Description

This invention relates to blowout preventers.

Blowout preventers are used to maintain control of wells during drilling. Ram-type blowout preventers are used to close on the drill or pipe string to contain pressure in the well. At times it is necessary to strip the string through the closed rams. This stripping movement can severely wear or abrade the face of the resilient packer. Another reason that the packers of ram-type blowout preventers are subject to wear is that to provide a seal they must move into tight engagement with the irregular surface of the string when closed and such ability causes the packers to be subject to extrusion. The design of ram packers is thus a compromise to provide the needed feed or available movement of the material with the maximum abrasion and extrusion resistance.

Examples of prior ram-type blowout preventers can be seen in U.S. Patent Nos. 2,883,141 and 3,692,316 which also disclose the use of upper and lower packer plates designed to minimize extrusion damage. Knitted wire mesh or braided wire in the packing immediately adjacent the face of the wear plates have been used in an attempt to limit extrusion of the packing. U.S. Patent No. 4,219,204 suggests the use of such knitted wire in a seal as an anti-extrusion means. Also, it has been known to embed a canvas fabric in seals, such as mud pump piston seal rings, to provide extended seal life.

U.S. Patent No. 2194259 described a ram-type blowout preventer in which the rams have front packing assemblies positioned at the front thereof. The packing assemblies include resilient packing material and an upper plate on the upper surface of the packing material.

The present invention provides in one aspect a ram-type blowout preventer comprising a housing having a bore with aligned ram guideways, a ram disposed in each ram guideway, each ram being movable inwardly and outwardly in its guideway, a front packer positioned in front of each ram, each front packer including a packing of resilient material, and an upper plate on the upper surface of said packing, characterised in that a layer of non-metallic reinforcing material is embedded in a front portion of said packing immediately below and extending generally parallel to said upper plate.

The present blowout preventer has an extended life when used in stripping service, can maintain its seal when closed even after many closing cycles and under conditions of high abrasion and extrusion.

Another aspect of the invention provides a front packer for use in a ram-type blowout preventer of the type having a housing with a bore having ram guideways within which ram means can move inwardly and outwardly, said front packer comprising a ram front packing of resilient material and an upper plate on the upper surface of said packing, characterised by including a layer of non-metallic reinforcing material, embedded in a front portion of said packing immediately below and extending generally parallel to said upper plate.

The invention will be described now by way of example only with particular reference to the accompanying drawings. In the drawings:

FIGURE 1 is an elevation view of an improved blowout preventer of the present invention with one side thereof shown in section to illustrate the improved packer,

FIGURE 2 is a plan view of an improved packer of the present invention showing the reinforcing material in the packing in dashed lines,

FIGURE 3 is a sectional view of the packer taken along line 3-3 in FIGURE 2,

FIGURE 4 is a plan view of a modified form of ram including an improved packer of the present invention,

FIGURE 5 is a sectional view of the modified ram taken along line 5-5 in FIGURE 4,

FIGURE 6 is a front elevation view of the packer in the modified ram shown in FIGURES 4 and 5,

FIGURE 7 is a sectional view of the ram of the present invention as shown in FIGURE 1 but enlarged.

A blowout preventer 10 is a ram-type preventer including housing 12 with vertical bore 14 therethrough and aligned ram guideways 16 extending outward through housing 12 from opposite sides of bore 14. One of rams 18 is positioned in each of guideways 16 and each ram 18 includes means 20, such as a piston (not shown), connected to ram 18 by actuator connecting rods 22 for moving rams 18 inward and outward in guideways 16 to close or open bore 14. While only one guideway 16 and one ram 18 are shown it is understood that there are two opposed guideways 16 and a ram in each guideway. Ram top seal 24 extends across the top of each ram 18 in groove 26 to provide a seal between ram 18 the interior of guideway 16 and coacts with ram packer 28 to retain well pressure below rams 18 when rams 18 are closed.

As shown in FIGURES 2 and 3, a ram packer 28 includes upper plate 30, lower plate 32 with resilient packing 34 therebetween. Plates 30 and 32 are elongated with outer portions 36 and 38 and central portion 40. Outer portions 36 and 38 are rectangular in shape and central portion 40 includes face recess 42 and rear projection 44. Pins 46 extend through packing 34 and connect between plates 30 and 32 with locking lugs 48 extending to the rear of packer 28 and are used to secure packer 28 within the recess on the front of rams 18. Embedded in resilient packing 34 immediately below upper plate 30 is a layer of non-metallic reinforcing material 50. It is preferred that the layer of material 50 extend from the front to the rear of packing 34 and completely across central portion 40 and into side portions 36 and 38 as shown in FIGURES 2 and 3.

Material 50 is preferred to be a woven fabric of aramid fibres (or filaments) such as the materials marketed by E.I. du Pont de Nemours, Inc. under the trademarks "Kevlar®" and "Nomex®". In the preferred structure of improved packer 28,

multiple layers of the fabric are embedded in the area immediately below plate 30. The fabric layers are first impregnated with uncured rubber stock of the compound having the desired properties. The fabric layers are then stacked to obtain the desired thickness, which is preferred to be such that the thickness "F" of the fabric is about 28 percent of the combined thickness "T" of the fabric and elastomer. The uncured rubber impregnated into the fabric has enough adhesive quality to allow the fabric to be held against plate 30 by a small amount of cold pressing. Plate 30, with fabric material 50 adhering thereto, pins 46 and plate 32 are all placed in a suitable mould whereupon the uncured rubber is injected into the mould and then vulcanized.

Alternately fabric material 50 may be of woven fibre-glass, polyester, nylon, or carbon fibres depending upon the anticipated service.

While the preferred form of the improved packer of the present invention is shown and described to have the reinforcing material 50 adjacent plate 30 it is believed that a very considerable improvement in the service life of the packer is achieved even when the reinforcing material is used adjacent both of plates 30 and 32.

The present packers have been tested by closing with a drill string running through the recesses and simulated well pressure beneath the rams and reciprocating the drill string back and forth through the closed rams many cycles. Such tests were designed to simulate actual field usage of the improved packer and blowout preventer of the present invention and they showed a completely unexpected improvement in the life of the packer which lasted as long as ten times the life of a typical prior art packer. In one test the packer after having run through 5,000 cycles continued to maintain its seal and when removed was found to have its resilient packing material to have worn completely through to the rear of the packer in the area of the rear projection 44. The opening was such that a large coin could be easily passed therethrough.

Another embodiment of the improved ram of the present invention is shown in FIGURES 4 and 5 wherein ram 52 includes ram body 54 having slot 56 in its rear surface for connection to an actuator connecting rod (not shown), resilient packer 58 and packer holder 60 which is positioned in recess 62 on the face of ram body 54 and is movable a short distance with respect to ram body 54 to energize ram top seal 68 and ram bottom seal 70.

Resilient packer 58 includes face portion 64 positioned in face recess 66 in the front of packer holder 60 and upper and lower seal strips 68 and 70 integral with face portion 64 and positioned in the spaces between ram body 54 and packer holder 60 to provide a complete seal around the ram 52 and across its face. Face portion 64 of packer 58 includes resilient material strip 72 with upper plate 74 and lower plate 76 embedded therein. Also fabric 78 in a plurality of layers is embedded in strip 72 both adjacent the underside of upper plate 74 and the upper side of lower plate 76 as shown in FIGURES 5 and 6. Fabric 78 is the same fabric as described above with reference to fabric material 50 of the preferred embodiment.

Claims

1. A ram-type blowout preventer (10) comprising a housing (12) having a bore (14) with aligned ram guideways (16), a ram (18) disposed in each ram guideway (16), each ram (18) being movable inwardly and outwardly in its guideway (16), a front packer (28 or 58) positioned in front of each ram (18), each front packer (28 or 58) including a packing of resilient material (34 or 72), and an upper plate (30 or 74) on the upper surface of said packing (34 or 72), characterised in that a layer of non-metallic reinforcing material (50) is embedded in a front portion of said packing (34 or 72) immediately below and extending generally parallel to said upper plate (30 or 74).

2. A ram-type blowout preventer (10) according to claim 1, characterised by including a lower plate (76) on the lower surface of said packing (72), and a further layer (78) of non-metallic reinforcing material embedded in a front portion of said packing (72) immediately above and extending generally parallel to said lower plate (76).

3. A ram-type blowout preventer (10) according to claim 1, or 2, characterised in that said packer (28 or 58) has a face recess (42 or 66) for engaging a string extending through the bore (14) of said housing (12).

4. A ram-type blowout preventer (10) according to claim 1, or 2, characterised in that said reinforcing material (50 or 78) is a fabric woven from fibres selected from the group consisting of aramid fibres, glass fibres, polyester fibres, nylon fibres or carbon fibres.

5. A ram-type blowout preventer (10) according to any preceding claim, characterised in that the thickness of the reinforcing material (50 or 78) is approximately 28% of the combined thickness of said packing (34 or 72) and said material.

6. A front packer (28 or 58) for use in a ram-type blowout preventer (10) of the type having a housing (12) with a bore (14) having ram guideways (16) within which ram means can move inwardly and outwardly, said front packer (28 or 58) comprising a ram front packing of resilient material (34 or 72) and an upper plate (30 or 74) on the upper surface of said packing, characterised by including a layer of non-metallic reinforcing material (50), embedded in a front portion of said packing (34 or 72) immediately below and extending generally parallel to said upper plate (30 or 74).

7. A front packer (58) according to claim 6, characterised by including a lower plate (76) on the lower surface of said packing (72), and a further layer of non-metallic reinforcing material embedded in a front portion of said packing, immediately above and generally parallel to said lower plate (76).

multiple layers of the fabric are embedded in the area immediately below plate 30. The fabric layers are first impregnated with uncured rubber stock of the compound having the desired properties. The fabric layers are then stacked to obtain the desired thickness, which is preferred to be such that the thickness "F" of the fabric is about 28 percent of the combined thickness "T" of the fabric and elastomer. The uncured rubber impregnated into the fabric has enough adhesive quality to allow the fabric to be held against plate 30 by a small amount of cold pressing. Plate 30, with fabric material 50 adhering thereto, pins 46 and plate 32 are all placed in a suitable mould whereupon the uncured rubber is injected into the mould and then vulcanized.

Alternately fabric material 50 may be of woven fibre-glass, polyester, nylon, or carbon fibres depending upon the anticipated service.

While the preferred form of the improved packer of the present invention is shown and described to have the reinforcing material 50 adjacent plate 30 it is believed that a very considerable improvement in the service life of the packer is achieved even when the reinforcing material is used adjacent both of plates 30 and 32.

The present packers have been tested by closing with a drill string running through the recesses and simulated well pressure beneath the rams and reciprocating the drill string back and forth through the closed rams many cycles. Such tests were designed to simulate actual field usage of the improved packer and blowout preventer of the present invention and they showed a completely unexpected improvement in the life of the packer which lasted as long as ten times the life of a typical prior art packer. In one test the packer after having run through 5,000 cycles continued to maintain its seal and when removed was found to have its resilient packing material to have worn completely through to the rear of the packer in the area of the rear projection 44. The opening was such that a large coin could be easily passed therethrough.

Another embodiment of the improved ram of the present invention is shown in FIGURES 4 and 5 wherein ram 52 includes ram body 54 having slot 56 in its rear surface for connection to an actuator connecting rod (not shown), resilient packer 58 and packer holder 60 which is positioned in recess 62 on the face of ram body 54 and is movable a short distance with respect to ram body 54 to energize ram top seal 68 and ram bottom seal 70.

Resilient packer 58 includes face portion 64 positioned in face recess 66 in the front of packer holder 60 and upper and lower seal strips 68 and 70 integral with face portion 64 and positioned in the spaces between ram body 54 and packer holder 60 to provide a complete seal around the ram 52 and across its face. Face portion 64 of packer 58 includes resilient material strip 72 with upper plate 74 and lower plate 76 embedded therein. Also fabric 78 in a plurality of layers is embedded in strip 72 both adjacent the underside of upper plate 74 and the upper side of lower plate 76 as shown in FIGURES 5 and 6. Fabric 78 is the same fabric as described above with reference to fabric material 50 of the preferred embodiment.

Claims

1. A ram-type blowout preventer (10) comprising a housing (12) having a bore (14) with aligned ram guideways (16), a ram (18) disposed in each ram guideway (16), each ram (18) being movable inwardly and outwardly in its guideway (16), a front packer (28 or 58) positioned in front of each ram (18), each front packer (28 or 58) including a packing of resilient material (34 or 72), and an upper plate (30 or 74) on the upper surface of said packing (34 or 72), characterised in that a layer of non-metallic reinforcing material (50) is embedded in a front portion of said packing (34 or 72) immediately below and extending generally parallel to said upper plate (30 or 74).

2. A ram-type blowout preventer (10) according to claim 1, characterised by including a lower plate (76) on the lower surface of said packing (72), and a further layer (78) of non-metallic reinforcing material embedded in a front portion of said packing (72) immediately above and extending generally parallel to said lower plate (76).

3. A ram-type blowout preventer (10) according to claim 1, or 2, characterised in that said packer (28 or 58) has a face recess (42 or 66) for engaging a string extending through the bore (14) of said housing (12).

4. A ram-type blowout preventer (10) according to claim 1, or 2, characterised in that said reinforcing material (50 or 78) is a fabric woven from fibres selected from the group consisting of aramid fibres, glass fibres, polyester fibres, nylon fibres or carbon fibres.

5. A ram-type blowout preventer (10) according to any preceding claim, characterised in that the thickness of the reinforcing material (50 or 78) is approximately 28% of the combined thickness of said packing (34 or 72) and said material.

6. A front packer (28 or 58) for use in a ram-type blowout preventer (10) of the type having a housing (12) with a bore (14) having ram guideways (16) within which ram means can move inwardly and outwardly, said front packer (28 or 58) comprising a ram front packing of resilient material (34 or 72) and an upper plate (30 or 74) on the upper surface of said packing, characterised by including a layer of non-metallic reinforcing material (50), embedded in a front portion of said packing (34 or 72) immediately below and extending generally parallel to said upper plate (30 or 74).

7. A front packer (58) according to claim 6, characterised by including a lower plate (76) on the lower surface of said packing (72), and a further layer of non-metallic reinforcing material embedded in a front portion of said packing, immediately above and generally parallel to said lower plate (76).

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8. A front packer (28 or 58) according to claim 6 or claim 7, characterised in that said packer (28 or 58) has a face recess (42 or 66) for engaging a string extending through the bore (14) of said housing (12).

9. A front packer (28 or 58) according to any one of claims 6 to 8, characterised in that said reinforcing material (50 or 78) is a fabric selected from the group consisting of aramid fibres, glass fibres, polyester fibres, nylon fibres or carbon fibres.

10. A front packer (28 or 58) according to any one of claims 6 to 9, characterised in that the thickness of the reinforcing material (50 or 78) is approximately 28% of the combined thickness of said packing (34 or 72) and said material.

11. A ram for use in a ram-type blowout preventer (10), said ram (52) comprising a ram body (54) and being characterised by including a ram front packing according to any one of claims 6 to 10.

Patentansprüche

1. Blowout-Preventer (10) vom Plungertyp, umfassend ein Gehäuse (12), das eine Bohrung (14) mit ausgerichteten Plungerführungswegen (16) aufweist, einen in jedem Plunger-Führungsweg (16) angeordneten Plunger (18), der in seinem Führungsweg (16) einwärts und auswärts bewegbar ist, eine Frontdichtungsanordnung (28 oder 58), die vor jedem Plunger (18) angeordnet ist, wobei jede Frontdichtungsanordnung (28 oder 58) eine Dichtungspackung aus nachgiebigem Material (34 oder 72) aufweist, und eine obere Platte (30 oder 74) auf der oberen Fläche der Dichtungspackung (34 oder 72) dadurch gekennzeichnet, daß eine Schicht aus nichtmetallischem Verstärkungsmaterial (50) in einem vorderen Teil der Dichtungspackung (34 oder 72) eingebettet ist, und zwar unmittelbar unterhalb der oberen Platte (30 oder 74) sowie im allgemeinen parallel zu dieser verlaufend.

2. Blowout-Preventer von Plungertyp (10) nach Anspruch 1, gekennzeichnet durch eine auf der unteren Fläche der Dichtungspackung (72) vorgesehene untere Platte (76) und eine weitere Schicht (78) aus nichtmetallischem Verstärkungsmaterial, das in einem vorderen Teil der Dichtungspackung (72) eingebettet ist, und zwar unmittelbar oberhalb der unteren Platte (76) und im allgemeinen parallel zu dieser verlaufend.

3. Blowout-Preventer (10) vom Plungertyp nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Dichtungsanordnung (28 oder 58) eine Flächenaussparung (42 oder 66) zur Aufnahme eines Gestänges, das sich durch die Bohrung (14) des Gehäuses (12) erstreckt.

4. Blowout-Preventer (10) vom Plungertyp nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Verstärkungsmaterial (50 oder 78) ein aus Fasern gewebtes Gewebe ist, die aus der aus Aramidfasern, Glasfasern, Polyesterfasern, Nylonfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt sind.

5. Blowout-Preventer (10) vom Plungertyp nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Dicke des Verstärkungsmaterials (50 oder 78) annähernd 28% der kombinierten Dicke von Dichtungspackung (34 oder 72) und dem Material ist.

6. Front-Dichtungsanordnung (28 oder 58) zur Verwendung in einem Blowout-Preventer (10) vom Plungertypus, wobei der Preventer ein Gehäuse (12) mit einer Bohrung (14) umfaßt, die ihrerseits Plungerführungswege (16) besitzt, innerhalb derer sich eine Plungereinrichtung einwärts und auswärts bewegen kann, wobei die Frontdichtungsanordnung (28 oder 58) eine Plungerfrontdichtungspackung aus nachgiebigem Material (34 oder 72) und eine obere Platte (30 oder 74) auf der oberen Fläche der Dichtungspakkung umfaßt, gekennzeichnet durch eine vorgesehene Schicht aus nichtmetallischem Verstärkungsmaterial (50), das in einem vorderen Teil der Packung (34 oder 72) eingebettet ist, und zwar unmittelbar unterhalb der oberen Platte (30 oder 74) sowie im allgemeinen parallel hierzu verlaufend.

7. Frontdichtungsanordnung (58) nach Anspruch 6, gekennzeichnet durch eine vorgesehene untere Platte (76) auf der unteren Fläche der Dichtungspackung (72) und eine weitere Schicht aus nichtmetallischem Verstärkungsmaterial, das in einem vorderen Teil der Dichtungspackung eingebettet ist, und zwar unmittelbar oberhalb der unteren Platte (76) sowie im allgemeinen parallel zu dieser verlaufend.

8. Frontdichtungsanordnung (28 oder 58) nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß die Dichtungsanordnung (28 oder 58) eine Flächenaussparung (42 oder 46) zur Aufnahme eines Gestänges aufweist, das sich durch die Bohrung (14) des Gehäuses (12) erstreckt.

9. Frontdichtungsanordnung (28 oder 58) nach einem der Ansprüche 6 bis 8, dadurch gekennzeichnet, daß das Verstärkungsmaterial (50 oder 78) ein Gewebe ist, das aus der aus Aramidfasern, Glasfasern, Polyesterfasern, Nylonfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt ist.

10. Frontdichtungsanordnung (28 oder 58) nach einem der Ansprüche 6 bis 9, dadurch gekennzeichnet, daß die Dicke des Verstärkungsmaterials (50 oder 78) annähernd 28% der kombinierten Dicke von Dichtungspackung (34 oder 72) und dem Material ist.

11. Plunger zur Verwendung in einem Blowout-Preventer (10) vom Plungertyp, wobei der Plunger (52) einen Plungerkörper (54) aufweist, gekennzeichnet durch Vorsehen einer Plungerfrontdichtungspackung nach einem der Ansprüche 6 bis 10.

Revendications

1. Bloc obturateur de puits (10), à mâchoires, comprenant une enveloppe (12) ayant un alésage (14) avec des glissières alignées (16) pour mâchoires, une mâchoire (18) disposée dans chaque glissière de mâchoire (16), chaque mâchoire

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(18) pouvant se déplacer vers l'intérieur et vers l'extérieur dans sa glissière (16), une garniture frontale (28 ou 58) étant placée à l'avant de chaque mâchoire (18), chaque garniture frontale (28 ou 58) comprenant un garnissage en un matériau élastique (34 ou 72), et une plaque supérieure (30 ou 74) sur la surface supérieure du garnissage (34 ou 72), caractérisé en ce qu'une couche d'un matériau de renforcement non-métallique (50) est noyée dans une partie frontale du garnissage (34 ou 72) et s'étend immédiatement en-dessous de ladite plaque supérieure (30 ou 74) d'une manière généralement parallèle à cette dernière.

2. Bloc obturateur de puits à mâchoires (10) selon la revendication 1, caractérisé en ce qu'il comprend une plaque inférieure (76) sur la surface inférieure du garnissage (72), et une couche supplémentaire (78) en matériau de renforcement non-métallique qui est noyée dans une partie frontale du garnissage (72) et s'étend immédiatement au-dessus de ladite plaque inférieure (76) d'une manière généralement parallèle à cette dernière.

3. Bloc obturateur de puits à mâchoires (10) selon la revendication 1 ou 2, caractérisé en ce que la garniture (28 ou 58) comporte un évidement avant (42 ou 66) pour recevoir une ligne s'étendant à travers l'alésage (14) de ladite enveloppe (12).

4. Bloc obturateur de puits de mâchoires (10) selon la revendication 1 ou 2, caractérisé en ce que ledit matériau de renforcement (50 ou 78) est un tissu tissé à partir de fibres choisies dans l'ensemble comprenant les fibres aramide, les fibres de verre, les fibres de polyester, les fibres de nylon et les fibres de carbone.

5. Bloc obturateur de puits à mâchoires (10) selon l'une quelconque des revendications précédentes, caractérisé en ce que l'épaisseur du matériau de renforcement (50 ou 70) est d'environ 28% de l'épaisseur combinée du garnissage (34 ou 72) et dudit matériau.

6. Garniture frontale (28 ou 58) pour utilisation dans un bloc obturateur de puits à mâchoires (10) du type ayant une enveloppe (12) avec un alésage (14) ayant des glissières pour mâchoires (16) dans lesquelles des moyens à usage de mâchoires peuvent se déplacer vers l'intérieur et vers l'extérieur, la garniture frontale (28 ou 58) comprenant un garnissage frontal de mâchoire en un matériau élastique (34 ou 72) et une plaque supérieure (30 ou 74) sur la surface supérieure du garnissage, caractérisé en ce qu'elle comprend une couche d'un matériau de renforcement non-métallique (50) qui est noyée dans une partie frontale du garnissage (34 ou 72) et s'étend immédiatement en-dessous de ladite plaque supérieure (30 ou 74), d'une manière généralement parallèle à cette dernière.

7. Garniture frontale (58) selon la revendication 6, caractérisée en ce qu'elle comprend une plaque inférieure (76) sur la surface inférieure du garnissage (72), et une couche supplémentaire en un matériau de renforcement non-métallique qui est noyée dans une partie frontale du garnissage immédiatement au-dessus de la plaque inférieure (76) et d'une manière généralement parallèle à cette dernière.

8. Garniture frontale (28 ou 58) selon la revendication 6 ou 7, caractérisée en ce que ladite garniture (28 ou 58) comporte un évidement avant (42 ou 66) pour recevoir une ligne traversant l'alésage (14) de ladite enveloppe (12).

9. Garniture frontale (28 ou 58) selon l'une quelconque des revendications 6 à 8, caractérisée en ce que le matériau de renforcement (50 ou 78) est un tissu choisi dans l'ensemble comprenant les fibres aramide, les fibres de verre, les fibres de polyester, les fibres de nylon et les fibres de carbone.

10. Garniture frontale (28 ou 58) selon l'une quelconque des revendications 6 à 9, caractérisée en ce que l'épaisseur du matériau de renforcement (50 ou 70) est d'environ 28% de l'épaisseur combinée du garnissage (34 ou 72) et dudit matériau.

11. Mâchoire pour utilisation dans un bloc obturateur de puits à mâchoires (10), ladite mâchoire (52) comprenant un corps de mâchoire (54), et étant caractérisée en ce qu'elle comprend une garniture frontale de mâchoire selon l'une quelconque des revendications 6 à 10.

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