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Inventor(s)	WILDERMUTH; Andreas et al.

REMOVAL SYSTEM AND REMOVAL AID FOR A SEPARATING ELEMENT

Abstract

A removal system is provided with a separating element for separating contaminants contained in a fluid and with a removal aid for removing the separating element from a housing. The separating element has an end disk arranged at an end face of the separating element. The end disk has a central recess. The removal aid has a grip section and an intermediate plate with at least two projecting locking fingers. The locking fingers extend along a center axis of the removal aid away from the intermediate plate. Each locking finger has a hook element that serves for engaging behind the end disk of the separating element radially outside of an end disk area that delimits in radial outward direction the central recess. A removal aid for such a removal system is provided.

Inventors: **WILDERMUTH; Andreas (Marbach am Neckar, DE), PFLÜGER; Frank (Sachsenheim, DE), JOKSCHAS; Günter (Murrhardt, DE)**

Applicant: **MANN+HUMMEL GmbH** (Ludwigsburg, DE)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation application of U.S. application Ser. No. 17/517,159 filed Nov. 2, 2021, which is a continuation of U.S. application Ser. No. 15/635,863 filed Jun. 28, 2017, which claims the benefit of German application no. 10 2016 007 849.9 filed Jun. 29, 2016, the entire contents of the aforesaid US applications and the aforesaid German application being incorporated herein by reference.

BACKGROUND
[0002] The invention concerns a removal system and a removal aid for removing a separating element from a housing.
[0003] Separating elements, for example, fuel or oil filters, must be exchanged in regular intervals. For this purpose, the separating elements to be exchanged are to be removed from a housing in which they are arranged during use. For removal of the separating elements from the housing, often standard tools such as screwdrivers or pliers are used in practice, for example, in an automotive repair shop. With these tools, it is attempted to pry and/or pull out the separating element from the housing. However, in doing so, there is the risk that the separating element or the housing becomes damaged, in particular in the area of a sealing surface for a housing cover closing off the housing. Broken-off pieces of the separating element may remain within the housing and may cause functional disturbances. Moreover, the employed tools when used improperly can slide off easily which may result in injuries.
[0004] U.S. Pat. No. 6,280,620 B1 discloses a removal system with an oil filter and with a socket wrench wherein radially projecting receiving openings on the oil filter are provided that are specifically designed for two corresponding extensions of the socket wrench. By means of the socket wrench, the oil filter can be rotated about a longitudinal axis when the extensions are inserted into the receiving openings. A disadvantage of this configuration of the oil filter is in particular that the receiving openings must be formed on the oil filter so as to project radially. This results in the space requirement of the oil filter to be disadvantageously increased. Also, pulling out the oil filter from the housing in axial direction is not possible with the socket wrench.
[0005] EP 1 817 093 B1 discloses a fuel filter element with an end disk and with a folding grip arranged fixedly on the element. In order not to enlarge the size of the oil filter excessively or not to impair the flow through the oil filter, such a grip must however be designed to be very slim. In this way, handling is made more difficult and there is the risk that the grip will fail upon removal of the oil filter. Moreover, the grip makes the oil filter more expensive because the grip is an integral component of the oil filter. A comparable removal system is disclosed in DE 11 2009 000 742 T5.
[0006] DE 44 15 890 A1 discloses a further removal system with a filter element comprising an end disk with a central opening. For removing the filter element from a housing, a removal aid with two locking fingers is provided which are inserted immediately through the central opening of the

end disk and locked with a grid-shaped support tube of the filter element. The removal aid is configured to be so small that only one finger can be passed through for gripping. Therefore, the force introduction is made difficult for a user. Moreover, the grip engaged on the filter element can easily tilt which increases the risk of injury.

[0007] It is therefore the object of the invention to provide a removal system, comprising a separating element for separating contaminants contained in a fluid and further comprising a removal aid, and to further provide a removal aid for such a system, the removal system and the removal aid enabling a reliable, quick, and comfortable removal of the separating element from a housing, without the removal aid enlarging the size of the separating element in separating operation of the separating element, impairing flow through the separating element, or increasing the manufacturing costs of the separating element.

SUMMARY

[0008] The object concerning the removal system is solved by a removal system including: [0009] a separating element for separating contaminants contained in a fluid, with a separating medium and with an end disk arranged at the end face on the separating element and comprising a centrally arranged recess, and [0010] a removal aid for removing the separating element from a housing, [0011] wherein the removal aid comprises a grip section and two or more locking fingers arranged to be spaced apart from each other, which each extend along a center axis of the removal aid away from the grip section, and [0012] wherein on each locking finger a hook element is arranged for engaging behind the end disk of the separating element radially outside of an end disk region which immediately delimits the central recess in radial outward direction.

[0013] The object concerning the removal aid is solved by a removal aid comprising a grip section and two or more locking fingers arranged to be spaced apart from each other, which each extend along a center axis of the removal aid away from the grip section, and wherein on each locking finger a hook element is arranged for engaging behind the end disk of the separating element radially outside of an end disk region which immediately delimits the central recess in radial outward direction.

[0014] In the removal system according to the invention, the removal aid is connected (locked/snapped on) with the separating element only for removal of the separating element from the housing. After removal of the separating element, the separating element may be disposed of together with the removal aid or, for its reuse, may be separated from the separating element. The size of the separating element is therefore not enlarged by the removal aid because the latter is not arranged on the separating element during use of the separating element. In its coupled or locked state on the separating element, the removal aid does not engage with its locking fingers in the central recess of the end disk of the separating element. Instead, the hook elements, in a radial direction relative to the longitudinal axis of the separating element, engage the end disk from behind outside of an end disk region that immediately delimits the central recess in radial outward direction. In this way, the removal system according to the invention enables as a whole a simplified and more reliable removal of the separating element from a housing. By means of the removal aid, the separating element can be loaded with such a great torque that it can be loosened more easily from its sealing seat in the housing. Since the removal aid is not an integral component of the separating element, the separating element as a whole can be produced less expensively and more compact. The central recess of the end disk as well as the end disk region adjoining the central recess can therefore be designed solely with respect to a desired flow guidance of the fluid or a sealing action of the end disk relative to the adjoining housing parts. The separating element can be configured, for example, as a fuel or oil filter but also as a water separator for water contained in fuel.

[0015] The separating medium encloses typically an interior of the separating element in a radial direction. In this context, the central recess of the end disk opens an access to the interior in axial direction. The separating medium can be configured as a star-shaped folded filter bellows.

[0016] The grip section of the removal aid may be configured such that it can be gripped by at least two fingers, for example by four fingers, of the human hand. In particular, the grip section can have grip depressions for the fingers. The grip section may be arranged centrally on the removal aid in such a way that, when the removal aid is locked on the end disk, it spans the central recess of the end disk. Alternatively, the grip section can also be of a two-part configuration, for example, in such a way that two grip part sections that are separate from each other are projecting radially in outward direction away from the removal aid.
[0017] For locking the removal aid on the end disk, the locking fingers can be deformed in radial direction, for example elastically. In other words, the locking fingers are spreadable or compressible relative to each other. When the removal aid has been pushed far enough onto the end disk, the locking fingers spring back automatically into the unloaded initial position and cause the hook elements to engage the end disk from behind.
[0018] According to an embodiment of the invention, the removal aid engages with its locking fingers the outer circumference of the end disk in its locked state on the end disk. The locking fingers extend thus in radial outward direction on an outer circumference of the end disk. In this way, a support width of the removal aid on the end disk is provided that is as large as possible. This improves the stability of the coupling action of the removal aid on the end disk and facilitates the introduction of torque into the separating element. For removal of the separating element, the removal aid can be inserted into a slot between the end disk and the housing. Typically, the locking fingers are contacting the end disk radially outwardly. This further improves the stability of the coupling action and provides lateral movement clearance for removal of the separating element.
[0019] A further development of this embodiment provides that the separating medium is configured as a star-shaped folded bellows which surrounds the longitudinal axis of the separating element in an annular shape, wherein the hook elements of the locking fingers in radial direction extend into folds of the separating medium. The separating medium in the form of a star-shaped bellows can serve as a filter medium or as a coalescing medium. Due to the folds, a large filter surface area can be provided with a compact configuration of the separating element. The locking fingers are arranged spaced apart from each other in such a way that they mesh with the folds when the removal aid is locked on the end disk. By means of the engagement of the hook elements in the folds, torque can be introduced into the separating element and the separating element can thereby be loosed in a simple way from its seat in the housing. Moreover, it is made possible to engage the end disk from behind with the hook elements in radial inward direction even when the end disk in radial direction is not projecting circumferentially past the separating medium.
[0020] According to the invention, the hook elements can be configured in particular for the purpose of engaging flow openings of the end disk which are arranged relative to the central recess of the end disk so as to be displaced in radial outward direction. The hook elements and/or the locking fingers can then be supported also in circumferential direction on a respective wall of the flow openings so that the separating element can be rotated also about a longitudinal axis with the removal aid. In this way, the separating element can be loosened more easily from its seat in the housing and can be pulled out with reduced force expenditure in axial direction (relative to the longitudinal axis of the separating element) from the housing.
[0021] Another embodiment provides that the end disk of the separating element comprises an annular slot and the locking fingers of the removal aid extend into the annular slot. The end disk may comprise an outer shoulder which delimits the annular slot in radial outward direction and the hook elements engage behind the outer shoulder. By a configuration of the end disk with annular slot, the flow through the separating element and the sealing action of the separating element relative to the housing can be improved. Such separating elements can be removed from the housing only with difficulty by means of unsuitable tools. The removal aid takes advantage of the configuration of the end disk in order to provide a particularly simple and reliable coupling action. The annular slot may comprise flow openings which are engaged by the locking fingers and/or

hook elements of the removal aid when the removal aid is locked on the end disk.
[0022] In another embodiment, it is provided that the hook elements are extending in radial direction outwardly, respectively. The removal aid can then be attached in a simple way on the end disk when the end disk comprises a circumferential groove, a circumferential annular slot, or further openings positioned in radial direction outward relative to the central recess. The hook elements of the removal aid engage then, for example, an outer shoulder of the end disk in radial outward direction. In use of the separating element, the outer shoulder can be supported fluid-tightly on the housing.
[0023] In an alternative embodiment thereto, the hook elements are oriented in radial direction inwardly, respectively. In this way, it is made possible to radially engage from behind the end disk from the exterior. The locking fingers in the locked state can then contact an outer circumference of the end disk.
[0024] Another embodiment provides that the removal aid comprises at least two arms, wherein on each one of the arms at least two, for example at least five, locking fingers are formed. The locking fingers can then be configured to be particularly slim. In this way, contacting and locking of the removal aid on the end disk is facilitated. At the same time, the stability of the removal aid is ensured. The locking fingers of an arm can be arranged to be spaced apart from each other in particular such that, when the removal aid is locked on the end disk, they mesh with folds of a separating medium that is arranged axially behind the end disk.
[0025] In a further embodiment, it is provided that the removal aid comprises three locking fingers. In particular, one locking finger is formed on a first end of a grip section of the removal aid and two locking fingers are arranged on a second end of the grip section. Due to this configuration, the risk of tilting or sliding off of the removal aid when locking the removal aid on the end disk as well as when pulling out the separating element from the housing is further reduced. A spacing distance between the two locking fingers at the second end of the grip section corresponds for example at least to the width of one of these locking fingers. In this way, the support action of the removal aid can be further improved. Moreover, between the two locking fingers at the second end of the grip section, a web or the like of the end disk can be received. It is then possible by rotation of the removal aid to introduce torque about the longitudinal axis of the separating element into the separating element.
[0026] The locking fingers may be positioned on a circular path. The hook element of a locking finger or the hook elements of the locking fingers of one arm can extend across a segment angle of between 10° and 90° on this circular path. The covered segment angle for example amounts to at least 15°, further for example at least 20°. The covered segment angle amounts to at most 40, and further to at most 30.
[0027] At least some of the hook elements may be formed with an insertion ramp and a projection, wherein the projection is arranged on the respective hook element so as to face away from a grip section of the removal aid and wherein each projection comprises a centering surface, the centering surface extending substantially parallel or at an acute angle relative to the center axis of the removal aid. Typically, all hook elements are provided with an insertion ramp and a projection. The centering surface may adjoin the insertion ramp. The acute angle for example amounts to at most 20°. In this way, it can be achieved that the removal aid upon contacting the end disk becomes centered relative thereto. The locking action of the removal aid on the end disk is thereby facilitated. Moreover, the centering surfaces provide a guiding action so that the risk of sliding off of the removal aid from the end disk upon locking can be further reduced.
[0028] In another embodiment, it is provided that the removal aid comprises a tubular centering socket which is insertable into the central recess of the end disk of the separating element. The centering socket is typically formed with an outer diameter that is minimally smaller, approximately by at most 10%, than an inner diameter of the central recess of the end disk. The centering socket may project in axial direction past the hook elements or their projections. Due to

the centering socket, the removal aid can be guided upon contacting and locking of the removal aid on the end disk. Moreover, by engagement of the centering socket in the central recess, it can be prevented that the removal aid upon removal of the separating element from the housing can laterally slide off the end disk of the separating element to be removed from the housing.
[0029] The removal aid for a removal system with the afore described features enables a particularly simple, reliable, and little time-consuming removal of the separating element from the housing. The removal aid can be comprised in particular of a plastic material or a metallic material, wherein the removal aid is embodied as an injection molded part. A removal aid of plastic material can be manufactured particularly inexpensively and has a minimal weight. A removal aid of a metallic material can be designed to be particularly sturdy. A removal aid of a metallic material according to the invention can be produced by a 3-D printing method. By means of a 3-D printing method, even small lot sizes of removal aids can be economically produced.
[0030] Further embodiments, features and advantages of the invention result from the following detailed description and the drawing figures. The afore described features to be further explained in the following can be used according to the invention individually by themselves or several combined in any combination.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0031] FIG. **1***a* shows a schematic, perspective view of a separating element in a housing and a first embodiment of a removal aid according to the invention.
[0032] FIG. **1***b* shows a schematic, perspective view of the removal aid of FIG. **1***a*, locked on an end disk of the separating element, during a removal process.
[0033] FIG. **1***c* shows a schematic section illustration of the removal aid and of the separating element of FIGS. **1***a*, **1***b*.
[0034] FIG. **2***a* shows a schematic, perspective illustration of a second embodiment of a removal aid according to the invention, locked on an end disk of a separating element.
[0035] FIG. **2***b* shows a schematic, perspective view of the removal aid of FIG. **2***a*.
[0036] FIG. **2***c* shows a schematic plan view of the removal aid of FIGS. **2***a*, **2***b*.
[0037] FIG. **3** shows a schematic cross-section of a third embodiment of a removal aid according to the invention, wherein a hook element and a projection are formed on locking fingers of the removal aid, respectively.
[0038] FIG. **4***a* shows a removal aid according to the invention in a fourth embodiment, locked on a separating element, in a schematic, perspective view.
[0039] FIG. **4***b* shows a schematic view of the removal aid and of the separating element of FIG. **4***a*.
[0040] FIG. **4***c* shows a schematic longitudinal section of the removal aid and of the separating element of FIGS. **4***a*, **4***b*.
DETAILED DESCRIPTION
[0041] FIG. **1***a* shows a schematic, perspective view of a removal system **10** according to the invention comprising a separating element **12** for separating contaminants contained in a fluid, here oil, and a removal aid **14** by means of which the separating element **12** can be removed comfortably from a housing **16**. The separating element **12** is embodied, for example, as an oil filter and comprises a filter medium **18** as well as an end disk **20** arranged at the end face and provided with a central recess **22** through which the fluid can be guided out of the separating element **12**. In radial direction, the central recess is immediately delimited outwardly by an end disk region **20***a*, or rim area, of the end disk **20**. The filter medium **18** is arranged in an annular shape relative to the longitudinal axis **24** of the separating element **12** and, with one end, is held

embedded in the illustrated upper end disk **20** or is glued to the end disk **20**. The filter medium **18** can be flowed through by the fluid in a radial direction relative to the longitudinal axis **24** from the exterior to the interior.

[0042] The removal aid **14** comprises a grip section **26** which is provided for ergonomic reasons with two grip depressions **28**. The grip section **26** can be gripped by several fingers (not illustrated) of a hand of a user of the removal aid **14**. The grip section **26** comprises as a whole a U-shaped form with two arms or legs **30** which are arranged to be spaced apart from each other. The legs **30** are attached at one end to an intermediate plate **32**, respectively. On the intermediate plate **32**, five locking fingers **34** are integrally formed here at both ends, respectively, and are extending along a center axis **36** of the removal aid **14** away from the intermediate plate **32** or the grip section **26**. It is understood that also more or fewer than five locking fingers can be provided. The locking fingers **34** each comprise a terminally arranged hook element **38** that is projecting away from the respective locking finger **34** in radial inward direction.

[0043] The removal aid **14** comprises an axial stop **40** for the end disk of the separating element **12** to be removed from the housing **16**. The axial stop **40** is facing in the direction of the hook elements **38** and is formed in an exemplary fashion by the locking fingers **34**.

[0044] The removal aid **14** may comprise a centering socket **42** which is for example tubular and which is insertable into the central recess **22** of the end disk **20** of the separating element **12**. In the illustrated embodiment of FIG. **1***a*, the centering socket **42** is arranged on the intermediate plate **32** in an exemplary fashion and extends away from the intermediate plate **32** in axial direction coaxially to the center axis **36** of the removal aid **14**. The centering socket **42** can project with its free end **44** in axial direction past the locking fingers **34** in order to enable a reliable guiding action of the removal aid **14** upon coupling on the end disk **20** of the separating element **12**. According to an embodiment that is not illustrated in detail in the Figures, the aforementioned axial stop **40** can also be formed by a collar or the like which is projecting in radial direction away from the centering socket **42**.

[0045] FIG. **1***b* shows the removal system **10** according to the invention of FIG. **1***a* during the removal process of the separating element **12** from the housing **16**. The removal aid **14** is locked with the end disk **20** of the separating element **12**. The locking fingers **34** engage across the end disk **20** at the outer circumference and engage behind the end disk **20** with their hook elements **38**. In this context, the hook elements **38** can engage in particular from the exterior in radial direction in folds **46** of the separating medium **18**. In this case, the removal aid **14** is secured against rotation, or substantially secured against rotation, on the separating element **12** by the separating medium **18** so that the separating element **12** can be loosened in a simplified way from its seat in the housing **16**. Due to the locking fingers **34**, a multi-point locking action of the removal aid **14** on both sides of the end disk **20** of the separating element **12** is moreover ensured. Additionally, the centering socket **42** extends through the central recess **22** of the end disk **20** into the separating element **12**. Therefore, the removal aid **14** cannot tilt relative to the end disk **20** so that an accidental detachment of the locking fingers **34** from engagement with the end disk **20** is prevented. When removing the separating element **12** from the housing **16**, an injury-prone sliding off of the removal aid **14**, locked with the end disk **20**, from the separating element **12** is therefore reliably counteracted.

[0046] FIG. **1***c* shows the removal system **10** of FIG. **1***b* in a longitudinal section with the removal aid **14** coupled on the separating element **12** during the removal process. The axial stop **40** and the hook elements **38** of the locking fingers **34** are spaced apart from each other in axial direction such that the removal aid **14** is arranged so as to be lockingly secured with axial clearance on the end disk **20**. It is understood that the axial stop **40** and the hook elements **38** can also be spaced apart from each other such that the removal aid **14** is lockable without such axial clearance with the end disk **20**.

[0047] When locking the removal aid **14** with the end disk **20** of the separating element **12**, the

removal aid **14** is first pushed in axial direction onto the separating element **12** arranged in the housing **16** until the end disk **20** of the separating element **12** contacts the axial stop **40** of the removal aid **14**. The locking fingers **34** of the removal aid **14** are guided in this context against the end disk **20** and in this way elastically deflected relative to the center axis **36** of the removal aid **14** in radial outward direction. As soon as the hook elements **38** have passed the end disk **20** in axial direction, the locking fingers **34** snap automatically back into their locking position in which the hook elements **38** engage from behind the end disk **20**. The separating element **12** is subsequently pulled out from the housing **16** by means of the removal aid **14**, held in locked engagement on the separating element **12**, in the direction of arrow **48** along the center axis **36** of the removal aid **14** or the longitudinal axis **24** of the separating element **12**. In its locked state on the end disk **20** of the separating element **12**, the removal aid **14** engages the end disk **20** outside of an end disk region **20***a* that immediately delimits outwardly the central recess **22** of the end disk in radial direction. In other words, the locking fingers **34** do not engage the central recess **22** of the end disk **20**.

[0048] FIG. **2***a* shows a further embodiment of the removal system **10** according to the invention. For reasons of simplifying the illustration, the separating element **12** is illustrated only partially and comprises a grid-like base member **50** (=support tube) which is provided for internal support of the separating medium, for example, a filter medium or a coalescing medium, not illustrated in detail in FIG. **2***a*. An end disk **20** with a central recess **22** is integrally formed on the base member **15** at the end face. On the end disk **20**, an annular slot **52** is formed in radial direction outside of the central recess **22**. The annular slot **52** in radial outward direction is circumferentially bounded by an outer shoulder **54** of the end disk **20**. The outer shoulder **54** can be inserted fluid tightly into a housing (not illustrated). The outer shoulder **54** can support for this purpose a sealing element which is not illustrated in detail in FIG. **2***a*. Flow openings **56** are formed in the end disk **20**. In circumferential direction of the separating element **12**, the flow openings **56** are arranged to be spaced apart from each other. Via the flow openings **56**, flow paths for the fluid out of the annular slot **52** into a radial outwardly positioned environment (=raw side) of the separating element **12** or of the separating medium are opened up. In this way, the fluid can flow in operation of the separating element **12** first into the annular slot **52** and from there, via the flow openings **56**, radially externally along the separating element **12** in order to then flow through the separating medium (not illustrated) as well as the grid-like base member **50** in radial direction from the exterior to the interior and to finally exit from the separating element **12** via the central recess **22** of the end disk **20**.

[0049] The removal aid **14** comprises in this context a grip section **26** with a total of three locking fingers **34**. One of the locking fingers **34** is arranged at a first end **58** of the grip section **26**. At the second end **60** of the grip section **26** which is opposite the first end **58**, two locking fingers **34** are arranged (see also FIGS. **2***b*-**2***c*). Each one of the locking fingers **34** engages a respective flow opening **56**. In this context, hook elements **38** (hidden in FIG. **2***a*; see FIGS. **2***b*-**2***c*) formed on the locking fingers **34** engage from behind the outer shoulder **54** of the end disk **20** in radial outward direction. The removal aid **14** engages thus from behind the end disk **20** in its state locked on the end disk **20** radially outside of the end disk region **20***a* that is immediately adjoining the central recess **20**. The locking arms **34** thus do not extend into the central recess **22** of the end disk **20**.

[0050] FIG. **2***b* shows a schematic, perspective illustration of the removal aid **14** of FIG. **2***a*. The locking finger **34** at the first end **58** of the grip section **26** is embodied symmetric to the center plane **62** of the removal aid **14**. The two other locking fingers **34** are arranged spaced apart from the center plane **62**, respectively.

[0051] For locking the removal aid **14** on the end disk **20** of the separating element **12** (compare FIG. **2***a*), the removal aid **14** is pushed with the locking fingers **34** leading against the end disk **20**. In doing so, the locking fingers **34**, upon contact on the end disk **20**, are bent in radial direction inwardly so that the hook elements **38** can slide across the outer shoulder **54** of the end disk. As soon as the removal aid **14** has been pushed far enough onto the end disk **20**, the locking fingers **34** spring in radial direction outwardly so that the hook elements **38** engage behind the outer shoulder

54. The separating element **12** can then be pulled from the housing by means of the removal aid **14** locked on the end disk **20** (compare FIG. **1***a*).

[0052] FIG. **2***c* shows a schematic plan view of the removal aid **14** according to the FIGS. **2***a*, **2***b*. At the first end **58** of the grip section **26**, the locking finger **34** with its hook element **38** is arranged symmetric to the center plane **62**.

[0053] At the second end **60**, the locking fingers **34** and the respective hook elements **38** are arranged to be spaced apart from the center plane **62**. The locking fingers **34** and the hook elements **38** are arranged on a circular arc **64**. A diameter **66** of the circular arc **64** is matched in this context to a shoulder diameter of the outer shoulder (compare FIG. **2***a*). The locking fingers **34** and the respective hook elements **38** have the same width **68**. A spacing **70** is provided between the locking fingers **34** and the respective hook elements **38**. The spacing **70** is greater than the width **68** by approximately 20%. Between the locking fingers **34**, a web (not illustrated) can be received between flow openings **56** (compare FIG. **2***a*) of the end disk **20** of the separating element.

[0054] FIG. **3** shows schematically a cross-section of a removal aid **14** according to the invention for removal of a separating element from a housing (compare FIGS. **1***a*, **1***b*) that is of a particularly simple configuration. The removal aid **14** comprises a grip section **26** with two locking fingers **34** with a hook element **38** each. The hook elements **38** each comprise a locking surface **72** which is facing the grip section **26**. Facing away from the grip section **26**, an insertion ramp **74** is formed on the hook elements **38**, respectively. Beyond the hook element **38**, each one of the locking fingers **34** ends in a projection **76**. The hook elements **38** face outwardly in radial direction. A centering surface **78** is formed on the projections **76** on the side of the hook elements **38**, i.e., externally.

[0055] The centering surface **78** begins directly at the insertion ramp **74**. The removal aid **14** illustrated in FIG. **3** is locked with the end disk of the separating element radially outside of an end disk region (**20***a*) which is adjoining the central recess (**22**), as has been shown, for example, in FIGS. **2***a*, **2***b*. According to an embodiment which is not illustrated in detail in the drawing, the hook elements **38** in radial direction can project inwardly away from the locking fingers so that the removal aid can be locked with the end disk of the separating element in a way corresponding to that of FIGS. **1***a* to **1***c*.

[0056] FIG. **4***a* shows a further embodiment of a removal system **10** according to the invention. Here, the removal aid **14** is already locked on the separating element **12** for removal of the separating element **12** from a housing **16**. The separating element **12** comprises at the end face an end disk **20** with a single central recess **22**. The central recess **22** in radial outward direction is delimited immediately by a rim area of the end disk **20**, i.e., the end disk region **20***a*. The removal aid **14** engages with locking fingers **34** an annular slot **52** of the end disk **20**.

[0057] The end disk **20** comprises an axial collar **80** with slots **82**. The slots **82** can be arranged so as to be spaced apart from each other, in particular regularly, in circumferential direction of the end disk **20** on the axial collar **80**. The removal aid **14** comprises projections **84** which each extend away in radial outward direction from the locking fingers **34** relative to the center axis **36** of the removal aid **14**. The projections **84** engage the slots **82** of the collar **80** in the locked state of the removal aid **14** on the separating element **12**. The removal aid is therefore coupled to the end disk **20** of the separating element **12** and secured against rotation. The separating element **12** can thus be rotated by means of the removal aid **14** relative to the housing **16** in order to loosen it from its (sealing) seat and in this way remove it more easily from the housing **16**.

[0058] FIG. **4***b* shows a schematic view of the removal aid **14** and of the separating element **12** according to FIG. **4***a*. The locking fingers **34** of the removal aid **14** engage from above the annular slot **52** of the end disk **20**. The central recess **22** is formed concentric to the annular slot **52** in the end disk **20**. The end disk region **20***a* delimits the central recess **22** in radial direction outwardly. The end disk region **20***a* is intermediately arranged in radial direction between the central recess **22** and the annular slot **52**.

[0059] FIG. **4***c* shows a schematic longitudinal section along the plane A-A (compare FIG. **4***b*)

through the removal aid **14** and the separating element **12** of the removal system **10** of FIGS. **4***a*, **4***b* after completed removal of the separating element **12** from the housing (compare FIG. **4***a*). The separating element **12** comprises a separating medium **18** that is secured with the end face on the end disk **20**. The separating medium **18** is glued to the end disk **12** in this case. The central opening or recess **22** of the end disk **20** provides a fluidic passage into an interior **86** of the separating element **12**. A fluid can flow in operation of the separating element through the central opening or recess **22** into the interior **86** or flow out from the interior **86**. The central opening or recess **22** provides therefore a flow opening for the fluid.

[0060] Radially outside of the end disk region **20***a* delimiting the central opening or recess **22**, the removal aid **14** projects with its locking fingers **34** into the annular slot **52** of the end disk **20**. Hook elements **38** which are integrally formed on the locking fingers **34** so as to face in radial outward direction engage behind the end disk **20**.

[0061] The afore described removal aids are distinguished by an improved tilting stability due to a point of attack at the end disk that, in radial direction, is spaced apart from the central recess of the end disk or from an end disk region that is immediately adjoining it. Moreover, the separating element to be removed from the housing can be more simply wiggled free or loosened by rotation from its seat within the housing and subsequently pulled out.

Claims

1. A removal system comprising: a separating element comprising: a separating medium defining a longitudinal axis extending through an interior of the separating medium; an end disk on an axial end face of the separating medium, the end disk having a back side and a central recess, the central recess arranged around the longitudinal axis of the separating medium and extending through the end disk into the interior of the separating medium; and a removal aid operable to remove the separating element from a housing, the removal aid defining a center axis and comprising: a grip section spaced from the end disk of the separating element with the removal aid positioned to remove the separating element from the housing, the grip section providing a grip handle configured for removing the separating element from the housing; and an intermediate plate spaced from the grip section and disposed between the grip section and the end disk of the separating element with the removal aid positioned to remove the separating element from the housing; wherein the intermediate plate has at least one locking finger projecting from the intermediate plate away from the grip section; and wherein the at least one locking finger comprises at least one hook element operable to engage the end disk of the separating element with the removal aid positioned to remove the separating element from the housing.

2. The removal system according to claim 1, wherein the at least one hook element of the at least one locking finger is configured to engage the back side of the end disk.

3. The removal system according to claim 1, wherein the at least one hook element of the at least one locking finger is configured to engage axially behind the end disk.

4. The removal system according to claim 1, wherein the end disk comprises an annular slot, and wherein the at least one hook element of the at least one locking finger extends into the annular slot.

5. The removal system according to claim 4, wherein the end disk further comprises an outer shoulder that delimits the annular slot, and wherein the at least one hook element of the at least one locking finger engages behind the outer shoulder.

6. The removal system according to claim 4, wherein the annular slot or the separating medium comprises at least one flow opening, and wherein the at least one hook element of the at least one locking finger engages the at least one flow opening.

7. The removal system according to claim 1, wherein the separating medium comprises folds arranged axially behind the end disk, and wherein the at least one hook element of the at least one

locking finger comprises a plurality of hook elements that mesh with the folds of the separating medium.

8. (canceled)

9. The removal system according to claim 1, wherein the at least one locking finger projects from the intermediate plate axially relative to the center axis defined by the removal aid, and wherein the least one hook element of the at least one locking finger is oriented radially di-relative to the center axis defined by the removal aid.

10. The removal system according to claim 1, wherein the at least one hook element of the at least one locking finger is configured to engage within an end disk region adjacent the central recess of the end disk of the separating element with the removal aid positioned to remove the separating element from the housing.

11. A removal aid for removing a separating element comprising a separating medium and an end disk arranged on the separating medium from a housing, the removal aid comprising: a grip section; and an intermediate plate spaced away from the grip section in an axial direction relative to a center axis defined by the removal aid; wherein the intermediate plate comprises at least one locking finger projecting away from the intermediate plate in the axial direction; and wherein the at least one locking finger has at least one hook element oriented radially relative to the center axis, the at least one hook element configured and operable to engage the end disk with the removal aid positioned to remove the separating element from the housing.

12. The removal aid according to claim 11, wherein the at least one hook element of the at least one locking finger is operable to engage behind an outer shoulder of the end disk in the axial direction.

13. The removal aid according to claim 11, wherein the at least one hook element of the at least one locking finger is operable to extend radially into an annular slot formed in the end disk of the separating element.

14. The removal aid according to claim 11, wherein the at least one hook element of the at least one locking finger is operable to radially engage flow openings provided in the end disk or the separating medium of the separating element.

15. The removal aid according to claim 11, wherein the at least one hook element of the at least one locking finger is operable to radially mesh with folds of the separating medium of the separating element.

16. The removal aid according to claim 11, wherein the at least one hook element of the at least one locking finger is configured and operable to engage and end disk region adjacent a central recess of the end disk of the separating element.

17. The removal aid according to claim 11, wherein the at least one locking finger is a plurality of locking fingers circumferentially spaced apart about a circumference of the intermediate plate, and wherein the at least one hook element of each of the plurality of locking fingers is configured and operable to engage the end disk or the separating medium of the separating element with the removal aid positioned to remove the separating element from the housing.

18. The removal aid according to claim 17, wherein the end disk or the separating medium of the separating element comprises flow openings, and wherein the plurality of locking fingers engage with the flow openings.

19. The removal aid according to claim 17, wherein the end disk of the separating element comprises an annular slot, and wherein the plurality of locking fingers engage with the annular slot.

20. The removal aid according to claim 19, wherein the end disk of the separating element comprises an outer shoulder delimiting the annular slot, and wherein the plurality of locking fingers engage behind the outer shoulder.

21. A removal aid comprising: a grip section; and an intermediate plate spaced away from the grip section in an axial direction relative to a center axis defined by the removal aid; wherein the intermediate plate comprises two or more locking fingers projecting away from the intermediate plate and away from the grip section in the axial direction; and wherein each of the two or more

locking fingers has at least one hook element extending radially inward or radially outward relative to the center axis, the at least one hook element configured to engage with a separating element to remove the separating element from a housing.