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(54) **PLATE KIND HEAT EXCHANGER WITH END PLATES**

(57) The present invention relate to a plate heat exchanger including a stack of patterned heat transfer plates connected to each other by brazing or welding, where patterns of the connected neighbouring heat transfer plates forms respectively a first flow path and second flow path on the opposing sides of a heat transfer plate, said heat transfer plates comprising aligned first pair of port holes forming respectively first inlet and first outlet for a first fluid to be distributed to said first flow path,

where a first end plate is connected to the stack first side outermost heat transfer plate with first opening aligned to the first inlet, and a second end plate is connected to the stack second side outermost heat transfer plate with a blank section aligned with the first inlet, where the second side outermost heat transfer plate is formed with a contacting projection connected and brazed or welded the inner surface of the second end plate.

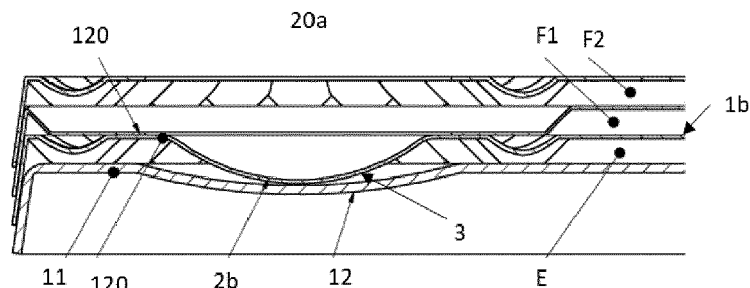


Fig. 6

Description

BACKGROUND

[0001] A typical construction of a plate heat exchanger comprises a plurality of heat transfer plate stacked on top of each other. The heat transfer plates are formed with patterns such that flow paths are formed between each set of neighboring heat transfer plates. Openings and are formed in the heat transfer plates to form inlets and outlets for fluids to these flow paths. The plates are positioned between end plates, which end plates to same material and weight often are relatively thin, e.g. of the same thickness as the heat transfer plates, or only slightly thicker.

[0002] The heat transfer plates are brazed or welded together at the connections, just as respectively the upper and lower heat transfer plates are brazed or connected to the respective upper and lower end plate.

[0003] Especially in the opening areas the pressures are high, and due to the relatively thin thickness the end-plates tend to deform at high pressures, possible breaking or breaking in the connection to the neighboring heat transfer plates, possible leading to leaks

[0004] The present invention is aimed to reducing assembly complexity of the typical plate heat exchanger and at the same time improving the mechanical strength by reducing level of deformations on the area around the openings/portholes at the second end plate.

SUMMARY OF THE INVENTION

[0005] The problems are solved according to the invention as is described in the claims.

[0006] This includes introducing a plate heat exchanger including a stack of patterned heat transfer plates connected to each other by brazing or welding and defining a first side and second side, where patterns of the connected neighbouring heat transfer plates forms respectively a first flow path and second flow path on the opposing sides of a heat transfer plate, said heat transfer plates comprising aligned first pair of port holes forming respectively first inlet and first outlet for a first fluid to be distributed to said first flow path, where a first end plate is connected to the stack first side outermost heat transfer plate with a first opening aligned to the first inlet, and a second end plate is connected to the stack second side outermost heat transfer plate with a blank area aligned with the first inlet, where the second side outermost heat transfer plate is formed with a contacting projection connected and brazed or welded the inner surface of the second end plate.

[0007] The blank area may be curving in an outwards direction relative to the stack and may be dome shaped.

[0008] In an embodiment the second side outermost heat transfer plate is formed as a blank section where aligned with the second end plate blank area, and is curving in an outwards direction relative to the stack and con-

nected by brazing or welding to the inner surface of the blank section of said second end plate, where the second side outermost heat transfer plate blank section may be dome shaped.

[0009] By 'aligned with' means they at least partly overlap.

[0010] In an embodiment heat transfer plate blank section projects outwards relative to the stack and has a flat top surface connected by brazing or welding to the blank area.

[0011] In an embodiment the heat transfer plate blank section projects outwards relative to the stack and has a flat top surface connected by brazing or welding to the circumference of the blank area.

[0012] In an embodiment a projection is formed as a circular projection contacting the second end plate at an area encircling the blank area.

[0013] In an embodiment the projection has a rounded top surface.

[0014] In an embodiment the projection has a flat top surface.

FIGURES

[0015]

Fig. 1 Side view of a stacked plate kind heat exchanger with upper and lower end plates and inlets and outlets.

Fig. 2 Illustrate several end plates and heat transfer plates to be stacked.

Fig. 3 Illustrate an embodiment of reinforcement connection in the inlet area.

Fig. 4 Illustrate an embodiment of reinforcement connection in the inlet area.

Fig. 5 Illustrate an embodiment of reinforcement connection in the inlet area.

Fig. 6 Illustrate an embodiment of reinforcement connection in the inlet area.

DETAILED DESCRIPTION OF THE INVENTION

[0016] It should be understood, that the detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from the detailed description.

[0017] Fig. 1 is a side view illustrates a typical plate heat exchanger (100) including a stack (110) of patterned heat transfer plates (1) connected to each other by brazing or welding.

[0018] A first end plate (10) is connected to the stack

(110) first side and a second end plate (11) to the stack (110) second side. In the illustration port connections (50) is connected to the first end plate (10) connecting the flow paths formed between the heat transfer plates (1) in the stack to a heating system fluid flow conduits or pipes. In the illustration seen from the side only two such port connections (50) is shown, and both in the first end plate (10). As seen in fig. 2 there usually are four such port connections (50), and in other embodiment some could be in the first end plate (10), and others in the second end plate (11).

[0019] Fig. 2 illustrate the same heat exchanger (100) having 6 heat transfer plates (1, 1a, 1b), though any number would apply, and usually it comprised significantly more heat transfer plates (1) than the illustration.

[0020] The heat transfer plates (1, 1a, 1b) are formed as thin sheets shaped with patterns (5), such as the illustrated chevron shaped corrugations. However, any other form of pattern (5) would also apply. Every second heat transfer plate (1, 1a, 1b) either may formed with different patterns (5), or may simply be rotated relative the other plates, such that the patterns (5) only cross each other forming respectively a first flow path and second flow path on the opposing sides of a heat transfer plate (1, 1a, 1b). The crossed patterns (5) then forms heat transferring regions.

[0021] The heat transfer plates (1, 1a, 1b) and first (10) and second (11) end plates are brazed or welded at the rims to seal the flow paths from the externals, and optionally at some, or all, of the other connection points.

[0022] At least some of the heat transfer plates (1, 1a, 1b) comprises a first pair of openings (20, 21) and a second pair of openings (22, 23) - one of which not visible in the figure. The openings (20, 21, 22, 23) are aligned to the corresponding openings of the neighbouring heat transfer plates (1, 1a, 1b) such that the e.g. the aligned first pair of openings (20, 21) forms a first inlet (20a) and first outlet (21a) for the first flow paths respectively (illustrated in fig. 1), and the aligned second pair of openings (22, 23) forms a second inlet and second outlet for the first flow paths respectively (not illustrated).

[0023] The first end plate (10) is connected to the first side outermost heat transfer plate (1a) with first connection opening (30) aligned to the first inlet (20a), and a second end plate (11) is connected to the stack (110) second side outermost heat transfer plate (1b) with a blank area (12) aligned with the first inlet (20a). The blank area (12) could be shaped relative to the bulk of the second end plate (11) or could simple just be the flat part of the second end plate (11) aligning with the first inlet (20a).

[0024] Further in the illustrated example second openings (31) aligns with the first inlet (21a), third openings (32) aligns with second inlet and fourth opening (33) aligns with second outlet. In other embodiments other of the openings. In other embodiments some of the openings (30, 31, 32, 33) are formed in the second end plate (11), the corresponding blank areas (12) thus being in the first end plate (10). Further, in some other embodi-

ments the respectively first and second pairs, and first and second inlets and outlets are arranged differently.

[0025] The port connections (50) are connected to the first end plate (10) (respectively second end plate (11)) and the openings (30, 31, 32, 33).

[0026] Fig. 3 illustrate a first reinforcement embodiment of the present invention, showing the area around the first inlet (20a) in the area of the second side outermost heat transfer plate (1b) and second end plate (11). In the embodiment second side outermost heat transfer plate (1b) is formed with a blank section (2), meaning it does not form any opening (20). The blank section (2) forms a flat top surface (2b) of a projection (3) formed in the second side outermost heat transfer plate (1b) in an outwards direction relative to the stack (110), where said flat top surface (2b) is connected by brazing or welding to the blank area (12) of the second end plate (11), which is seen to be flat. A sealing area (120) is illustrated between the second side outermost heat transfer plate (1b) and its neighbouring plate (1) in the inlet area (20a). The first flow path F1 and second flow path F2 is illustrated between neighbouring heat transfer plates (1, 1b), but the area E between the inner surface of the second end plate (11) and outer surface of the second outer most heat transfer plate (1b) is empty.

[0027] Fig. 4 is a similar illustration to fig. 3, showing a second reinforcement embodiment, where the blank area (12) is curving in an outwards direction relative to the stack (110). In this embodiment the projection (3) is formed as in the embodiment of fig. 3, only such that it's top surface (2b) is larger than the curvy blank area (12), thus being connected to its circumference. The rest of the flat top surface (2b) thus 'covering' the blank area (12) in the plane of the bulk of the second end plate (11). In one embodiment the curvy blank area (12) is dome shaped.

[0028] Fig. 5 is a similar illustration to fig. 4, showing a third reinforcement embodiment, where the projection (3) in a circular shape with a top surface (2b) with a diameter which is larger than the curvy blank area (12), thus being connected the second end plate (11) in an area encircling the blank area (12).

[0029] Fig. 6 is a fourth reinforcement embodiment similar to illustrations of figs. 4 and 5, with a curvy or dome shaped blank area (12), but where the projection (3) has curvy shape with a top surface (2b) curving in an outwards direction relative to the stack (110) and connected by brazing or welding to the second end plate (11) blank area (12).

Claims

1. A plate heat exchanger (100) including a stack (110) of patterned (5) heat transfer plates (1) connected to each other by brazing or welding and defining a first side and second side, where patterns (5) of the connected neighbouring heat transfer plates (1)

- forms respectively a first flow path and second flow path on the opposing sides of a heat transfer plate (1), said heat transfer plates (1) comprising aligned first pair of port holes (20, 21) forming respectively first inlet (20a) and first outlet (21a) for a first fluid to be distributed to said first flow path, where a first end plate (10) is connected to the stack (110) first side outermost heat transfer plate (1a) with a first opening (30) aligned to the first inlet (20a), and a second end plate (11) is connected to the stack (110) second side outermost heat transfer plate (1b) with a blank area (12) aligned with the first inlet (20a), **characterized in that**, the second side outermost heat transfer plate (1b) is formed with a contacting projection (3) connected and brazed or welded the inner surface of the second end plate (11).
2. A plate heat exchanger (100) as in claim 1, wherein the blank area (12) is curving in an outwards direction relative to the stack (110).
 3. A plate heat exchanger (100) as in claim 2, where the blank area (12) is dome shaped.
 4. A plate heat exchanger (100) is in claim 2 or 3, where the second side outermost heat transfer plate (1b) is formed as a blank section (2) where aligned with the second end plate (11) blank area (12), and is curving in an outwards direction relative to the stack (110) and connected by brazing or welding to the inner surface of the blank area (12) of said second end plate (11).
 5. A plate heat exchanger (100) as in claim 4, where the second side outermost heat transfer plate (1b) blank section (2) is dome shaped.
 6. A plate heat exchanger (100) as in any of claims 1-3, wherein heat transfer plate (1b) formed as a blank section (2) where aligned with the second end plate (11) blank area (12), and where said blank section (2) projects outwards relative to the stack (110) and has a flat top surface (2a) connected by brazing or welding to the blank area (12).
 7. A plate heat exchanger (100) as in any of claims 1-3, wherein heat transfer plate (1b) is formed as a blank section (2) where aligned with the second end plate (11) blank area (12), where said blank section (2) projects outwards relative to the stack (110) and has a flat top surface (2a) connected by brazing or welding to the circumference of the blank area (12).
 8. A plate heat exchanger (100) as in any of claims 1-3, wherein a projection (3) is formed as a circular projection contacting the second end plate (11) at an area encircling the blank area (12).
 9. A plate heat exchanger (100) as in claim 8, wherein the projection (3) has a rounded top surface (2b).
 10. A plate heat exchanger (100) as in claim 8, wherein the projection (3) has a flat top surface (2b).

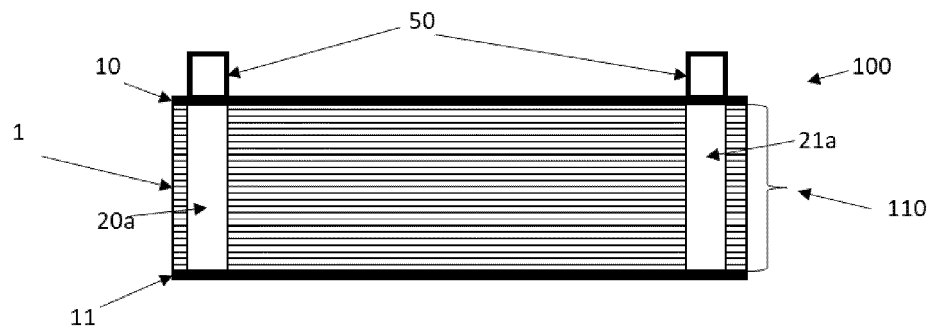


Fig. 1

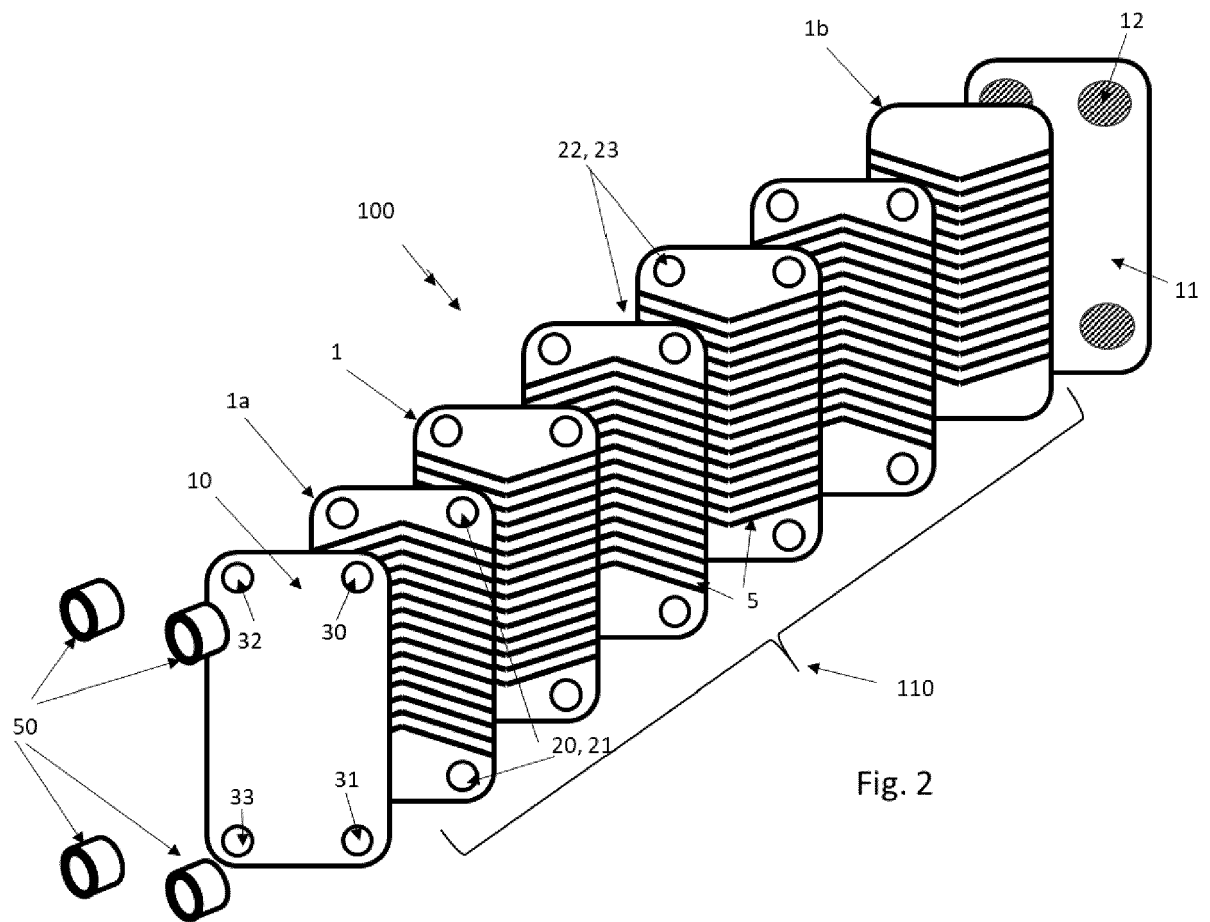


Fig. 2

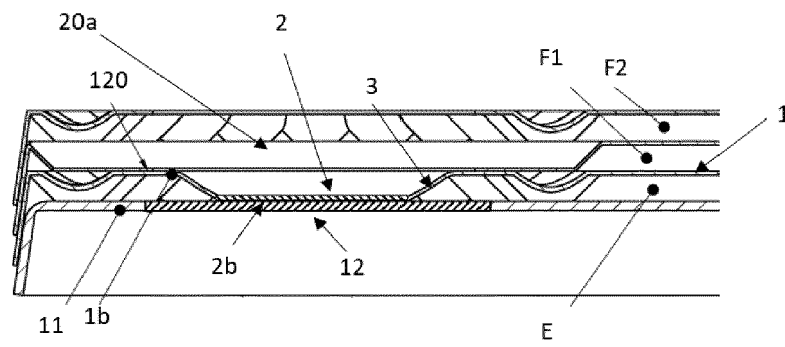


Fig. 3

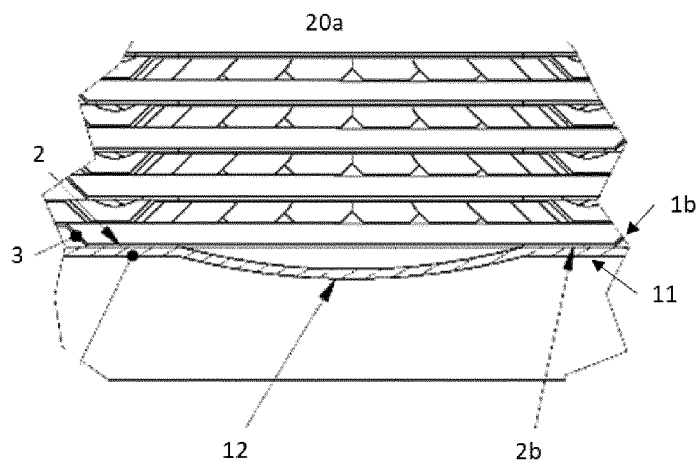


Fig. 4

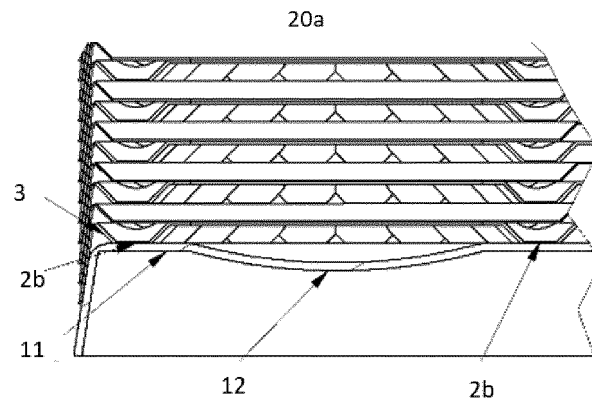


Fig. 5

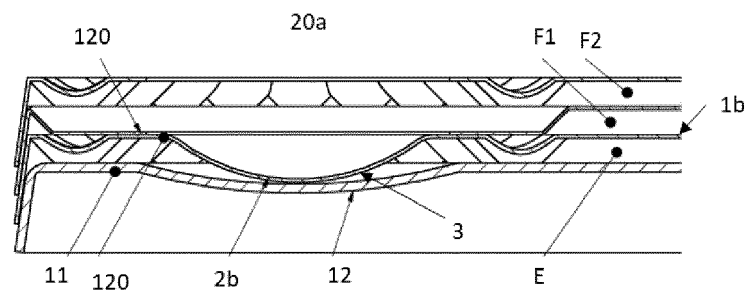


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 20 20 0578

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 97/15798 A1 (SWEP INTERNATIONAL AB [SE]; ANDERSSON SVEN [SE] ET AL.) 1 May 1997 (1997-05-01) * figure 4 *	1,6,7	INV. F28D9/00
X	WO 88/09473 A1 (ALFA LAVAL THERMAL [SE]) 1 December 1988 (1988-12-01) * figure 4 *	1,6,7	
X	EP 3 109 582 A1 (NISSHIN STEEL CO LTD [JP]) 28 December 2016 (2016-12-28) * figure 2a *	1,6,7	
X	EP 3 413 006 A1 (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO LTD [CN]) 12 December 2018 (2018-12-12) * figures 1-3 *	1	
A	DE 10 2014 203102 A1 (MAHLE BEHR GMBH & CO KG [DE]) 20 August 2015 (2015-08-20) * figure 1 *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			F28F F28D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 February 2021	Examiner Mellado Ramirez, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 20 20 0578

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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05-02-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9715798 A1	01-05-1997	AT 204069 T AU 707014 B2 DE 69614402 T2 DK 0857288 T3 EP 0857288 A1 ES 2160259 T3 JP 3958367 B2 JP H11513785 A KR 19990066955 A PT 857288 E US 5988269 A WO 9715798 A1	15-08-2001 01-07-1999 29-05-2002 01-10-2001 12-08-1998 01-11-2001 15-08-2007 24-11-1999 16-08-1999 28-12-2001 23-11-1999 01-05-1997
WO 8809473 A1	01-12-1988	AT 84140 T DE 3877215 T2 DK 9189 A EP 0418227 A1 JP 2719380 B2 JP H01503558 A SE 458884 B US 4987955 A WO 8809473 A1	15-01-1993 29-04-1993 10-01-1989 27-03-1991 25-02-1998 30-11-1989 16-05-1989 29-01-1991 01-12-1988
EP 3109582 A1	28-12-2016	CA 2939817 A1 CN 106062499 A EP 3109582 A1 ES 2774033 T3 JP 6192564 B2 JP 2015152282 A KR 20160121573 A SG 11201606806Q A US 2017067700 A1 WO 2015125831 A1	27-08-2015 26-10-2016 28-12-2016 16-07-2020 06-09-2017 24-08-2015 19-10-2016 29-09-2016 09-03-2017 27-08-2015
EP 3413006 A1	12-12-2018	CN 107036481 A CN 111006532 A EP 3413006 A1 US 2019033015 A1 WO 2017133349 A1	11-08-2017 14-04-2020 12-12-2018 31-01-2019 10-08-2017
DE 102014203102 A1	20-08-2015	NONE	