US 20130164080A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2013/0164080 A1**

(43) **Pub. Date: Jun. 27, 2013**

Miller et al.

(54) **COUPLER**

(71) Applicant: **Miller International Ltd.**, Gibraltar (GI)

(72) Inventors: **Gary Miller**, Washington (GB); **Howard Reay**, Washington (GB)

(73) Assignee: **MILLER INTERNATIONAL LTD.**, Gibraltar (GI)

(21) Appl. No.: **13/726,024**

(22) Filed: **Dec. 22, 2012**

(30) **Foreign Application Priority Data**

Dec. 22, 2011 (GB) 1122270.0

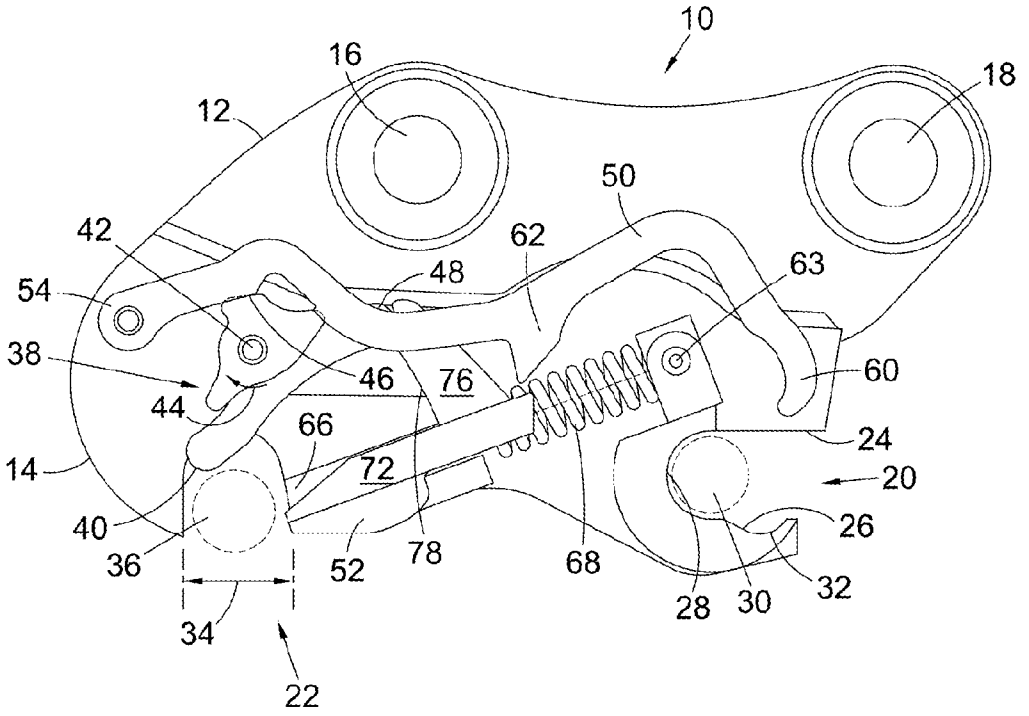
Publication Classification

(51) **Int. Cl.**
E02F 3/36 (2006.01)

(52) **U.S. Cl.**
CPC *E02F 3/3604* (2013.01)
USPC **403/327**; 403/373; 403/326

(57) **ABSTRACT**

A coupler (**10**) for securely attaching an accessory to an excavator arm of an excavator. The coupler (**10**) comprises a first half (**16**) for connecting to the excavator arm and a second half (**18**) for connecting to the accessory. The second half comprises a front jaw with a movable front latch associated therewith, the front latch having a latching position and a non-latching position, and being for latching one of two attachment pins of the accessory within the front jaw when it is in its latching position. The second half also has a rear latch, the rear latch having a retracted position and an advanced position, and being for engaging a second of the attachment pins when it is in its advanced position. The second half also has a trigger member mounted for movement relative to the frame, the trigger member being arranged for movable interaction with both the front latch and the rear latch so as to move, respectively, the front latch between its latching position and its non-latching position and the rear latch between its advanced position and its retracted position.



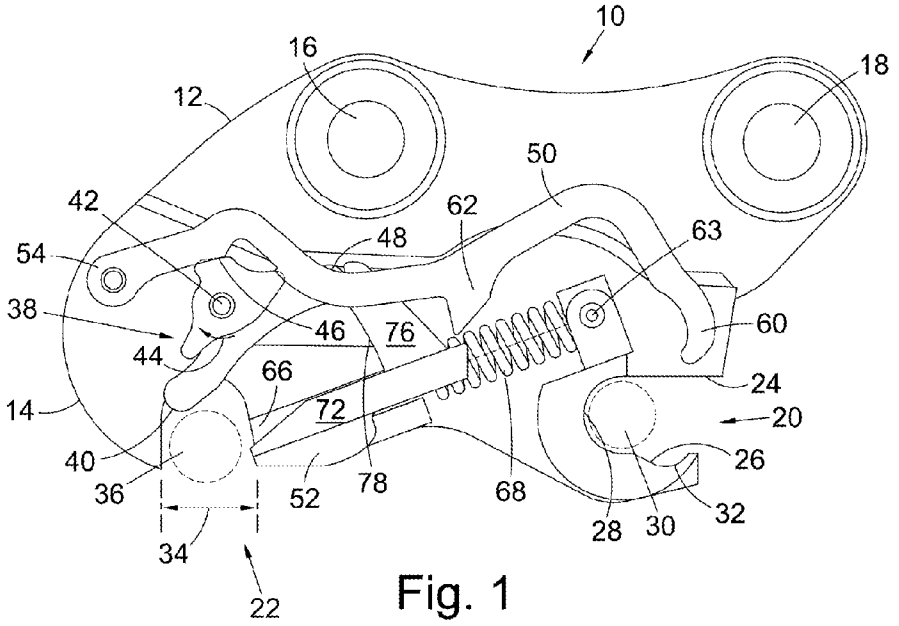

10
16
18
12
50
42
62
48
63
54
38
46
76
60
44
66
24
14
72
20
40
26
36
52
78
68
32
28
30
34
22

Fig. 1

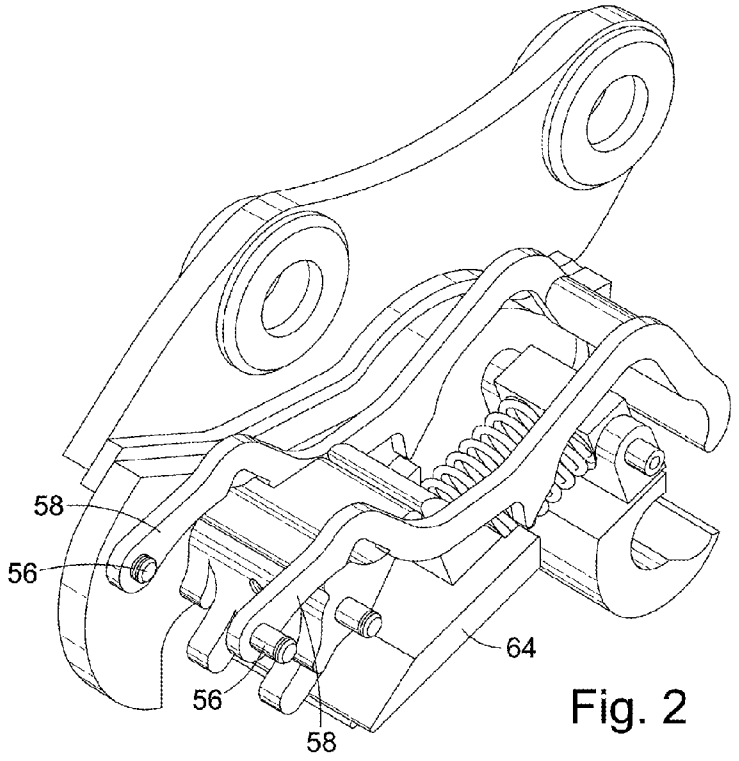

58
56
64
56
58

Fig. 2

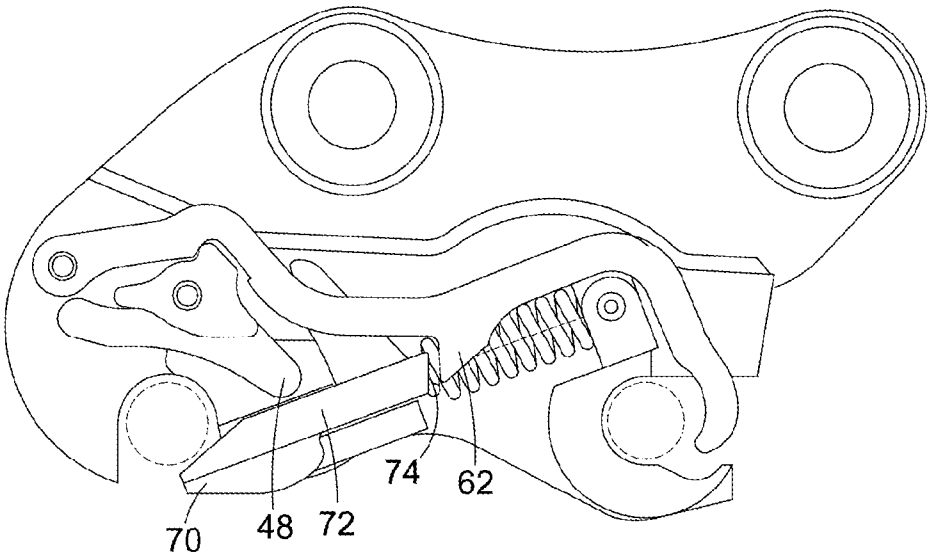


Fig. 3

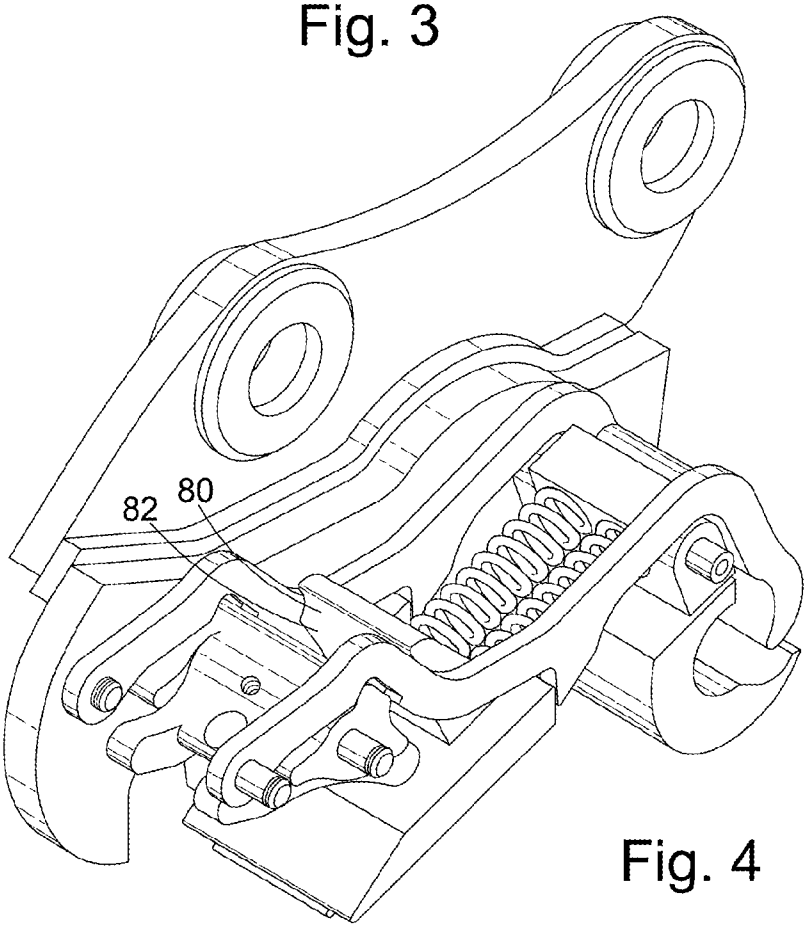


Fig. 4

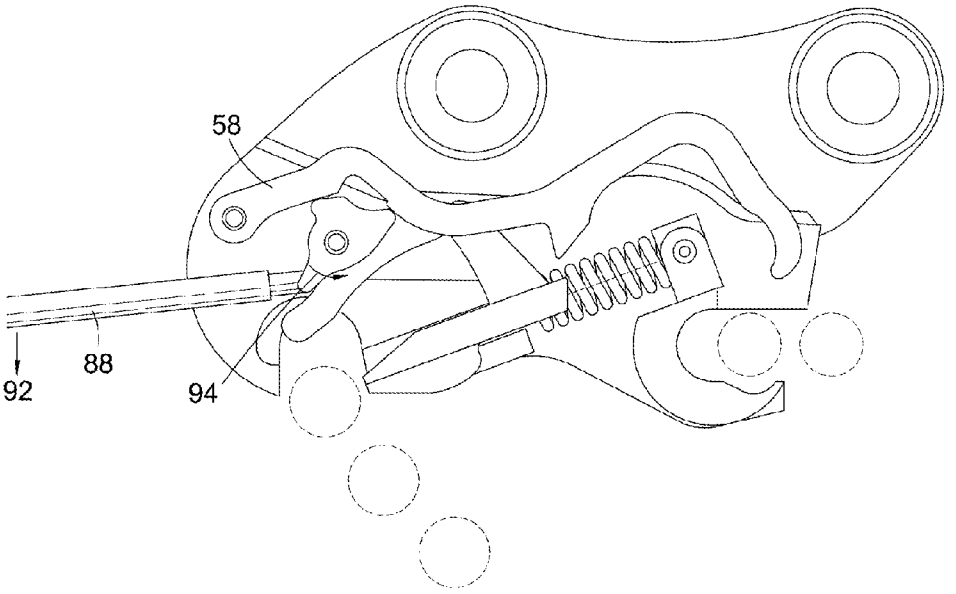


Fig. 5

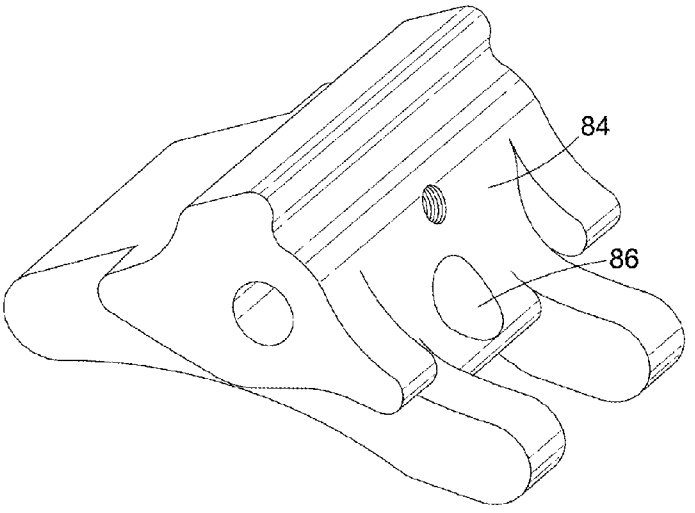


Fig. 6

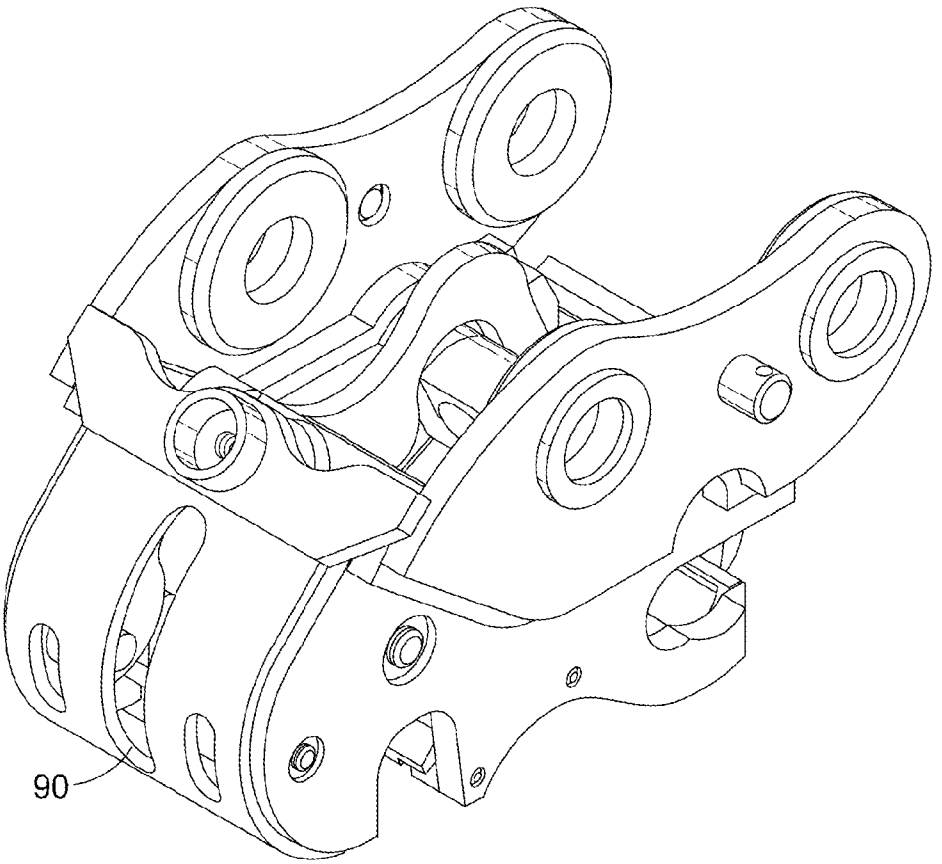


Fig. 7

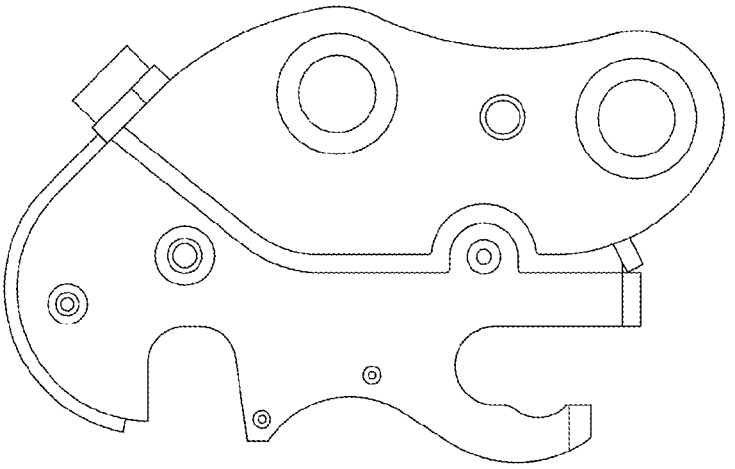


Fig. 8

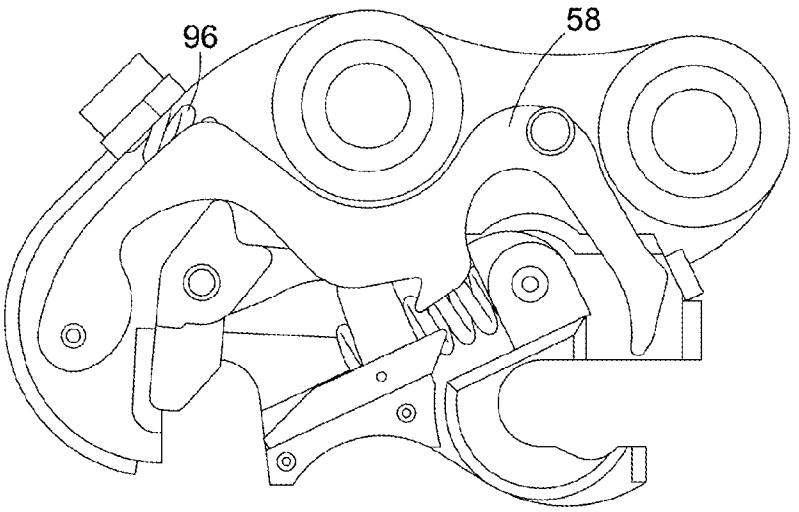


Fig. 9

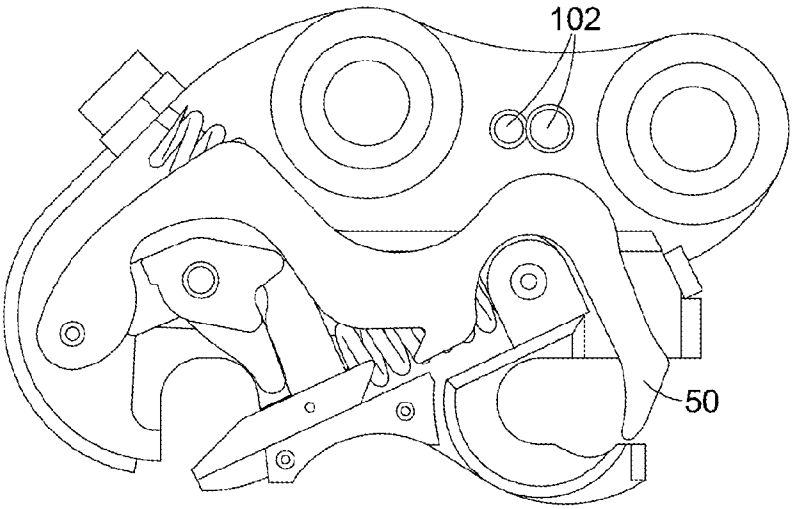


Fig. 10

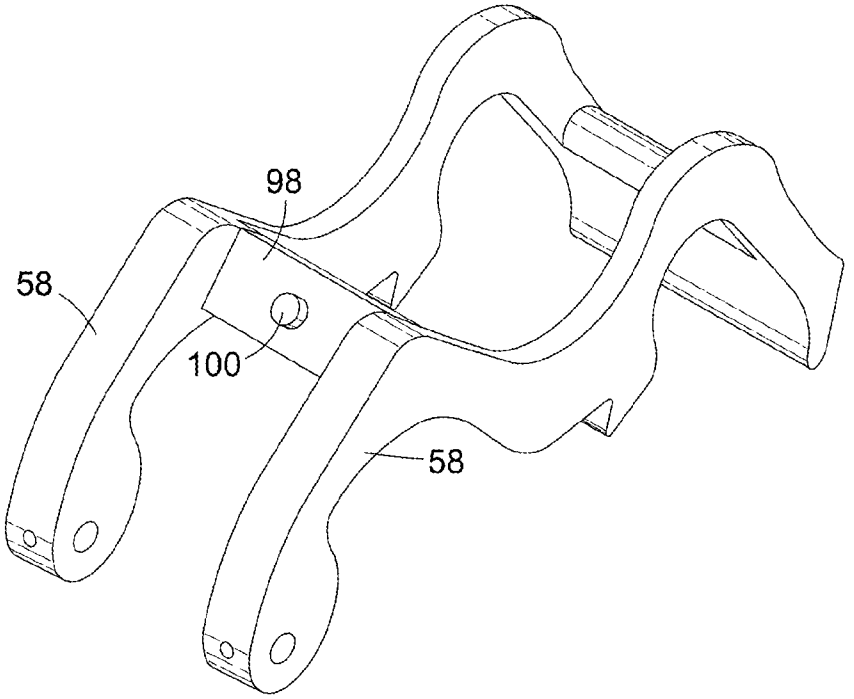


Fig. 11

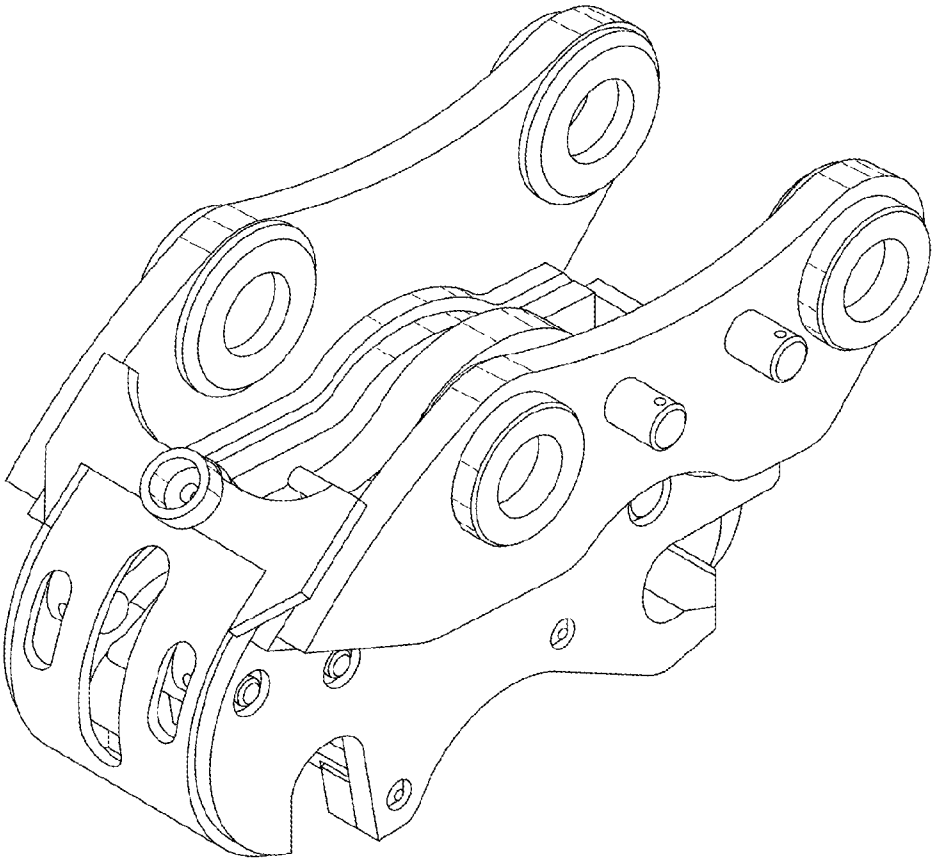


Fig. 12

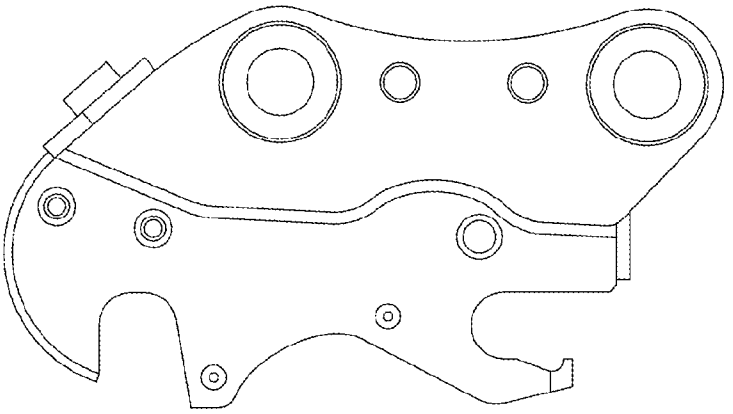


Fig. 13

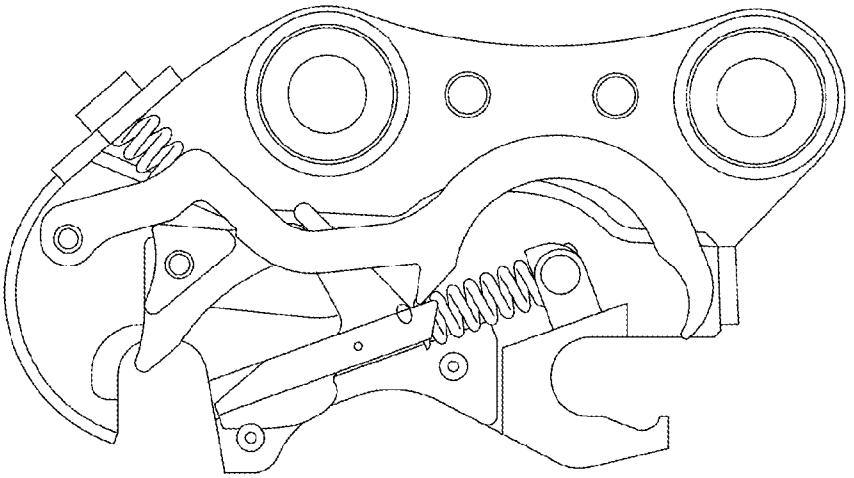


Fig. 14

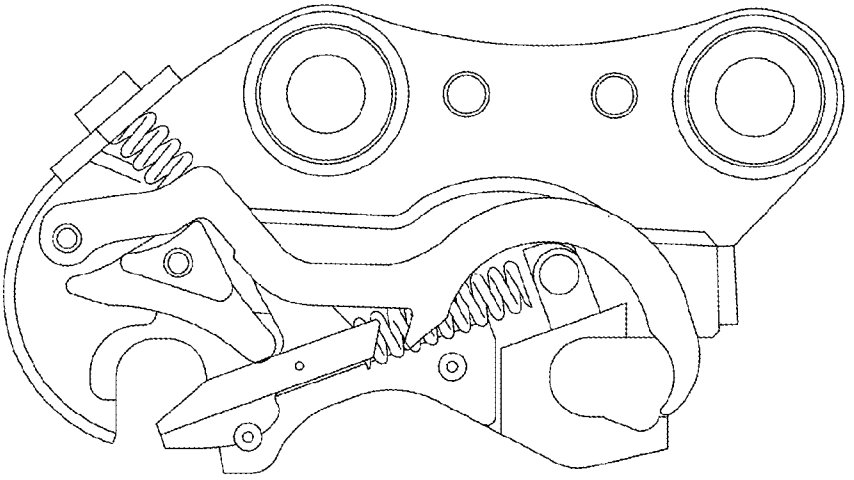


Fig. 15

COUPLER

TECHNICAL FIELD

[0001] The present invention relates to a coupler for coupling an accessory to an excavator arm of an excavator. One such accessory could be an excavator bucket.

BACKGROUND OF THE INVENTION

[0002] Couplers for coupling accessories to the excavator arm of an excavator are well known in the art. Indeed many prior art patents and patent applications describe such couplers. See, for example, GB2330570, GB21 77674, EP0184282, U52005169703A1, U.S. Pat. No. 6,699,001, WO2010/059948, GB2412361, GB24631 58, GB2447809 and WO2008/031590.

[0003] These couplers generally comprise a top half that is connectable to an excavator arm using two attachment pins (via two pairs of holes provided for those attachment pins) and a bottom half for engaging two further attachment pins, on the accessory. For that latter purpose that bottom half typically comprises two jaws, rather than holes. Those jaws engage respective ones of those two further attachment pins of the accessory.

[0004] A common feature of many couplers is that a first of the two jaws is usually referred to as a front jaw. Its opening (for receiving the first or front attachment pin) is generally directed out of the front end of the coupler, i.e. generally parallel to an imaginary line joining the two pairs of holes in the top half of the coupler. Often it is angled slightly upwards from that line, perhaps at an angle of up to 15°.

[0005] The second jaw is then usually referred to as a rear jaw. It generally points downwardly, i.e. in a direction that is generally perpendicular to the front jaw.

[0006] The rear jaw commonly has an associated latching hook. The latching hook can be slid or pivoted between a latched position and an unlatched position. In the latched position, the opening of rear jaw is at least partially closed by the latching hook. In the unlatched position, however, the latching hook is usually fully retracted so as to leave the jaw's opening open so that the attachment pin can be removed from the jaw downwardly.

[0007] The coupler in GB2330570 also features a blocking bar which is adapted to fall under the influence of gravity (when in normal, in-use, orientations of the coupler, i.e. non-inverted orientations) into a blocking position in front of the latching hook. In that blocking position, the blocking bar will resist the unlatching of the latching hook by blocking its path from its latching position into an unlatched position.

[0008] The blocking bar is pivotally mounted about a pivot. That pivot is positioned near the front jaw. The blocking bar therefore points generally towards the rear jaw from that pivot and is balanced about that pivot such that gravity will usually urge it towards its blocking position, i.e. while the coupler is in the normal, in-use, orientations, i.e. rather than upside down or partially inverted. Then, in order to unblock the latching hook (for decoupling the accessory from the coupler), either the coupler would need to be inverted or else some form of urging means would be provided for lifting the blocking bar from its blocking position into a non-blocking position. One such urging means could be a small hydraulic ram.

[0009] During normal use, i.e. when digging with a bucket, very high forces can be loaded onto the latching hook by the attachment pins of the accessory. Occasionally those forces may be transferred, at least in part, onto the blocking bar. In order to cope with those forces, therefore, the blocking bar is usually a rather substantial element. This is to prevent the blocking bar from buckling under those occasional loads.

[0010] Other couplers are disclosed in U.S. Pat. No. 6,699,001 and GB2447809. In those documents, the rear pivoting latching hook is replaced by a sliding member.

[0011] Further couplers are disclosed in GB2463158 and WO2008/031590. In those couplers, both jaws feature a pivotable latch.

[0012] The movement of the latches can be by a spring bias, or by a mechanical actuator (usually either a hydraulic ram or a large screw-thread drive, or for the case of the front latch, by gravity. The movement of the blocking bar, where provided, can also be by actuator or gravity. For the actuator, it is typically a separate hydraulic ram to the ram for the rear latch.

[0013] The latching and securing actions, and also the later detachment/disconnection actions on these couplers, typically have to be performed using a series of predefined steps since the mechanisms such as the latches for each jaw, and any blocking means therefor, are designed not to actuate together so as to prevent inadvertent detachment. What would be desirable, however, would be to provide a coupler arrangement in which latches are still blocked from inadvertent detachment, but in which a single element can trigger the secured attachment of an accessory in the first place, and likewise cause a required detachment or disconnection of an accessory to occur. It is important, however, for the coupler still to feature the requisite precautionary, effective, but generally redundant, latch back-up mechanisms so as to prevent inadvertent detachment upon a failure of an element within the coupler.

SUMMARY OF THE INVENTION

[0014] According to embodiments of the present invention there is provided a coupler for attaching an accessory to an excavator arm of an excavator, the coupler comprising a frame with a first half for connecting to the excavator arm and a second half for connecting to the accessory, the second half comprising:

[0015] a front jaw with a movable front latch associated therewith, the front latch having a latching position and a non-latching position, and being for latching one of two attachment pins of the accessory within the front jaw when it is in its latching position;

[0016] a rear latch, the rear latch having a retracted position and an advanced position, and being for engaging a second of the attachment pins when it is in its advanced position; and

[0017] a trigger member mounted for movement relative to the frame, the trigger member being arranged for movable interaction with both the front latch and the rear latch so as to move, respectively, the front latch between its latching position and its non-latching position and the rear latch between its advanced position and its retracted position.

[0018] Preferably the trigger member is pivotally mounted relative to the frame.

[0019] Preferably the trigger member directly bears against either one or both of the latches.

[0020] Preferably the trigger member is mounted within a rear half of the coupler. The rear half of the coupler can be defined as any point rearwards of a lateral plane extending

between sideplates of the frame, which plane is located midway between the rearmost lip of the rear latch when the rear latch is in its most retracted position and the rearmost part of the front jaw.

[0021] The trigger member is preferably arranged above a rear jaw of the coupler, the rear jaw being a second jaw, and it being associated with the rear latch.

[0022] Preferably the front latch is pivotable between its latching position and its non-latching position.

[0023] Preferably the front latch at least partially closes its associated front jaw when in its latching position.

[0024] Preferably the rear latch at least partially closes its associated rear jaw when in its advanced position.

[0025] Preferably the accessory couples to the coupler by a two-pin attachment, wherein the front jaw engages a first one of those two pins and the rear latch engages the second of those two pins, the rear latch cooperating with the frame and the front jaw to provide the engagement force for retaining the first pin in the front jaw and the second pin against the rear latch.

[0026] Preferably the mode of attachment includes first engaging the first pin in the front jaw, and then engaging the second pin with the rear latch

[0027] Preferably the front jaw is a first jaw and the rear latch is associated with a second jaw—a rear jaw.

[0028] Preferably the rear jaw faces a different direction to the first jaw. Preferably the rear jaw faces a direction that is perpendicular to the direction of the first jaw.

[0029] Preferably the second jaw has a wider opening than the first jaw—this allows for accessories from different manufacturers to be accommodated—pin diameters of the attachment pins, for a given application/machine load rating, tend to be generally similar, i.e. rarely differing by more than 5%, but pin centre spacings can vary more than that, e.g. often by up to 15% between manufacturers.

[0030] The rear latch will typically be permanently biased towards its advanced position. The bias may be provided by a spring, such as a coil spring. There may be more than one such coil springs—preferably there are two. This ensures that if one fails, the other will still provide a desired bias towards a latching position.

[0031] The front latch may be permanently or selectively biased towards its latching position. Selective bias may be provided by gravity, e.g. when the coupler is appropriately oriented. In another arrangement the bias may be permanent, such as by a spring, such as a coil spring. There may be more than one such coil springs, but often just the one will be enough, especially if gravity can provide a redundant back-up bias.

[0032] Further bias might be provided by selectively operable hydraulic rams, potentially with selectively operable oil circuit bypasses, thereby allowing actions from the trigger member to not need to overcome such hydraulic bias forces.

[0033] Preferably the rear jaw points directly away from the first (top) half of the coupler, i.e. it is a downwardly facing jaw.

[0034] Preferably the front jaw faces substantially forwards or generally longitudinally, i.e. generally along the long-axis of the coupler (or generally parallel to an imaginary line extending between the centres of the two attachment pins of the accessory—once correctly mounted onto the coupler). The front jaw in further arrangements may face slightly upwards of that longitudinal line, but preferably by no more than 15° from that line.

[0035] The rear latch will usually comprise a nose portion having a substantially constant or solid section that extends between two jaw members, one in each sidewall of the frame.

[0036] The front latch will usually comprise a nose portion having substantially constant or solid cross section that extends downwardly into the mouth of the front jaw, the throat of the front jaw, and the bottom lip of the front jaw, both having a substantially constant or solid cross section.

[0037] The or each jaw, or jaw part, will usually be provided with a reinforced or hardened steel insert to provide additional strength for the jaw. That additional strength assists the jaw to accommodate the heavy loading that will be applied to it during the use of the coupler.

[0038] Preferably the accessory is an excavator bucket.

[0039] Preferably the front latch is merely a generally redundant back-up mechanism for the coupler, the rear latch and front jaw providing the primary latching mechanism for the accessory to the coupler. As a redundant back-up mechanism, the front latch serves to secure the accessory to the coupler in the event of a failure in the primary latching mechanism, such as if the rear latch bends or breaks off. As such, the front latch is unlikely actually to engage against an attachment pin that might be engaged within the front jaw, even though it laches that pin within that jaw.

[0040] Preferably the front latch has a centre of gravity such that disengagement of the front latch from its latching position into its non-latching position cannot occur, purely under the influence of gravity, through a range of angles of rotation from the upright horizontal working position in which the longitudinal axis, or at least 80° in each direction.

[0041] With the spring bias, that angle can increase beyond 90°, and even beyond 180° so as to provided full inversion-ability without a compromise to the attachment condition.

[0042] Preferably the front latch has a pivot pin about which it can rotate, that pivot pin extending in a lateral direction relative to the frame of the coupler.

[0043] Preferably the front latch is bifurcated, and has two pivot pins, each being coaxial and extending in a lateral direction relative to the frame of the coupler.

[0044] Preferably the or each pivot pin is positioned in a rear half of the coupler.

[0045] Preferably the front latch includes one or more arm member extending from a nose portion to a pivot pin. The arm is preferably substantially flat in one plane—preferably a vertical, longitudinal plane.

[0046] Preferably the arm has a blocking member extending therefrom, the blocking member being arranged to locate in front of an end of the rear latch when the rear latch is in an advanced position and simultaneously the front latch is in a latching position. The blocking member thus serves to prevent the rear latch from being retracted into its retracted position until the front latch has been moved into a non-latching position.

[0047] Preferably the arm has a trigger interaction region. Preferably the trigger interaction region has a latch-open region, against which the trigger member can bear when the trigger member is interacting therewith to hold the front latch in a non-latching position. Preferably the trigger interaction region has a latch-closed region, against which the trigger member can bear when the trigger member is interacting therewith with the front latch in a latching position.

[0048] The trigger interaction region is preferably blended so as to offer a smooth, curved surface against which the

trigger member can slide, e.g. when moving between the latch-open region and the latch-closed region thereof.

[0049] Preferably there are two arms, and preferably they mirror one another.

[0050] Preferably the trigger member comprises at least three protruding surfaces—a first protruding surface for interacting with the front latch, e.g. as described above with respect to the trigger interaction region thereof, a second protruding surface for interacting with the rear latch, and a third protruding surface for interacting with a pin of the accessory, e.g. within a rear jaw of the coupler.

[0051] The protruding surfaces preferably are rounded or smooth, rather than pointed or rough. This is to assist with interactions with the surfaces against which they bear. The surfaces may even feature bearings to further improve the low-resistance interaction between the surfaces.

[0052] The rear latch is preferably arranged for transitional movement along tracks within the sidewalls of the frame.

[0053] The rear latch preferably has a tapered end in cross section. This facilitates an insertion of an attachment pin past the end in the event that the end is not fully retracted.

[0054] The front latch may also be adapted for facilitated insertion of an attachment pin past the end thereof, e.g. past the end of its nose portion, in the event that the end is not fully moved into a non-latching position. For this purpose, the end may present an outwardly facing angled surface, or a rounded surface, whereby a pin would force the end upwards due to an angle of a reactionary force generated thereby.

[0055] The rear latch preferably has an upstanding flange thereon, the flange having an end or surface for interaction with the trigger member—e.g. the second protruding surface thereof.

[0056] The interaction between the trigger member and the two latches causes the trigger member to move those latches between their relatively open and relatively closed positions, as described above with reference to latching/non-latching positions and advanced/retracted positions. That interaction can be such that either the first or the second, or both the first and the second, protruding surfaces of the trigger have a transitional resistance point at one or both ends of their travels, such that to retract or open the latches (i.e. to move them to a retracted or non-latching position), at least one of the transitional resistance points has to be overcome, whereupon the release or opening of the latches occurs under the impulse of the mechanism as a whole, or becomes easier to achieve, or more preferably to move from the released or open condition of the latches, at least one of the transitional resistance points has to be overcome, whereupon the movement of the latches into their advanced or latching positions occurs under the impulse of the mechanism as a whole, e.g. driven by the spring bias of the rear latch.

[0057] The transitional resistance points can be provided by providing a smoothly stepped surface on the trigger interaction region, or by providing a smoothly stepped surface on the flange of the rear latch, or by providing a flat or flattened portion on the end of the relevant protruding surface of the trigger member, or by providing a concavity on the trigger member into which a concave surface of the relevant latch can rest.

[0058] Preferably the trigger member has a hole in it for receiving a latch disengagement bar therein, whereby, with the latch disengagement bar, the trigger member can be forced to rotate about its pivot, thereby interacting with the two latches.

[0059] Preferably the rear end of the frame has an elongated aperture through which that latch disengagement bar can be threaded to access the hole in the trigger member.

[0060] Alternatively the trigger may be power actuated, e.g. by having a screwdrive or hydraulic ram associated therewith. Preferably that actuator can be disengageable so as to prevent the possibility of an accidental actuation.

[0061] The may be a blocking member or safety pin for preventing unintentional release of the trigger member.

[0062] The front latch is preferably pivotably mounted to the frame at a position lying more rearward than the pivot point of the trigger member. The hole in the trigger member is preferably accessible between two arms of that front latch.

[0063] The front latch may be biased into its latching position by a spring that is positioned generally above the trigger member. The spring may act against a bridge spanning between two arm members of the front latch.

[0064] The front latch may have one or more arms adopting the general shape of an M, with two upper peaks, two dropping ends and a dipping middle. This shape will be lighter than a bar with substantially straight top and bottom walls.

[0065] Preferably the blocking member is formed on, or is attached to, the dipping middle.

[0066] Preferably the pivot point is arranged at an end of one of the dropping ends.

[0067] Preferably the nose portion is arranged at the other dropping end.

[0068] Preferably the trigger member interacts with the front latch in the inside of the upper peak that lies nearest the pivot point.

[0069] Preferably the front jaw has a cut-out in its lower lip, the cut-out extending across the full extent of the jaw. The cut-out is to accommodate an attachment pin to provide a further resistance to a pin exiting the front jaw—due to the outer lip formed thereby.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0070] These and other features of the present invention will now be described, by way of example only, with reference to the accompanying drawings.

[0071] FIG. **1** schematically shows a first embodiment of the invention in a jaw open condition.

[0072] FIG. **2** shows a cut-away perspective of the embodiment of FIG. **1**.

[0073] FIG. **3** shows the embodiment of FIG. **1** but in a jaw closed configuration.

[0074] FIG. **4** shows a cut-away perspective of the embodiment of FIG. **3**.

[0075] FIG. **5** shows the embodiment of FIG. **1**, but in which a release member has opened the jaws, whereby the attachment pins are released from those jaws.

[0076] FIG. **6** shows in more detail the trigger member of the embodiment of FIGS. **1-5**.

[0077] FIG. **7** shows a perspective view of a further embodiment of the present invention.

[0078] FIG. **8** shows a side elevation of the embodiment of FIG. **7**.

[0079] FIG. **9** schematically shows the internal mechanisms of the embodiment of FIG. **7**, with the internal mechanisms in a jaws-open configuration.

[0080] FIG. **10** schematically shows the embodiment of FIG. **7** with the internal mechanisms in a jaws-closed configuration.

[0081] FIG. **11** shows the front latch of the embodiment of FIG. **7** separated from the rest of the coupler to more clearly illustrate its shape.

[0082] FIG. **12** shows a third embodiment of the present invention.

[0083] FIG. **13** shows a side elevation of the embodiment of FIG. **12**.

[0084] FIG. **14** schematically shows the internal mechanisms of the embodiment of FIG. **12**; with the internal mechanisms in a jaws-open configuration.

[0085] FIG. **15** schematically shows the embodiment of FIG. **12** with the internal mechanisms in a jaws-closed configuration.

DETAILED DESCRIPTION OF THE INVENTION

[0086] Referring first of all to FIG. **1**, a coupler for attaching to an arm of an excavator is shown. It is for attaching accessories onto the arm of the excavator. Such accessories include buckets and other tools. They are mounted via attachment pins—two parallel attachment pins.

[0087] The coupler **10** of this first embodiment has a first (or top) half **12** and a second (or bottom) half **14**. The first half **12** has two holes **16**, **18** therein for receiving attachment pins of the arm of the excavator. The second half instead has two jaws—a front jaw **20** and a rear jaw **22**. These are for receiving attachment pins **30**, **36** of the accessory.

[0088] The front jaw **20** has an upper wall **24** and a lower wall **26** and a throat at its back **28**. One of the attachment pins **30** of an accessory will, in use, sit towards the back **28** of that front jaw **20**, i.e. when properly coupled to the coupler **10**.

[0089] The front jaw **20** has a recess **32** towards the free end of its lower wall **26**. That recess **32** is shown to be sized also to seat such an attachment pin **30**. This recess **32** therefore provides a means of resistance against exiting of the attachment pin **30** from the front jaw **20**, e.g. in the event that it becomes loose within the jaw **20**. This works efficiently due to the weight of the accessory naturally pulling the pin into the recess—something that can happen throughout most in-use (i.e. digging) orientations of the coupler **10**. However, when the coupler is properly coupled, this recess **32** serves no function.

[0090] The front jaw **20** has its opening oriented to point generally in the forwards direction of the coupler **10**, i.e., it opens essentially in a direction extending parallel to the longitudinal axis of the coupler (or directly away from the rear jaw).

[0091] The rear jaw **22** is spaced from the front jaw, rearwardly with respect to the coupler **10**. Its opening faces generally downwards, away from the first half **12** of the coupler **10**. Its opening has a width **34** which is typically wider than the height of the opening of the front jaw **20**. In this embodiment, that width **34** is relatively narrow compared to many prior art universal couplers since this coupler is designed more for a specific range of accessories—i.e. accessories having a narrow range of pin-centre spacings. A wider rear jaw **22** would permit a greater range of pin-centre spacings to be accommodated by the coupler, and the coupler may be thus adapted.

[0092] A second of the attachment pins **36** is arrangeable within the rear jaw **22** and ultimately will be captured therein at a full-depth insertion into that rear jaw **22**, as shown in FIG. **3**.

[0093] Associated with that rear jaw, there is provided a trigger member **38**. The trigger member **38** is in this embodiment a generally triangular sectioned member (in cross section, in a vertical, longitudinal plane of the coupler). Importantly, though, it has a protruding surface **40** that can selectively extend into the rear jaw **22** for interaction with the second attachment pin **36**. This is so that as the second attachment pin **36** is inserted into the rear jaw **22**, it can bear against that protruding surface **40** so as to activate the internal latching mechanism of the coupler, as explained below.

[0094] That trigger member **38** is mounted for rotation relative to the frame of the coupler **10** by a pivot pin **42**. That pivot pin **42** extends laterally across the width of the frame of the coupler **10**, and can be mounted to the sidewalls of the frame. As the second attachment pin **36** pushes against the protruding surface **40** of the trigger member **38**, the trigger member **38** will rotate as shown by arrow **44**—as illustrated this is in a clockwise direction.

[0095] The trigger member **38** additionally has two further protruding surfaces—a front latch engaging protruding surface **46** and a rear latch engaging protruding surface **48**, better seen in FIG. **3**. These three protruding surfaces **40**, **46**, **48** are shown to be at the approximate corners of the trigger member.

[0096] As a result of these three protruding surfaces, and their interaction with other elements of the coupler/accessory, the trigger member **38**, in response to insertion of the second attachment pin **36** into the rear jaw **20**, can operate both the front and rear latches **50**, **52**. These interactions will each be discussed below.

[0097] The front latch **50** takes the form of a latching end, an arm and a hingepoint. In this embodiment, it adopts a generally M shaped form, when viewed in side elevation, or a U shaped form when viewed from above. The U and M shapes offer a useful means for fitting the front latch within and around other components of the working mechanism of the coupler, but while still ensuring stability and strength.

[0098] The front latch has a pivotable connection to the frame at a first end **54**. For that purpose, a pair of pivot pins **56** are provided—see FIG. **2**. There are two pivot pins **56** since the front latch **50** is a bifurcated member having two substantially identical arms **58** that extend substantially along the full length of the coupler **10** (the uprights of the U), which arms extend away from the latching end (located at the far end from the pivot pins—i.e. the base of the U).

[0099] The front-latch-engaging protruding surface **46** of the trigger member **38** engages on an underside of the arms **58** so as to be able to lift the front latch **50** from a latching position for rotation about the pivot pins **56** into a non-latching position.

[0100] The free end of the latch **50**—the latching end—is instead provided with a nose portion **60** which is adapted to descend through a hole (not shown, but see the cut-aways of FIGS. **2** and **4**) in the upper wall **24** of the front jaw **20** so as to selectively close the front jaw **20**—the latching position. When lifted, however, the front jaw will be open—the non-latching position.

[0101] The nose portion is shown to be curved on both an inside face and an outside face. These serve to assist in ensuring firstly that a pin **30** cannot exit past the latch **50** (since the inside curve catches the pin and imparts a closing moment on the latch), and secondly that a pin can enter the front jaw if the latch is closed (since the outer curve engages the pin and imparts a lifting moment on the latch. Instead of the curves, however, the surfaces may instead be angled so as to point down and rearwardly, e.g. towards the recess.

[0102] Towards the middle of the front latch **50** there is also provided a blocking member **62**. This blocking member—here in the form of a shark-fin—is for interaction with the rear latch **52**, as will be explained below, and is for securing that rear latch in its pin engaging state when the front latch **50** is in its latching position, as shown in FIG. **3**.

[0103] The front latch's M shape also provides two peaks. One is to accommodate the trigger member **38**—in an underside thereof. The other is to take the latch over the top of an attachment point **63** of a biasing member **68** for the rear latch **52**.

[0104] The front latch's M shape also provides a middle trough. This provides a position for the blocking member **62**, whereby the blocking member **62** is low enough to engage behind the rear latch **52**.

[0105] The front latch's M shape also provides the two end-legs—they provide respectively the first end for the pivotable mounting of the front latch **50** to the frame of the coupler **10** and the second end which provides the latching end and nose portion **60**.

[0106] As can be seen in FIG. **2**, the two arms **58** of the front latch have a generally constant transverse thickness with respect to the frame of the coupler. They also extend from the latching end/nose portion **60**. The latching end instead is a solid member—it has a substantially solid cross section, were arranged to extend between the ends of the two arms **58** by being welded thereto.

[0107] Referring now to the rear latch **52**, it comprises a sliding plate **72** having edges **64** (see FIG. **2**) for sliding in tracks **66** in the side walls of the frame of the coupler **10**. The rear latch, therefore, rather than being pivotably mounted relative to the frame is arranged for sliding in and out of a retracted and advanced position, with the advanced position being such as to secure a pin within the rear jaw, as shown in FIG. **3**. Pivoting arrangements, however, are also envisaged.

[0108] To provide a bias for that sliding motion towards the advanced position of FIG. **3**, a pair of coiled springs **68** are provided, spaced laterally relative to one another with respect to the frame of the coupler **10**, and affixed at their other ends to block that is affixed in place by a removable pin that extends through an attachment point **63**. This arrangement—with the removable pin—permits the springs to be removed, and thus the plate to be serviced.

[0109] A single spring could be enough, instead of the illustrated two, although two springs provides a redundant spring in the event of a failure of one of the springs.

[0110] The plate of the rear latch **52** can have an underside reinforcement member **70** to provide additional strength to the free end of the nose of that rear latch. This is useful since this rear latch will be exposed to the digging forces of the excavator during use.

[0111] The plate **72** also has at its enclosed end a pair of angled surfaces **74**—see FIG. **3**. The angled surfaces **74** are for interacting with the blocking members **62** on the arms of the front latch. A single angled surface may be enough—on one side—e.g. if the front latch has only a single arm.

[0112] The angled surfaces **74** are adapted to face correspondingly angled surfaces on the blocking members **62**. The angles are chosen so as to be oriented so as to prevent digging forces applied by the second attachment pin **36** on the rear latch **52** from forcing the rear latch **52** rearwardly past the blocking member **62** (i.e. downwardly and rearwardly with respect to the coupler). This can be achieved since increased forces on the rear latch—trying to cause the plate to slide towards a retracted position—will tighten the angled surface **74** of the plate against the shark fin, thus improving the connection between the shark fin blocking member **62** and the angled surface **74**. Angling them in the other direction, however, would instead cause the arm to lift in that scenario, which would be undesirable.

[0113] That angled surface is preferably at least 10° from perpendicular to the plane of the plate **72**.

[0114] On the top side of the plate **72** a further member of the rear latch is provided—an upwardly extending flange **76**. The upwardly extending flange **76**, in this embodiment, has an angled rearward face **78** and a recess **80** in its top—see FIG. **4**. The angled rearward face **78** is angled by perhaps 5 or more degrees from the perpendicular with respect to the plane of the plate **72**. That angle cooperates with the rear-latch-engaging protruding surface **48** of the trigger member **38** so as to reduce the amount of rotation needed by that trigger member **38** for releasing the rear latch **52**. However, it is optional—it is not present, for example, in the embodiment of FIG. **9**.

[0115] The upwardly extending flange also provides a recess **80** at its end. The recess defines a ridge **82** that the end of the rear-latch-engaging protruding surface **48** of the trigger member **38** can rest upon when the trigger member is in its primed condition—i.e. with the rear latch retracted and the front latch lifted, as shown in FIG. **2**.

[0116] By having the ridge, a transitional resistance point is provided between the trigger member and the rear latch, which transitional resistance point has to be overcome before the trigger mechanism can be released. Thereafter the spring of the rear latch can propel the rear latch into its extended position for engaging an attachment pin in the rear jaw **22**.

[0117] A further transition resistance point is provided by the front-latch-engaging protruding surface **46** since it has a flat face that rests against the underside of the arm **58** when in the primed condition of FIG. **1**. Therefore, a rotation of the trigger member will initially lift the front latch above its primed position before dropping it down into its latching position.

[0118] With the above described arrangement, therefore, from the condition of FIG. **1**, upon inserting a pin **36** into the rear jaw **20** of the coupler **10**, the trigger member **38** rotates in the clockwise direction **44** so as to move the front-latch-engaging protruding surface on the underside of the arm **58** and the rear-latch-engaging protruding surface over the ridge **82** of the recess **80** and then onto the angled rearward face **78** of the rear latch **52**. That then allows the spring bias of the springs **68** to force the rear latch **52** into its advanced position of FIG. **3** and the front latch **50** will also pivot down into its latching position, whereupon the condition of FIG. **3** is arrived at. In this condition, the blocking member **62** has been brought into position behind the rear latch **52**, thereby preventing retraction of the rear latch **52** back into its retracted position of FIG. **1**. The two jaws **20**, **22** are thus both closed, with pins therein being either latched or secured their respective coupled positions.

[0119] Referring next to FIG. **5**, a release of those attachment pins is shown. In that Figure, and with reference to FIG. **6**, the trigger member **38** has a hole **86** in a rearwardly facing surface **84** thereof. That hole **86** is for accommodating an end of a release bar—a lever arm **88**. The lever arm **88** can extend through a slot **90** in the rear end of the frame of the coupler **10**, as shown with respect to the second embodiment in FIG. **7**.

[0120] A downward leverage force **92** on the free end of the lever arm **88** can then force the rotation of the trigger member

in an opposite (anti-clockwise) direction, as signified by the arrow **94** in FIG. **5**. This then causes the rear-latch-engaging protruding surface **48** of the trigger member **38** to ride up the angled rearward face **78** of the rear latch, thus tending to force that rear latch into its retracted position. Simultaneously (or preferably just prior to that, for preventing the blocking member preventing that retraction), it also lifts the front latch **50** due to the front-latch-engaging protruding surface **46** of the trigger member riding up on the inside of the arm **58** so as also to lift the blocking member **62** away from the path of the angled surface **74** of the plate **72** of the rear latch **52**. The two jaws **20**, **22** can thus be opened by that lever arm **88**, and the pins **30**, **36** can then be removed as shown.

[0121] Referring next to FIGS. **7** to **15**, two further embodiments of the present invention are shown in which many features are similar to the first embodiment. For example, there are still the trigger members, the front latches, the rear latches, the front jaws, the rear jaws, the pairs of coil springs and the various pivot points. They may not be identical in shape or form, but they are still there. However, in these later two embodiments the front latch **50** is biased into a latching position by a further coil spring **96**. This further coil spring **96** pushes against a bridge **98** extending between the two arms **58** and is located thereon by a peg **100**. The spring bias helps to bias the front latch towards its latching position, and prevents the front latch from opening if the coupler is inverted, for from opening if the coupler is exposed to high vibrational forces (e.g. due to pneumatic hammer actions, as often used on excavator tools).

[0122] In place of the illustrated spring bias, alternative positions for that spring are possible. Further, a bias towards a latching position can be provided by many other mechanisms, such as by leaf springs—e.g. ones that engage against the arm of the excavator, such as the one shown in GB 2330570 for the blocking bar in that coupler.

[0123] In addition, apertures **102** are provided in the frame of the coupler for accommodating a safety pin—see FIG. **10**. Those apertures **102** can accommodate a safety pin, e.g., that laterally extends through the sidewalls of the frame of the coupler so as to prevent a lifting of the front latch **50**. FIG. **9** shows how holes overlie the path of the arm of the front latch, whereby a safety pin would foul against that arm, thus resisting a lifting of the front latch from a latching position. If used, the safety pin would need to be removed when releasing the coupler.

[0124] As briefly mentioned above, in these second and third embodiments, the shapes of the trigger member **38** are different. Likewise the shapes of the front and rear latches are slightly different. However, the functionality is the same as with the first embodiment in that there are still front- and rear-latch-engaging protruding surfaces on the trigger members, and also the protruding surfaces for engagement against the second attachment pins within the rear jaws **22**. There are also the blocking members **62** for engaging angled surfaces **74** in the non-free ends of the plates **72** of the rear latches **52**. A further discussion of the functionality of these additional embodiments is therefore not needed herein since the above described first embodiment operates in a sufficiently close manner.

[0125] The frames of the couplers will typically be cast substantially in a single piece, although hardened steel inserts might be added/welded therein post casting. Alternatively the frames can be fabricated from plate steel using known cutting and welding techniques.

[0126] The other components such as the latches and the trigger members can also be cast, although they can instead be fabricated from plate steel using known cutting and welding techniques.

[0127] The present invention therefore provides an easily activatable, and an easily releasable, coupler that still offers the secured attachment of the prior art—with the numerous (more than one) redundant safety features, such as the blocking member for the rear latch, the curved front latch, the concealed (non-externally accessible—it requires the use of a lever arm) release trigger member and the front latch per se.

[0128] It should be appreciated that the invention has been described above purely by way of example. However, modifications in detail may be made to the invention as limited purely by the claims appended hereto.

1. A coupler for attaching an accessory to an excavator arm of an excavator, the coupler comprising a frame with a first half for connecting to the excavator arm and a second half for connecting to the accessory, the second half comprising:

a front jaw with a movable front latch associated therewith, the front latch having a latching position and a non-latching position, and being for latching one of two attachment pins of the accessory within the front jaw when it is in its latching position;

a rear latch, the rear latch having a retracted position and an advanced position, and being for engaging a second of the attachment pins when it is in its advanced position; and

a trigger member mounted for movement relative to the frame, the trigger member being arranged for movable interaction with both the front latch and the rear latch so as to move, respectively, the front latch between its latching position and its non-latching position and the rear latch between its advanced position and its retracted position.

2. The coupler of claim **1**, wherein the trigger member is pivotally mounted relative to the frame.

3. The coupler of claim **1**, wherein the coupler additionally comprises a rear jaw associated with the rear latch, and the rear latch at least partially closes its associated rear jaw when in its advanced position.

4. The coupler of claim **1**, wherein the front latch is pivotable between its latching position and its non-latching position.

5. The coupler of claim **1**, wherein the rear latch is permanently biased towards its advanced position.

6. The coupler of claim **1**, wherein either the front latch is biased towards its latching position by gravity when the coupler is oriented such that the first half is above the second half, or the front latch is permanently biased towards its latching position by a spring.

7. The coupler of claim **1**, wherein the front latch is bifurcated, and has two pivot pins, each being coaxial and extending in a lateral direction relative to the frame of the coupler.

8. The coupler of claim **1**, wherein the front latch has a blocking member extending therefrom, the blocking member being arranged to locate in front of an end of the rear latch when the rear latch is in its advanced position and simultaneously the front latch is in its latching position.

9. The coupler of claim **1**, wherein the trigger member comprises at least three protruding surfaces—a first protruding surface for interacting with the front latch, a second protruding surface for interacting with the rear latch, and a third protruding surface for interacting with a pin of the accessory.

10. The coupler of claim **1**, wherein the rear latch has an upstanding flange thereon, the flange having an end or surface for interaction with the trigger member.

11. The coupler of claim **1**, wherein interaction between the trigger member and the two latches causes the trigger member to move those latches when itself is moved, the interaction being such that there is at least one transitional resistance point.

12. The coupler of claim **11**, wherein to move the second latch from the retracted position to an advanced position, at least one of the transitional resistance points has to be overcome, whereupon the movement of the latches into their advanced or latching positions occurs under the impulse of the mechanism as a whole.

13. The coupler of claim **12**, wherein the impulse of the mechanism as a whole is driven at least in part by one or more of a spring bias for the rear latch and a spring bias for the front latch.

14. The coupler of claim **11**, wherein at least one of the transitional resistance points is provided by providing a flat or flattened portion on an end of a protruding surface of the trigger member.

15. The coupler of claim **11**, wherein at least one of the transitional resistance points is provided by providing a concavity on the trigger member into which a concave surface of one of the latches latch can selectively rest.

16. The coupler of claim **1**, wherein the trigger member has a hole in it for receiving a latch disengagement bar therein, whereby, with the latch disengagement bar, the trigger member can be forced to move, thereby interacting with the two latches.

17. The coupler of claim **1**, wherein the front latch is pivotably mounted to the frame at a position lying more rearward than a pivot point of the trigger member.

18. The coupler of claim **1**, wherein the front latch is biased into its latching position by a spring that is positioned generally above the trigger member.

19. The coupler of claim **1**, wherein the front latch has one or more arms adopting the general shape of an M, with two upper peaks, two dropping ends and a dipping middle, and a blocking member for selectively blocking retraction of the rear latch from an advanced position into a retracted position in which a pin cannot be disengaged from the coupler is formed on, or is attached to, the dipping middle of the one or more arms.

20. The coupler of claim **19**, wherein the trigger member interacts with the front latch in an inside of an upper peak thereof.

* * * * *