main axis (P) along which the coupling or decoupling of the rapid coupling in and from the terminal occurs, the terminal (T) having a respective axis, when coupled, that coincides with the main axis.
3. The rapid coupling (1) of claim 1 or 2, wherein the engaging clamp (5) has an overall shape which is substantially cylindrical and provided with a central axis (C) coinciding with the main axis (P) of the coupling, and/or wherein the longitudinal slits (9) are realised by means of spark erosion or blade cutting of a single cylindrical body, and/or wherein the flexible elements (7) are configured such as to flex radially with respect to the central axis (C) of the engaging clamp by means of inclination of the respective upper end (7b) with respect to the respective lower end (7a), solidly constrained to the collar (6), in such a way as to be orientated transversally with respect to the central axis (C).

4. The rapid coupling (1) of any one of the preceding claims, wherein the flexible elements (7) are orientated transversally to the central axis (C) of the engaging clamp (5) when it is in the first configuration and are orientated substantially parallel to the central axis of the clamp when it is in the second configuration, the flexible elements (7) being configured so that the action of the activating means (30) causes flexion thereof, and a consequent passage of the engaging clamps between the first and the second configurations.

5. The rapid coupling (1) of any one of the preceding claims, wherein the second configuration of the engaging clamp (5) corresponds to a rest condition of the flexible elements (7), which are structured such as to be normally arranged parallel to the central axis of the clamp, and the first configuration of the engaging clamp corresponds to a stressed condition of the flexible elements, which are structured such as to generate, when arranged transversally to the central axis, an elastic force tending to cause a return to the rest condition.

6. The rapid coupling (1) of any one of the preceding claims, wherein each flexible element (7) of the engaging clamp (5) has a respective width calculated as a distance between two respective sides of the flexible element open on the two longitudinal slits (9) adjacent to the element, the distance being preferably equal for each element of the plurality of flexible elements, and/or wherein each flexible element (7) occupies an angular sector of the collar equal to a first angle (A) identified by the flexible element on a perpendicular plane to the central axis (C) of the engaging clamp with respect to the central axis.

7. The rapid coupling (1) of any one of the preceding claims, wherein the longitudinal extension of the flexible elements (7), from the respective lower end (7a) to respective upper end (7b), i.e. the extension of the longitudinal slits (9), is
such as to enable the upper end to flex by a second angle (B), with respect to the central axis (C) of the engaging clamp (5), sufficient to enable the engaging clamp, in the first configuration, to insert in or be extracted from the terminal (T) without interfering with the threading (F1, F2) or the profiling (S1, S2) of the terminal, the second angle being preferably less than 10°, more preferably less than 6°, still more preferably less than 2°.

8. The rapid coupling (1) of any one of the preceding claims, wherein the flexible elements (7) have a thickness, along the longitudinal development with the exception of the operating portion (8), such as to guarantee the necessary structural resistance of the engaging clamp and, at the same time, enable each flexible element to elastically flex, between the rest and stressed conditions, at least by the second angle (B), and/or wherein the width of the flexible elements, and thus the angular sector occupied by each thereof, is such as to guarantee the flexible element an elasticity that is sufficient to enable a flexion by at least the same angle (B).

9. The rapid coupling (1) of any one of the preceding claims, wherein the operating portion (8) of each flexible element projects, externally or internally with respect to the body of the respective flexible element, by an operating distance at least equal to the difference in diameter between a bottom surface (11) and a crest surface (12) of the terminal (T) to be connected, and/or wherein the operating portions (8) of the flexible elements (7) realise overall a threading or a profiling of the same type as the threading present on the terminal to be connected.

10. The rapid coupling (1) of any one of the preceding claims, wherein where the rapid coupling is for externally-threaded terminals (F1) or externally-profiled terminals (S1), the longitudinal slits (9) between the flexible elements (7) of the engaging clamp have a minimum width, preferably comprised between 0.05mm and 0.5mm, such that the flexible elements, when the engaging clamp (5) is in the second configuration, are substantially laterally in contact with one another, and/or wherein, where the rapid coupling is for internally-threaded terminals (F2) or internally profiled terminals (S2), the longitudinal slits (9) between the flexible elements (7) of the engaging clamp have a minimum width, preferably comprised between 0.5mm and 2mm, such that the flexible elements, when the engaging clamp (5) is in the second configuration, are laterally distanced from one another.

11. The rapid coupling (1) of any one of the preceding claims, wherein the
activating means (30) comprise an obturator (31) slidably associated to the central body (2) and mobile at least between a first position, in which it acts on the upper ends (7a) of the flexible elements (7) of the engaging clamp (5), maintaining the engaging clamp (5) in the first configuration and enabling the insertion and extraction of the central body (2) into and from the terminal (T) to be connected, and a second position, in which it does not act on the flexible elements of the engaging clamp, enabling passage into the second configuration and determining the engaging of the operating portions (8) of the flexible elements (7) to the threading (F1, F2) or the profiling (S1, S2) of the terminal (T), the passage of the obturator (31) from the first to the second position taking place by effect of the thrust exerted by an edge of the terminal on the obturator during the inserting of the rapid coupling into the terminal and corresponding to a lowering, along a parallel direction to the longitudinal axis of the central body, of the obturator (31) with respect to the central body (2), and/or wherein the central body or obturator, when the obturator is brought into the second position, provide a support to the engaging clamp (5) which prevents it from returning into the first configuration.

12. The rapid coupling (1) of any one of the preceding claims, comprising a washer (32) operatively active on the upper ends of the flexible elements (7) and axially mobile with respect to the engaging clamp (5) and the central body (2).

13. The rapid coupling of claim 12, when it depends on claim 11, wherein the washer (32) is axially mobile with respect to the obturator (31).

14. The rapid coupling of claim 12 or 13, wherein the washer (32) is retained abutting on the obturator (31) by means of an elastic element, such that the thrust exerted by the terminal on the obturator (31) causes a compression of the elastic element by action of the washer (32) and a detachment, by axial sliding, thereof by the obturator (31), the detachment being functional such as to enable complete transfer of the pressure of by the obturator (31) on the terminal to be connected without the engaging claim (5) being subjected to traction loads.

15. The rapid coupling of claim 12, wherein an engaging edge (32a) of the washer (32) facing towards the upper end (3) exhibits a conical entry able to centre the washer (32) on the terminal (T) during coupling engagement.

16. The rapid coupling of any one of the preceding claims, wherein the single piece of the engaging clamp (5) exhibits an incision (100) which develops over the
whole axial length of the clamp (5) such as to enable a radial deformation of the single piece during assembly.

17. The rapid coupling of claim 16, wherein the incision (100) is defined by one of the slits (9) which extends in the base collar (6).

18. The rapid coupling of any one of the preceding claims, comprising a relief (3a, 45a, 46a) located at the upper end (3) which abuts head-on the flexible elements (7) engaged on the portion of the thread (F1, F2) or the profile (S1, S2) of the terminal (T).

19. A method for realising a rapid coupling (1) for threaded or profiled terminals (T) comprising steps of:
   - predisposing a central body (1) extending along a longitudinal axis (2a) between an upper end (3), destined to be removably sealedly connectable with the terminal (T), and a lower end (4), opposite the upper end (3), destined to be connected with a fluid circuit, the central body being configured such as to enable, when the coupling is connected to the terminal, the passage of the fluid between the circuit and the terminal;
   - realising an engaging clamp (5);
   - associating the engaging clamp (5) to the central body (2) and operable at least between a first configuration, in which it is not engaged to the terminal (T) and enables the coupling or decoupling of the central body into and out of the terminal, and a second configuration, in which it is engaged, internally or externally, to the terminal and connects the central body thereto;
   - predisposing activating means (30) movably active on the central body (2) and/or on the engaging clamp (5) such as to enable passage of the engaging clamp between the first and second configurations and, consequently, the coupling and decoupling of the central body to and from the terminal,

wherein the step of realising an engaging clamp (5) comprises steps of:
   - predisposing a tubular cylindrical body in a single piece;
   - realising a base collar (6) of the engaging clamp (5) at a lower end of the cylindrical body;
   - threading or profiling an upper end of the cylindrical body;
   - longitudinally cutting the cylindrical body starting from the upper end up to inferiorly reaching the base collar, such as to realise a plurality of flexible elements
(7) extending axially from the collar (6) in circumferentially flanked positions and separated from one another by longitudinal slits (9), wherein the engaging claim (5) is associated to the central body (2) such as to rotate freely about the central body (2).
According to International Patent Classification (IPC) or to both national classification and IPC

Minimum documentation searched (classification system followed by classification symbols)

F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

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