SINCORE

Intellectual Property Consultancy

IDEAS
TECHNOLOGY
PROTECTION
VALUE

PATENTABILITY SEARCH

SAMPLE REPORT

CASE

FlowBalance CP-2

CLIENT

Sample / Demonstration Case

REPORT DATE

25 October 2026

REFERENCE

SINC-PAT-001

Patent Search & Intelligence

From Information to Intelligent Decisions.

A SMARTER
IP TOMORROW

sincoreip.com

CONTENTS

01 / Executive summary 3
Key findings 3
Patentability outlook 4
Search scope and evidentiary boundary 4

02 / Invention, scope and controlling assumptions 5
2.1 Invention summary and claimed features 5
2.2 Draft independent claim 6
2.3 Reference date and prior-art cut-off 6
2.4 Assessment basis and scope notes 6

03 / Invention architecture and assessment focus 7
3.1 Core patentability question 7
3.2 Technical features relevant to the assessment 7

04 / Search methodology 8
4.1 Search concepts and representative terminology 8
4.2 Classification development 8
4.3 Databases and query construction 9
4.4 Integrated search architecture 9
4.5 Screening, retention and stopping rule 12
4.6 Selection rationale 12

05 / Closest prior art, feature by feature 13
5.1 US20240387899A1 — Audi AG 13
5.2 CN106602175A — Hefei Guoxuan High-Tech Power Energy 16
5.3 DE102015014690A1 — Daimler AG 18
5.4 CN117223154A — Fuji Seiko Co., Ltd 20
5.5 US4578324A — Ford Aerospace & Communications 22
5.6 Further charted documents 24
5.7 Feature disclosure matrix 25

06 / Novelty and inventive step 26
6.1 Novelty 26
6.2 Closest prior art 26
6.3 Distinguishing feature 26
6.4 Technical effect and objective technical problem 26
6.5 Assessment of combinations 27
6.6 Dependent claims and fallback positions 27

07 / Additional retained publications 28

08 / Conclusions and recommendations 30
8.1 Overall assessment 30
8.2 Claim-drafting recommendations 30
8.3 Next steps 30
8.4 Final reporting note 31

Appendix A / Document and data references 32

Appendix B / Disclosure status and category key 33

01 / Executive summary

This illustrative patentability assessment demonstrates Sincore IP's patent intelligence methodology using **FlowBalance CP-2**, a fictional liquid cooling plate for battery modules. The assessment asks whether the draft independent claim of CP-2 is new and inventive over the patent literature published up to the search cut-off of 25 October 2026.

CP-2 combines two flow-control measures at the entrance of each parallel coolant channel: a base open flow area that is graded according to the channel's position along the inlet manifold, and a thermally responsive element that opens the channel further as the region it serves becomes warmer. A worldwide patent literature search was carried out in Espacenet, WIPO PATENTSCOPE and Google Patents, followed by citation expansion, abstract review and a feature-by-feature full-text analysis of the closest documents.

Key findings

Document	Published	Category	Features disclosed	Role in the assessment
US20240387899A1 — Audi	21 Nov 2024	Y	A, B, C, E, F (also H, K, L)	Closest prior art: passive bimetal flap at each channel inlet of an inter-cell cooling plate, responding to the local temperature. No position-dependent base open areas (D).
CN106602175A — Guoxuan	26 Apr 2017	Y	A, B, E, F; C partly	Alternative starting point: shape-memory flow-intercepting parts in the branch channels, each in contact with the battery it cools.
DE102015014690A1 — Daimler	21 Jul 2016	Y	C, E, F; A, B partly	Bimetal temperature-switch valve at each branch of the main cooling line; names position-dependent cooling differences along the supply line as the problem.
KR20260078277A — LG Energy Solution	29 May 2026	Y	B, C, E, F; A partly	Bimetal flow regulator between each supply outlet and the inlet of each cooling unit, driven by the heat of its target battery.
CN122576505A	14 Aug 2026	Y	E, F; A, B, C partly	Temperature-sensing driving piece in the plate surface moves a stop block at the inlet end of each liquid-cooling plate.
CN117223154A — Fuji Seiko	12 Dec 2023	Y	B, E, I; A, C, D, F partly	Self-acting thermostat valve with leak hole for each battery-pack jacket; describes graded inlet diameters along the supply line as known and insufficient on their own.
US4578324A — Ford Aerospace	25 Mar 1986	Y	A, B, C, D (also J)	Orifices of monotonically increasing size along the input manifold of a cell-cooling panel; no thermally responsive element.
US2015053385A1 — KFUPM	26 Feb 2015	Y	B, C, D; A partly	Restriction diameters at the tube inlets selected according to tube position (analogous heat-exchanger field).
JPS62237676A — Sanyo	17 Oct 1987	Y	B; A, C, D, E partly	Shape-memory vanes in the coolant inlet manifold of a fuel-cell stack shift the flow distribution with temperature (analogous field).

Document	Published	Category	Features disclosed	Role in the assessment
Section 7 publications	2010–2026	Y / A	Subsets of A–F	19 further retained publications, four of them reviewed in full text. None discloses features D and E together.

Category Y: relevant in combination with another document. No X-category document (anticipating claim 1 on its own) was identified. Feature letters refer to Section 2.1.

Patentability outlook

Novelty. No document retrieved discloses the combination of features A–F. The documents with a thermally responsive, locally coupled element at each channel (E, F) do not set the base open areas according to channel position (D); the documents with position-dependent restrictions (D) contain no thermally responsive element (E). Claim 1 is novel over the documents retrieved.

Inventive step. Starting from US20240387899A1 (Audi), the only distinguishing feature is D. US4578324A, from the same field of cell cooling, teaches orifices graded in size along the input manifold to equalise flow among cooling paths, and CN117223154A confirms that graded inlet diameters are a known measure in battery cooling. The two measures act side by side, each with its own effect. In its current form, claim 1 is therefore exposed to an inventive-step objection based on the combination of Y documents.

Dependent claims. The additional features G–L are each disclosed or suggested in the retrieved documents and do not provide reliable fallback positions on their own.

Recommendation. Before filing, re-centre claim 1 on a feature that creates a real interaction between the static grading and the thermal response, for example a single thermally responsive element whose graded rest position itself defines the position-dependent base open area. This should be supported by comparative data, and a targeted supplementary search should be run on the amended feature (Section 8).

Search scope and evidentiary boundary

The search covered patent literature published worldwide up to and including the search cut-off of 25 October 2026, regardless of legal status. Searching was carried out in free databases (Espacenet, WIPO PATENTSCOPE and Google Patents) through 16 documented routes (S1–S13), including native-language Chinese routes and forward and backward citation searches of the closest documents.

Nine documents were analysed feature by feature on their full texts; the five that carry the assessment are charted in detail in Section 5. A further 19 retained publications are summarised in Section 7, and the complete record-level search log is supplied as a separate Excel annex. Non-patent literature is outside the scope of this patent literature search.

The findings represent a professional pre-filing assessment of novelty and inventive step against the documents retrieved. They are not a legal opinion, and the final assessment of patentability rests with the examining office.

02 / Invention, scope and controlling assumptions

2.1 Invention summary and claimed features

FlowBalance CP-2 is a conceptual liquid cooling plate for battery modules. Coolant flows from an inlet manifold through parallel channels to an outlet manifold. Each channel entrance carries a flow restriction with two functions. Its base open area, at a reference temperature, is chosen according to the channel's position along the inlet manifold to compensate for the manifold's pressure distribution. Its thermally responsive element opens the restriction further when the region served by the channel warms up.

Technical problem addressed. Fixed-area channel-entry restrictions can compensate manifold-induced flow maldistribution at a design operating point, but cannot respond to non-uniform heat generation across battery cells during operation. Active valves solve this at the cost of actuators, wiring and control electronics.

The features of the draft claims are labelled as follows. Features A–F form independent claim 1; features G–L are the additional features of the dependent claims.

Ref	Claimed feature	Claim position
A	Plate body defining a plurality of coolant channels extending in parallel	Claim 1
B	Inlet manifold and outlet manifold, each channel extending between and in fluid communication with both manifolds	Claim 1
C	Flow restriction at the entrance of each of at least two channels, each restriction defining an open flow area	Claim 1
D	At a reference temperature, the flow restrictions have different open flow areas selected according to the position of the respective channel along the inlet manifold	Claim 1
E	Each flow restriction comprises a thermally responsive element configured to increase its open flow area with increasing temperature	Claim 1
F	Each thermally responsive element is thermally coupled to the region of the plate body served by its channel, so that the open flow area of each restriction varies independently with the local temperature of that region	Claim 1
G	Plate body formed from two joined (e.g. brazed) aluminium sheets	Dependent claim 2
H	Thermally responsive element is a bimetallic or shape-memory-alloy tongue partly covering the channel entrance	Dependent claim 3
I	Each restriction retains a non-zero minimum open flow area at all temperatures (fail-safe flow)	Dependent claim 4
J	Reference-temperature open areas increase with distance from the manifold inlet port	Dependent claim 5
K	No externally powered valve or electronic control acts on the restrictions (fully passive)	Dependent claim 6
L	Battery module comprising battery cells in thermal contact with the cooling plate of any preceding claim	Claim 7

2.2 Draft independent claim

> *1. A cooling plate for thermal management of a battery module, comprising:*
>
> *(A) a plate body defining a plurality of coolant channels extending in parallel;*
>
> *(B) an inlet manifold and an outlet manifold, each channel extending between and in fluid communication with the inlet manifold and the outlet manifold;*
>
> *(C) a flow restriction at the entrance of each of at least two of the channels, each flow restriction defining an open flow area;*
>
> *(D) wherein, at a reference temperature, the flow restrictions have different open flow areas selected according to the position of the respective channel along the inlet manifold;*
>
> *(E) wherein each flow restriction comprises a thermally responsive element configured to increase the open flow area of that restriction with increasing temperature; and*
>
> *(F) wherein each thermally responsive element is thermally coupled to the region of the plate body served by its respective channel, such that the open flow area of each restriction varies independently in response to the local temperature of that region.*

The claim is an illustrative draft prepared for this sample case. Its feature split follows the letters used throughout the report.

2.3 Reference date and prior-art cut-off

The search cut-off is 25 October 2026, which is also the report date. The assessment assumes that a CP-2 application would be filed on or after that date. All documents published up to the cut-off form prior art for both novelty and inventive step, irrespective of their legal status, territory or language.

2.4 Assessment basis and scope notes

- **Search type.** Patent literature search in free databases: Espacenet (worldwide collection), WIPO PATENTSCOPE and Google Patents. Result counts are those reported by each platform on the search date.
- **Non-patent literature.** Journal articles, conference papers, standards and product documentation are outside the scope of this search.
- **Unpublished applications.** Patent applications are normally published about 18 months after their priority date. Applications filed in that period before the cut-off are not yet searchable and may later become relevant to novelty (Art. 54(3) EPC and equivalent national provisions). Post-filing monitoring covers this period (Section 8.3).
- **Language.** Chinese, Korean, Japanese and German documents were reviewed in their original publications. English renderings of cited passages are the searcher’s working translations.
- **Assessment standard.** Novelty and inventive step are assessed by the problem-solution approach applied by the European Patent Office. The assessment is technical and is not a legal opinion.

03 / Invention architecture and assessment focus

CP-2 distributes coolant from a common inlet manifold into parallel channels. In a plain manifold, the static pressure varies along its length, so channels at different positions receive different flows even when the plate is at a uniform temperature. CP-2 compensates for this by grading the base open area of the entrance restrictions according to channel position.

On top of this static balance, each restriction carries a thermally responsive element coupled to the region its channel cools. When a local hot zone forms, the element of the affected channel opens further and increases the flow there, independently of the neighbouring channels.

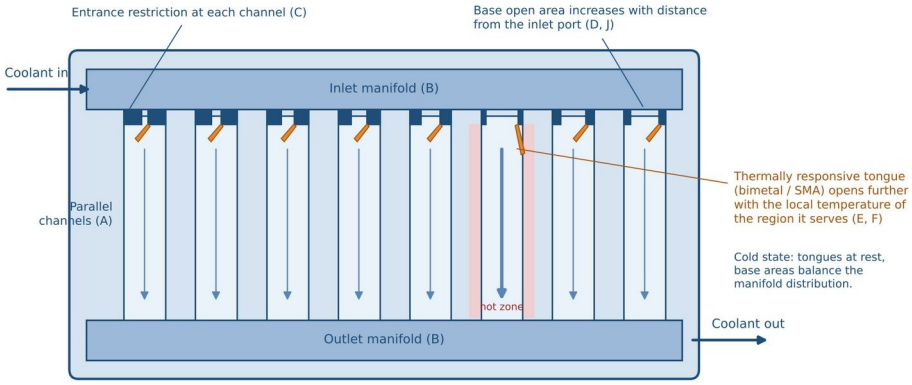


Figure 1. Conceptual flow arrangement of FlowBalance CP-2.

The schematic shows eight parallel channels between common inlet and outlet manifolds, graded entrance restrictions and thermally responsive tongues. It is conceptual and not to scale.

3.1 Core patentability question

> Does the patent literature published before 25 October 2026 contain a document, or a combination of documents, that discloses or renders obvious a battery cooling plate in which the channel-entrance restrictions combine position-dependent base open areas (D) with a thermally responsive, locally coupled opening behaviour (E, F)?

3.2 Technical features relevant to the assessment

The assessment focuses on the following technical aspects of CP-2:

Technical area	CP-2 configuration	Assessment focus
Cooling plate structure	Plate body with parallel channels between inlet and outlet manifolds (A, B)	Known plate architectures; context features
Static flow balancing	Base open areas graded by channel position along the inlet manifold (D, J)	Position-dependent restriction sizing in battery cooling and heat-exchanger headers
Thermal self-regulation	Thermally responsive element at each channel entrance, opening with temperature (C, E, H)	Bimetal, shape-memory and expansion elements controlling coolant flow
Local independence	Each element coupled to the region its channel serves (F); passive operation (K)	Per-channel or per-cell response to local temperature
Decisive combination	Static grading and thermal response at the same restriction (D + E + F)	Whether any document or combination discloses or suggests this pairing

04 / Search methodology

The search strategy was built around the claimed features of CP-2, with particular emphasis on thermally responsive flow elements in battery cooling plates and on position-dependent sizing of channel-entrance restrictions.

A structured, iterative approach was applied. It combined keyword, classification, proximity and full-text routes in several databases, native-language Chinese routes, and forward and backward citation searches of the closest documents. Retrieved families were screened for technical relevance, consolidated across routes, and the closest documents were analysed feature by feature on their full texts.

4.1 Search concepts and representative terminology

Feature	Concept	Keywords / search terms
L — Application	Battery and energy-storage cooling	batter*, accumulator*; IPC/CPC H01M10/6556 as field limiter
A — Plate	Liquid cooling plates	"cooling plate(s)", "cold plate(s)", "heat exchange plate"
E — Element	Thermally responsive element	bimetal*, nitinol, "shape memory", "memory alloy", "thermally responsive", "temperature responsive", "thermally actuated", "temperature sensing", thermosensitive, "thermostatic element", "wax element" Chinese: 形状记忆, 记忆合金, 双金属, 感温, 感温驱动, 感温弹性, 温敏, 热敏
C — Restriction	Restriction at the channel entrance; open flow area	inlet*, orifice*, throttl*, "cross section", "flow area" Chinese: 进液口, 入口端, 节流, 通流截面, 流通面积, 挡块, 开度
D, J — Grading	Position-dependent restriction size; flow equalisation	"different" / "increas*" near diameter*, orifice*, aperture*; orifice* / throttl* near manifold*; uniform*, distribut*, maldistribut*, equal* Chinese: 孔径, 节流孔, 开口面积, 流阻, 递增, 依次增大
F, K — Local, passive	Self-regulating, locally coupled response	self-adaptive, self-regulating, passive Chinese: 自适应, 自调节, 自动调节; 均流, 进液, 分流, 流量分配

Truncation (*) and proximity operators were adapted to each database. Terms were combined into concept blocks rather than used as isolated keywords.

4.2 Classification development

Classification candidates were identified from the CPC facets of the exploratory route (S1b) and from the classification of relevant documents found in the first refined routes. The selected classes are summarised below.

Classification	Features	Technical relevance	Use in the search
H01M10/6556	A, B, L	Battery cooling: solid parts with flow channels or pipes for heat exchange	Core class: S3a–S9b, S12, S13
H01M10/637	E, K	Battery temperature control using reversible temperature-sensitive devices, e.g. bimetal devices	Added in S3b and S4 after recurring in relevant S2 records
F28F27/02	C, D, E	Controlling the distribution of heat-exchange media between different channels	Analogous-field routes S5 and S7
F28F9/026	B, D	Header boxes with static flow control, e.g. means for uniform distribution into conduits	Analogous-field routes S5 and S7

Classification	Features	Technical relevance	Use in the search
H01M10/6567, 6568	L	Liquid heat-exchange media; circulation in the battery cooling circuit	Recorded as co-classification of retrieved documents (e.g. CN117223154A)
G05D23; F28D	E	Self-acting temperature control; general heat-exchanger art	Identified in S1b facets; addressed through the keyword and citation routes (S5, S10)

No single classification describes the complete CP-2 configuration. Feature D lies mainly in heat-exchanger header art (F28F), while features E and F lie mainly in battery thermal management (H01M). The classification routes were therefore run separately and combined with feature-specific keywords.

4.3 Databases and query construction

Database	Routes	Role in the strategy
Google Patents	S1, S1b	Free-text scoping and exploratory retrieval; CPC, applicant and filing-year facets used for classification and terminology discovery
Espacenet	S2–S7, S10, S11	Worldwide collection: concept-block, classification, proximity and full-text routes on title, abstract and claims (ctxt) and full text (ftxt); citation searches (ct) and publication-number lookups (pn). Results reported per family.
WIPO PATENTSCOPE	S8, S9, S9b, S12, S13	Multi-office English full text including PCT; native-language Chinese full text, abstracts and claims; control and combination routes. Exports include abstracts.

Text searching covered English, German and French full text and claims, and English abstracts of Japanese, Korean and Chinese publications. In view of the concentration of recent filings in the Chinese collection, additional native-language routes were run on Chinese abstracts, claims and full text.

A representative query (S7, the route directed at feature D) is shown below. All query strings are recorded as executed in the search log annex.

> (cpc = "H01M10/6556/low" OR cpc = "F28F9/026/low" OR cpc = "F28F27/02/low") AND (ctxt=("different" prox/distance<5 "diameter*") OR ctxt=("different" prox/distance<5 "orifice*") OR ctxt=("different" prox/distance<5 "aperture*") OR ctxt=("increas*" prox/distance<5 "diameter*") OR ctxt=("orifice*" prox/distance<10 "manifold*") OR ctxt=("throttl*" prox/distance<10 "manifold*")) AND ctxt any "uniform* distribut* maldistribut* equal*"

4.4 Integrated search architecture

The search ran through six stages. Discover routes mapped terminology and classes. Refine routes produced result sets of a size suitable for document-level screening. These were consolidated across routes, expanded through citations, analysed in full text and finally reviewed against the stopping rule. The stages overlap in practice because the search was iterative.

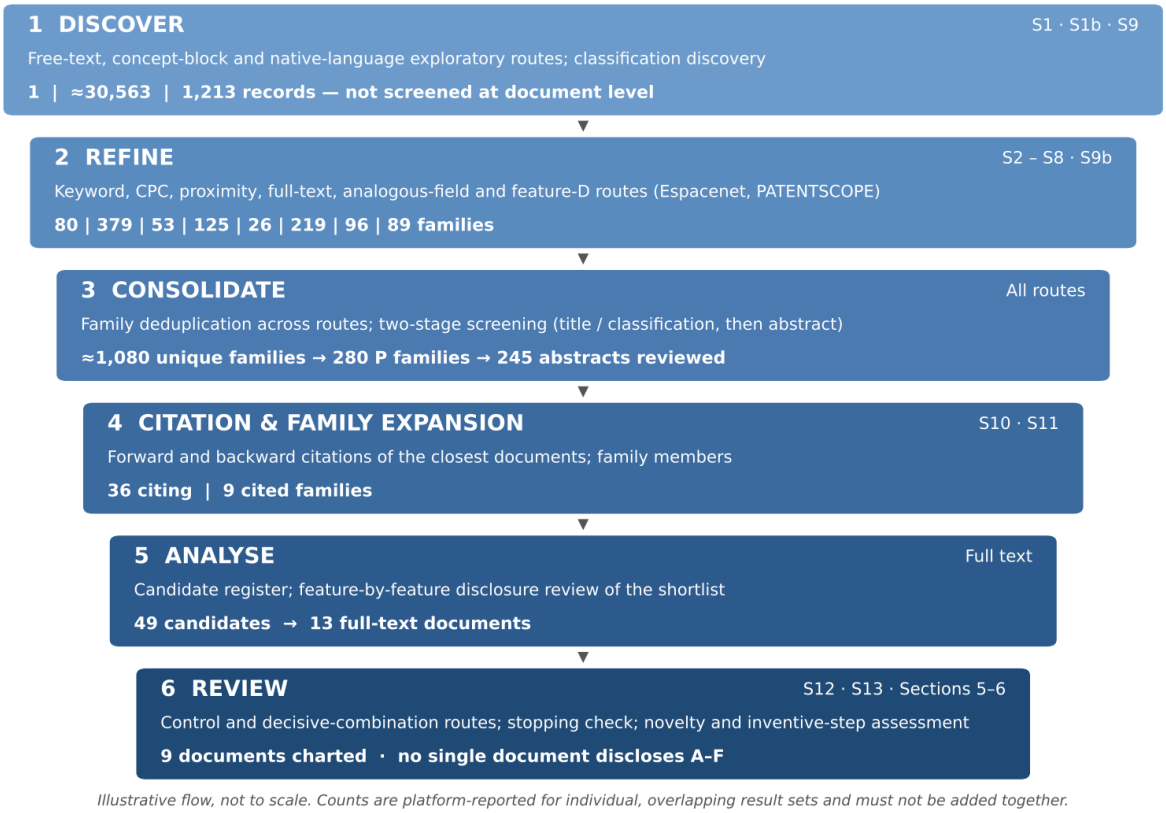


Figure 2. Search and screening flow for FlowBalance CP-2 (illustrative).

4.4.1 Search log — observed retrieval volumes

The log below lists each route with its purpose, the features it targets and its funnel stage. All routes were run on 25 October 2026. Counts are platform-reported for individual, overlapping sets and must not be added together. Espacenet reports results per family. For PATENTSCOPE, families were grouped on the first priority.

ID	Database	Route and purpose	Features	Results	Families	Stage
S1	Google Patents	Free-text scoping of the invention concept	A–F	1	1	Discover
S1b	Google Patents	Concept-block exploratory route for classification and terminology discovery	A, E	≈30,563	—	Discover
S2	Espacenet	Battery + cooling plate + thermally responsive element (title, abstract, claims)	A, E	80	80	Refine
S3a	Espacenet	H01M10/6556 + thermally responsive element	A, E	128	128	Refine
S3b	Espacenet	S3a broadened with H01M10/637 and closest-document terminology	A, E, F	379	379	Refine
S4	Espacenet	Proximity of element terms to flow / channel / inlet terms	C, E, F	53	53	Refine
S5	Espacenet	Analogous field: F28F27/02, F28F9/026 + thermally responsive element	C, E, F	125	125	Refine
S6	Espacenet	Full-text proximity of element terms to inlet / orifice / throttle terms	C, E	26	26	Refine

ID	Database	Route and purpose	Features	Results	Families	Stage
S7	Espacenet	Feature-D route: position-dependent restriction sizing for flow equalisation	B, C, D	219	219	Refine
S8	PATENTSCOPE	Multi-office English full text incl. PCT, IPC H01M10/6556	C, E, F	131	96	Refine
S9	PATENTSCOPE	Chinese full-text route, IPC H01M10/6556 (coverage check)	C, E, F	1,213	1,023	Discover
S9b	PATENTSCOPE	S9 restricted to Chinese abstracts and claims with element-specific terms	C, E, F	91	89	Refine
S10	Espacenet	Forward citations of eleven closest documents	A–F	36	36	Citation & family
S11	Espacenet	Backward citations of six closest documents	A–F	9	9	Citation & family
S12	PATENTSCOPE	Control route: functional terminology (self-adaptive, flow distribution), CN and EN abstracts	C, D, E, F	123	118	Review
S13	PATENTSCOPE	Combination route for the decisive features D + E, CN and EN abstracts	D, E	23	23	Review

S1 returned a single document from an unrelated field (thermal energy storage) and was reformulated as S1b. S3a is fully contained in S3b. S1b and S9 were used for classification discovery and coverage checks; documents relevant from S9 were retrieved again by the narrower S9b route.

4.4.2 Screening funnel

The funnel runs from broad retrieval to a small set of documents charted feature by feature. The criteria show how documents moved from one stage to the next.

Stage	Activity	Figures	Criteria and outcome
1 Discover	Free-text, concept-block and native-language exploratory routes (S1, S1b, S9)	1 / ≈30,563 / 1,213 records	No document-level screening; classes, terminology and collection coverage noted for the refined routes.
2 Refine	Keyword, classification, proximity, full-text, analogous-field and feature-D routes (S2–S8, S9b)	80 / 379 / 53 / 125 / 26 / 219 / 96 / 89 families	Stage-1 screening of titles, applicants, classification and representative drawings: relevant (R), possibly relevant (P) or not relevant (N).
3 Consolidate	Family deduplication across routes; abstract review of P families	≈1,080 unique families; 280 P families; 245 abstracts reviewed	35 P families resolved through the abstracts in the S8 and S9b exports. Abstract review outcome: R 34 · A 44 · N 167.
4 Citation & family	Forward and backward citations of the closest documents (S10, S11)	36 citing / 9 cited families	New families screened as in stage 2; family members recorded in the candidate register.
5 Analyse	Candidate register; full-text review of the shortlist	49 candidates (groups 1 / 2 / 3: 25 / 12 / 12) → 13 full-text documents	Shortlist: closest documents for E + F in battery cooling, for D in battery cooling or the nearest analogous field, and the earliest representatives of each.
6 Review	Control and combination routes (S12, S13); feature-by-feature analysis	9 documents charted; 4 further full-text documents in Section 7	No document discloses A–F. Results in Sections 5–7.

Candidate groups: 1 = thermally responsive flow element in battery liquid cooling; 2 = position-dependent restriction or flow equalisation; 3 = analogous field (electronics and aerospace cold plates, heat exchangers).

4.5 Screening, retention and stopping rule

Screening was carried out in two stages. In the first stage, titles, applicants, classification and representative drawings were reviewed for each refined route. Families marked as possibly relevant were consolidated across routes and reviewed at abstract level in the second stage. Families retained at abstract level entered the candidate register with a preliminary feature mapping (A–F) and a preliminary category.

A family was retained when it disclosed a thermally responsive element controlling coolant flow at channel, branch or cell level (E with C or F), or a position-dependent restriction or distribution arrangement for parallel coolant paths (D). Families retained only as general background received category A.

Searching was concluded when new routes returned families and feature combinations already identified. The battery-field routes converged progressively: 25 of 53 families in S4 and 14 of 26 in S6 had already been seen. Features C, D, E and F were each documented by several independent families. The final combination route S13, directed at the decisive pairing of D and E, returned 16 of 23 families already identified, and none of its new families combined the two features. The stopping criterion was therefore met at feature and combination level.

4.6 Selection rationale

Nine of the thirteen full-text documents are charted in Section 5: five in full detail and four in summary form. They give the closest disclosures of each feature group and form the basis of the inventive-step analysis in Section 6.

Document	Reason for detailed review	Decisive technical question
US20240387899A1	Passive per-channel bimetal flaps at channel inlets of a battery cooling plate	Are base open areas graded by channel position (D)?
CN106602175A	Earliest battery cooling plate with locally coupled SMA restriction per branch channel	Is the restriction at the entrance, and is it graded (C, D)?
DE102015014690A1	Per-branch bimetal temperature-switch valve; problem of position-dependent cooling	Does it compensate position statically (D)?
KR20260078277A	Recent per-inlet bimetal regulator driven by the target battery's heat	Is there a graded base opening (D)?
CN122576505A	Region-wise temperature-sensing stop block at each plate inlet	Per-channel restriction and graded base area (C, D)?
CN117223154A	Self-acting valve per jacket; background on graded inlet diameters	Does it teach combining grading with thermal regulation?
US4578324A	Position-graded orifices in the input manifold of a cell-cooling panel	Same field as CP-2; source of D and J
US2015053385A1	Position-dependent tube-inlet restrictions in a heat exchanger	Analogous source of D
JPS62237676A	Shape-memory vanes setting a temperature-dependent manifold distribution	Closest single element linking distribution and temperature

05 / Closest prior art, feature by feature

Five documents carry the inventive-step analysis and are charted feature by feature against features A–F of draft claim 1 (Sections 5.1–5.5). Four further documents analysed in full text are summarised in Section 5.6, and all nine appear in the matrix in Section 5.7. Each feature is mapped to the document with a reasoned comment and a disclosure status. Purple text identifies claim-side features and teal text identifies the document's disclosure; these colours are reading aids, not ratings.

Status	Meaning	Treatment in this report
DISCLOSED	The feature is directly and unambiguously disclosed in the document.	Counts towards anticipation; used in the inventive-step combinations.
PARTIALLY DISCLOSED	The document discloses the feature in part, in a different arrangement or only in general terms.	Does not anticipate; considered for inventive step.
NOT DISCLOSED	The feature is absent from the document.	Basis of a distinguishing feature.
NOTE	Interpretation point that is not itself a claim feature.	Informs the weighting of the other features.

A document anticipates claim 1 only if it discloses every feature A–F in combination. Paragraph, column and claim references are to the reviewed publication.

5.1 US20240387899A1 — Audi AG

1. Document overview

Item	Details
Publication	US20240387899A1
Applicant	Audi AG
Title	Self-regulating cooling device for an energy storage, cooling arrangement, energy storage and motor vehicle
Filing date	1 May 2024 (US 18/651,854)
Priority	DE 10 2023 112 709.8, 15 May 2023
Publication date	21 November 2024
Prior-art status	Published before the cut-off; prior art for novelty and inventive step
Basis reviewed	Full text: claims 1–17, description [0015]–[0049], Figs. 1–4 (English)
Category	Y — closest prior art

2. Feature analysis

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Draft claim 1				
A	Plate body defining a plurality of coolant channels extending in parallel	Inter-cell cooling element 20 (cooling plate) with several cooling channels 32a–32d separated by partition walls 34 ([0044]–[0045]; claim 1).	**DISCLOSED**	Channels run side by side between the distribution and collection regions (Fig. 2).

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
B	Inlet and outlet manifolds, each channel extending between and in fluid communication with both	Distribution region 36 fed by the coolant supply connection 24; collection region 38 with the discharge connection 26 ([0023], [0044]).	**DISCLOSED**	The distribution and collection regions act as inlet and outlet manifolds.
C	Flow restriction at the entrance of each of at least two channels, each defining an open flow area	Adjusting elements 42a–42c formed as flaps 44 enlarge or reduce the inlet opening of the channels; one element per channel is possible ([0018], [0045]; claim 5: size of an inlet opening).	**DISCLOSED**	The flap at the channel inlet defines a variable inlet opening.
D	At a reference temperature, different open flow areas selected according to channel position along the inlet manifold	Different flow cross-sections, including different inlet-opening sizes, are named as a way of giving channels different flow characteristics ([0019]). No selection according to channel position along the distribution region is described.	**NOT DISCLOSED**	Differences arise from the local temperature, not from a static, position-based sizing. Distinguishing feature.
E	Thermally responsive element increasing the open flow area with increasing temperature	Passive bimetal strip 46 forming a flap opens on a temperature increase in its region and enlarges the inlet opening ([0021], [0048]; claims 2–3).	**DISCLOSED**	Shape-memory and expansion elements are named as alternatives ([0015]).
F	Element thermally coupled to the region served by its channel; open area varies independently with local temperature	Flow through each channel is set by the local temperature at the location of the respective element ([0023]); in a hot-spot channel the element opens while the adjacent channel is reduced ([0047]).	**DISCLOSED**	One element per channel is disclosed ([0018]); an element on a partition wall may act on two adjacent channels ([0045]).
Document-level result: A, B, C, E and F disclosed; D not disclosed. Closest prior art for the assessment in Section 6.				

3. Relevant patent figures

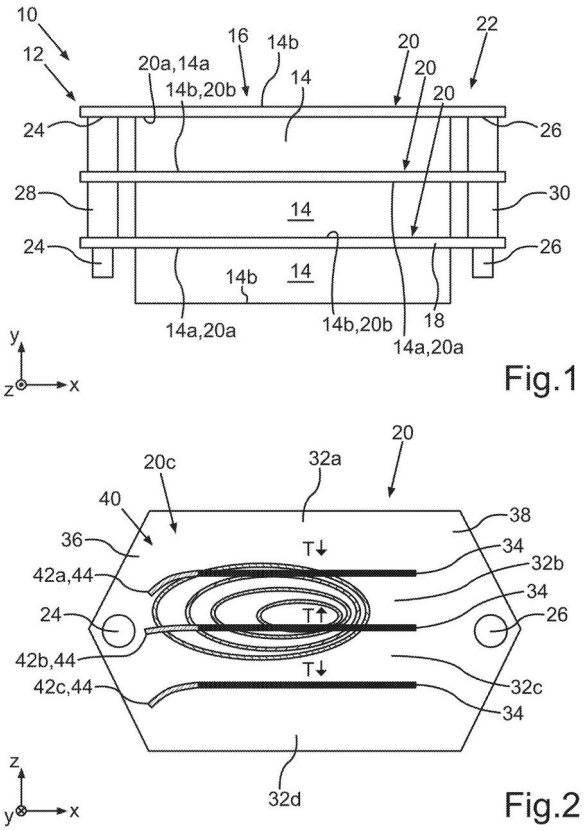


Figure 3. Inter-cell cooling element (20) with cooling channels (32a–32d), distribution region (36), collection region (38), supply and discharge connections (24, 26) and adjusting elements (42a–42c) formed as flaps (44), as illustrated in US20240387899A1 (original Figs. 1–2).

4. Technical assessment

US20240387899A1 addresses the same technical problem as CP-2: local hot spots and inhomogeneous temperature in a battery cooling plate with parallel channels. It solves the problem with passive bimetal flaps at the channel inlets that open further when the region around them warms up, so that the flow is redistributed towards the hot channel without any active control ([0045]).

The document also discloses several dependent features. At low temperature, part of the inlet opening is blocked by the flap ([0021]), which corresponds to a partly covering tongue (H) and implies a rest position with a remaining base opening (I, partly). Self-regulation without active control corresponds to K, and the cooling plate is arranged in a battery module (L).

Each flap therefore has a cold-state rest position that defines a base inlet opening. The document does not set these base openings differently according to the channel's position along the distribution region; the differences between channels arise only from the local temperature.

Preliminary technical assessment: Closest prior art. The document differs from claim 1 only in feature D (position-dependent base open areas).

5.2 CN106602175A — Hefei Guoxuan High-Tech Power Energy

1. Document overview

Item	Details
Publication	CN106602175A (related: CN206432356U; WO2018137374A1)
Applicant	Hefei Guoxuan High-Tech Power Energy Co., Ltd. (合肥国轩高科动力能源有限公司)
Title	Battery liquid cooling device and battery system (电池液冷装置及电池系统)
Filing date	26 January 2017 (CN 201710061597)
Publication date	26 April 2017
Prior-art status	Published before the cut-off; prior art for novelty and inventive step
Basis reviewed	Full text: claims 1–8, description [0009]–[0017] and [0026], Figs. 1–2 (Chinese)
Category	Y

2. Feature analysis

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Draft claim 1				
A	Plate body defining a plurality of coolant channels extending in parallel	Liquid-cooling plate 1 whose plate shell 14 contains several branch channels 13 separated by ribs 15 ([0014], [0026]).	**DISCLOSED**	Branch channels run in parallel between the main channels (Fig. 2).
B	Inlet and outlet manifolds, each channel extending between and in fluid communication with both	Main inflow channel 11 and main return channel 12 connected by the branch channels 13 ([0013]; Fig. 2).	**DISCLOSED**	The main channels act as inlet and outlet manifolds.
C	Flow restriction at the entrance of each of at least two channels, each defining an open flow area	Flow-intercepting portion 22 of a flow-regulating part arranged in at least one branch channel ([0012]–[0013]).	**PARTIALLY DISCLOSED**	A restriction per branch channel is present; its location at the channel entrance is not specified.
D	At a reference temperature, different open flow areas selected according to channel position along the inlet manifold	No position-dependent base cross-sections of the intercepting portions are described.	**NOT DISCLOSED**	Distinguishing feature.
E	Thermally responsive element increasing the open flow area with increasing temperature	The flow-regulating part contains shape-memory material and adjusts the channel flow according to the surface temperature of the battery it contacts (claim 1; [0009]).	**DISCLOSED**	Shape-memory alloy or thermally induced shape-memory polymer ([0015]–[0016]).
F	Element thermally coupled to the region served by its channel; open area varies independently with local temperature	Contact portion 21 passes through the plate shell and contacts the battery outside; each part deforms according to its own battery, so the cooling differs between batteries ([0011]; description).	**DISCLOSED**	Independent, locally coupled response per branch channel.
Document-level result: A, B, E and F disclosed; C partially disclosed; D not disclosed.				

3. Relevant patent figures

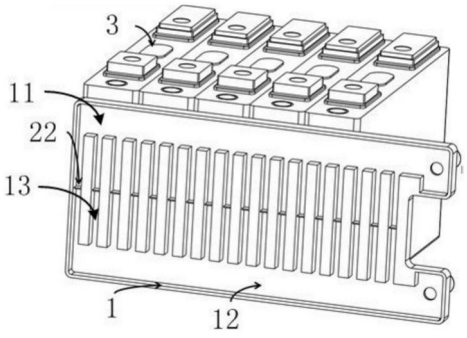


图1

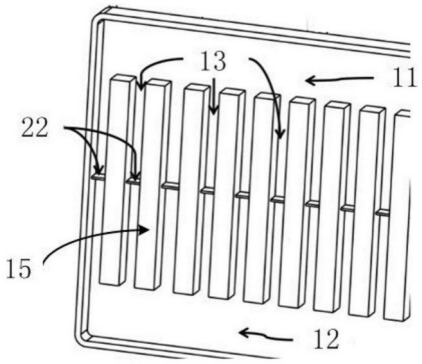


图2

Figure 4. Liquid-cooling plate with main inflow channel (11), main return channel (12) and branch channels (13); flow-regulating parts with contact portions in contact with the batteries (3), as illustrated in CN106602175A (original Figs. 1–2).

4. Technical assessment

CN106602175A is the earliest battery cooling plate retrieved in which each branch channel carries its own shape-memory flow restriction that is thermally coupled to the battery it cools. The plate shell is made of aluminium alloy or copper ([0017]).

The document gives an alternative starting point for the inventive-step analysis. Compared with US20240387899A1 it lacks a defined entrance location of the restriction (C, partly) and, like that document, any position-dependent base cross-section (D).

Preliminary technical assessment: Relevant Y document and alternative closest prior art. Distinguishing features: D, and C in part.

5.3 DE102015014690A1 — Daimler AG

1. Document overview

Item	Details
Publication	DE102015014690A1
Applicant	Daimler AG
Title	Kühlvorrichtung für eine Batterie eines Kraftfahrzeugs sowie Batterie (Cooling device for a battery of a motor vehicle, and battery)
Filing date	12 November 2015 (DE 10 2015 014 690.4)
Publication date	21 July 2016
Prior-art status	Published before the cut-off; prior art for novelty and inventive step
Basis reviewed	Full text: claims 1–7, description [0003]–[0004], Fig. 2 (German)
Category	Y

2. Feature analysis

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Draft claim 1				
A	Plate body defining a plurality of coolant channels extending in parallel	The cell cooling line 20 may be a cooling plate with a meandering cooling path 26 (claim 5); several cell cooling lines branch in parallel from the main line.	**PARTIALLY DISCLOSED**	Parallel paths are formed by separate cell cooling lines, not by channels of one plate body.
B	Inlet and outlet manifolds, each channel extending between and in fluid communication with both	Main cooling line 18 supplies the coolant; cell cooling lines branch from it and return to it (claims 1, 5).	**PARTIALLY DISCLOSED**	One main line acts as common supply and return; no separate manifolds within a plate.
C	Flow restriction at the entrance of each of at least two channels, each defining an open flow area	Valve 32 coupling the main cooling line with each cell cooling line, i.e. at the entrance of each branch (claim 1).	**DISCLOSED**	Restriction at the branch entrance.
D	At a reference temperature, different open flow areas selected according to channel position along the inlet manifold	No position-dependent sizing of the valves. [0003] notes that, in known systems, cells at the start of the cooling system are cooled more strongly than cells at the end.	**NOT DISCLOSED**	The document names the position-dependent problem but solves it thermally only. Distinguishing feature.
E	Thermally responsive element increasing the open flow area with increasing temperature	Valve formed as a bimetal temperature switch 34 with intermediate switching positions that admit a growing share of coolant to the cell cooling line (claims 2–3).	**DISCLOSED**	Closed in end position P2 below the minimum temperature: no flow through the cell line.
F	Element thermally coupled to the region served by its channel; open area varies independently with local temperature	Temperature switch thermally coupled to its battery cell (claim 4).	**DISCLOSED**	Independent response per cell.
Document-level result: C, E and F disclosed; A and B partially disclosed; D not disclosed.				

3. Relevant patent figures

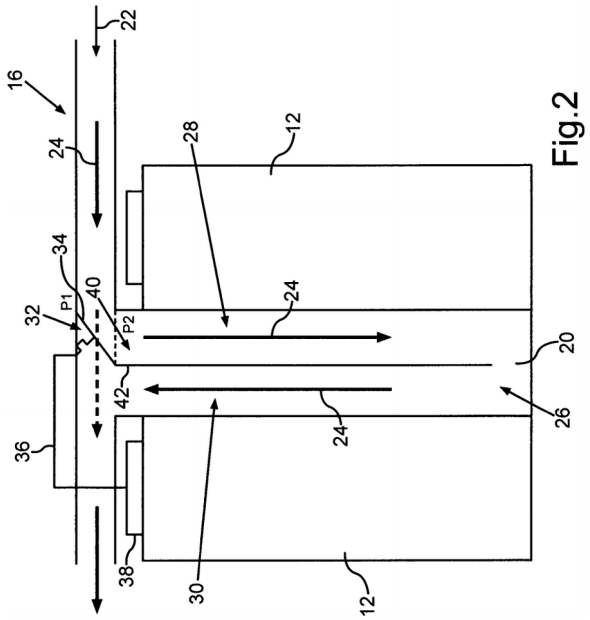


Figure 5. Valve (32) formed as temperature switch (34) coupling the main cooling line with the cell cooling line (20); sub-paths (28, 30) and switching positions P1, P2, as illustrated in DE102015014690A1 (original Fig. 2).

4. Technical assessment

DE102015014690A1 uses a bimetal temperature switch at each branch of the main cooling line to admit coolant to the cell cooling line in proportion to the cell temperature. The background explicitly identifies the position-dependent cooling difference along the supply line ([0003]), which is the problem that CP-2's feature D addresses statically.

The document therefore confirms that the skilled person was aware of position-dependent maldistribution in battery cooling and of locally coupled bimetal valves as a remedy. It does not combine the thermal valve with a static, position-graded base opening, and the valve closes fully at low temperature, so it provides no minimum flow (I).

Preliminary technical assessment: Relevant Y document, mainly as evidence of the problem and of locally coupled bimetal regulation. Distinguishing features: D, and A and B in part.

5.4 CN117223154A — Fuji Seiko Co., Ltd.

1. Document overview

Item	Details
Publication	CN117223154A (PCT/JP2022/048137; WO2023/176095)
Applicant	Fuji Seiko Co., Ltd. (富士精工株式会社)
Title	Battery cooling system (电池冷却系统)
Filing date	27 December 2022 (PCT/JP2022/048137); national phase CN 202280031658.1
Priority	JP 2022-043228, 17 March 2022
Publication date	12 December 2023 (WO publication 21 September 2023)
Prior-art status	Published before the cut-off; prior art for novelty and inventive step
Basis reviewed	Full text: claims 1–7, description [0006]–[0008] and [0033], Fig. 1 (Chinese)
Category	Y

2. Feature analysis

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Draft claim 1				
A	Plate body defining a plurality of coolant channels extending in parallel	Jackets 2 with internal coolant passages, one per battery pack 3 (claim 1).	**PARTIALLY DISCLOSED**	Separate jackets, not channels of one plate body.
B	Inlet and outlet manifolds, each channel extending between and in fluid communication with both	Supply and discharge trunk flow paths 10, 11 with supply and discharge branch flow paths 12, 13 to each jacket (claim 1; Fig. 1).	**DISCLOSED**	Trunks act as common supply and return manifolds.
C	Flow restriction at the entrance of each of at least two channels, each defining an open flow area	Thermostat valve 5 in the discharge branch 13 of each jacket (claim 1).	**PARTIALLY DISCLOSED**	Restriction at the outlet of each jacket, not at the entrance.
D	At a reference temperature, different open flow areas selected according to channel position along the inlet manifold	Background [0007]: in an earlier battery cooling device, the inlet and outlet diameters d1 of the upstream jackets are smaller than the diameters d2 of the downstream jackets, so that the supply to all jackets is equalised.	**PARTIALLY DISCLOSED**	Position-graded openings described as known; no thermal element in that arrangement. [0008]: grading alone does not equalise the temperatures.
E	Thermally responsive element increasing the open flow area with increasing temperature	Self-acting thermostat valve (wax, bellows or shape-memory alloy) adjusting its opening with the surrounding coolant temperature (claims 1–4).	**DISCLOSED**	Passive operation (K).
F	Element thermally coupled to the region served by its channel; open area varies independently with local temperature	Each valve senses the coolant leaving its own jacket, i.e. indirectly the temperature of the pack it serves.	**PARTIALLY DISCLOSED**	Indirect thermal coupling through the coolant.

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Document-level result: B and E disclosed; A, C, D and F partially disclosed. Also discloses a leak hole giving a minimum flow (I; claims 5–6, [0033]).				

3. Relevant patent figures

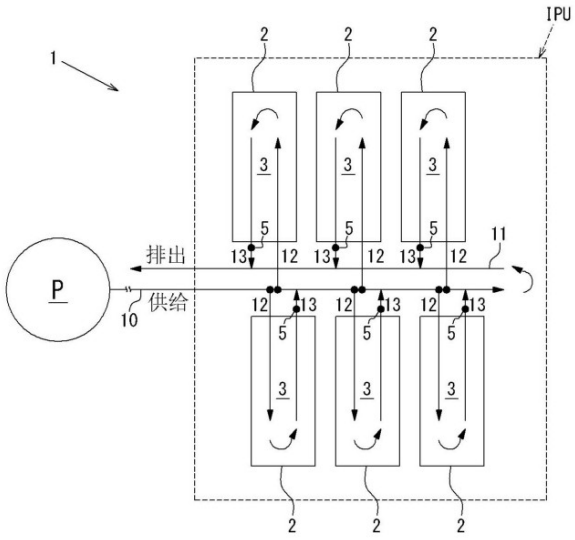


图1

Figure 6. Supply and discharge trunk flow paths (10, 11), branch flow paths (12, 13) of the jackets (2) of each battery pack (3) and self-acting thermostat valves (5) on the discharge branches; pump P, as illustrated in CN117223154A (original Fig. 1).

4. Technical assessment

CN117223154A is important for the motivation to combine. Its background describes position-graded inlet and outlet diameters along the supply line as a known way of equalising the coolant supply to several battery jackets ([0007]). It then states that resistance-based equalisation alone cannot compensate for scatter in passage areas or in the heat generated by each pack ([0008]), and adds a self-acting thermostat valve per jacket.

The document thus places static grading and thermal regulation side by side in the same battery cooling context. It also discloses a leak hole that keeps a minimum flow when the valve is closed (I).

Preliminary technical assessment: Relevant Y document; supports the motivation to combine position-graded openings with per-branch thermal regulation, and discloses feature I.

5.5 US4578324A — Ford Aerospace & Communications

1. Document overview

Item	Details
Publication	US4578324A
Applicant / assignee	Ford Aerospace & Communications Corporation
Title	Active cooling system for electrochemical cells
Filing date	5 October 1984 (US 658,015)
Publication date	25 March 1986 (grant)
Prior-art status	Published before the cut-off; prior art for novelty and inventive step
Basis reviewed	Full text: claims 1–9 (in particular claim 5), description col. 4, Figs. 2 and 7 (English)
Category	Y

2. Feature analysis

Ref	Claimed feature	Disclosure in the document	Status	Searcher's comment
Draft claim 1				
A	Plate body defining a plurality of coolant channels extending in parallel	Hollow cooling panels 15, 16 pressed against the cells; the panels may be divided into parallel channels 33 (Fig. 7).	**DISCLOSED**	Plate-type panel with parallel channels.
B	Inlet and outlet manifolds, each channel extending between and in fluid communication with both	Input manifold 25 and output manifold 27 at the ends of each panel (col. 4; Fig. 2).	**DISCLOSED**	
C	Flow restriction at the entrance of each of at least two channels, each defining an open flow area	Orifices 28 in the common wall between the input manifold and the panel, at the entry of the cooling paths 12 (col. 4; claim 5).	**DISCLOSED**	The number of orifices need not equal the number of cells.
D	At a reference temperature, different open flow areas selected according to channel position along the inlet manifold	Orifices of monotonically increasing size as the fluid moves away from the pump, compensating the pressure drop along the manifold so that all cooling paths receive equal flow (col. 4; claim 5).	**DISCLOSED**	Fixed geometry. Also discloses J (increase with distance from the inlet).
E	Thermally responsive element increasing the open flow area with increasing temperature	Fixed orifices; no thermally responsive element.	**NOT DISCLOSED**	
F	Element thermally coupled to the region served by its channel; open area varies independently with local temperature	No locally coupled response.	**NOT DISCLOSED**	
Document-level result: A, B, C and D disclosed (also J); E and F not disclosed.				

3. Relevant patent figures

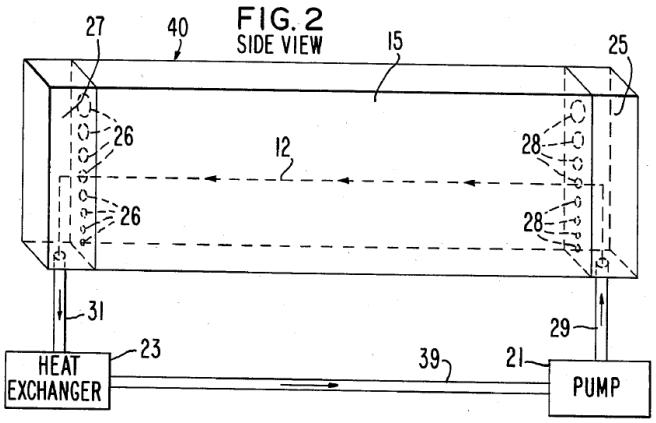


Figure 7. Cooling panel (15) with input manifold (25) and orifices (28), output manifold (27) and orifices (26), cooling path (12), pump (21) and heat exchanger (23), as illustrated in US4578324A (original Fig. 2).

4. Technical assessment

US4578324A concerns the cooling of electrochemical cells, i.e. the same technical field as CP-2, and addresses the same static problem: cooling paths along a manifold receive unequal flow because of the pressure drop along the manifold. The solution is a series of orifices whose size increases monotonically away from the pump.

The document discloses features D and J in a cell-cooling panel. It contains no thermally responsive element, so it is not relevant to features E and F on its own.

Preliminary technical assessment: Principal secondary document for feature D (and J) in the same technical field. Combined with US20240387899A1 or CN106602175A it supplies the only distinguishing feature of claim 1.

5.6 Further charted documents

The following four documents were also analysed feature by feature on their full texts. They confirm the feature groups established in Sections 5.1–5.5 and do not change the assessment, so they are summarised here.

Document	Relevant disclosure	Disclosed	Partly disclosed	Not disclosed	Category and role
KR20260078277A	LG Energy Solution; filed 22 Nov 2024, published 29 May 2026. Bimetal flow-regulating part 240 between each supply outlet 221 and the cooling inlet of each inter-battery cooling unit 210, driven by the heat of its target battery through heat-transfer part 230 (claims 1–2; [0046]–[0047]). Closed in the initial state.	B, C, E, F	A	D	Y. Per-inlet, locally coupled bimetal regulation in recent battery practice.
CN122576505A	广西易德科技有限责任公司; filed 26 May 2026, published 14 Aug 2026. Temperature-sensing driving piece 133 embedded in the plate surface of each heat-dissipation region moves a stop block 132 at the inlet end 1211 of the liquid-cooling plate, without external control signals (claim 1; [0034]–[0049]).	E, F (also K)	A, B, C	D	Y. Region-wise passive regulation per plate.
US2015053385A1	King Fahd University of Petroleum and Minerals; filed 22 Aug 2013, published 26 Feb 2015. Restriction orifices or conical nozzles at the juncture of each tube with the inlet plenum; diameters graded by tube position relative to the inlet pipe (claims 1–3; [0023]).	B, C, D	A	E, F	Y (analogous field). Feature D as a general flow-balancing measure.
JPS62237676A	Sanyo Electric; filed 7 Apr 1986, published 17 Oct 1987. Shape-memory straightening vanes (transformation at about 145 °C) in the coolant inlet manifold of a fuel-cell stack shift the flow distribution between stack ends and centre with temperature.	B	A, C, D, E	F	Y (analogous field). Closest single element linking distribution and temperature; relevant to Section 8.2.

5.7 Feature disclosure matrix

The matrix summarises the disclosure status of each charted document for the features of claim 1 and for the dependent features H–K. Features G and L are general (plate material and battery module) and are treated in Section 6.6.

Document	A	B	C	D	E	F	H	I	J	K	Cat.
US20240387899A1	D	D	D	N	D	D	D	P	N	D	Y
CN106602175A	D	D	P	N	D	D	P	N	N	D	Y
DE102015014690A1	P	P	D	N	D	D	P	N	N	D	Y
KR20260078277A	P	D	D	N	D	D	P	N	N	D	Y
CN122576505A	P	P	P	N	D	D	P	N	N	D	Y
CN117223154A	P	D	P	P	D	P	P	D	P	D	Y
US4578324A	D	D	D	D	N	N	N	n/a	D	D	Y
US2015053385A1	P	D	D	D	N	N	N	n/a	P	D	Y
JPS62237676A	P	D	P	P	P	N	P	N	N	D	Y

D = disclosed · P = partially disclosed · N = not disclosed · n/a = not applicable (fixed restriction without a thermal element). The pattern shows the split that decides the assessment: documents with E and F lack D, and documents with D lack E and F.

06 / Novelty and inventive step

The assessment follows the problem-solution approach: identify the closest prior art, determine the distinguishing features and their technical effect, formulate the objective technical problem, and ask whether the prior art as a whole would have led the skilled person to the claimed solution.

6.1 Novelty

No document retrieved discloses all features A–F in combination (Section 5.7). The documents divide into two groups that do not overlap on the decisive features:

- Documents with a thermally responsive, locally coupled element at each channel, branch or cell (E, F), such as US20240387899A1, CN106602175A and DE102015014690A1: none sets the base open areas according to channel position (D).
- Documents with position-dependent restrictions (D), such as US4578324A, US2015053385A1 and the background of CN117223154A: none contains a thermally responsive element at the restrictions (E).

Claim 1 is therefore novel over the documents retrieved. The scope note on unpublished applications in Section 2.4 applies.

6.2 Closest prior art

US20240387899A1 (Audi) is the closest prior art. It concerns the same purpose, passive flow regulation between the parallel channels of a battery cooling plate, and shares the largest number of features with claim 1 (A, B, C, E and F, as well as H, K and L). CN106602175A is a credible alternative starting point; starting from it leads to the same result, since US4578324A supplies the missing feature D in both cases.

The application frames the problem from fixed-area channel-entry restrictions, i.e. from an arrangement of the US4578324A type. From that starting point the distinguishing features are E and F, which US20240387899A1 provides for the same purpose: a passive, local response to non-uniform heat generation without actuators or control electronics. Both starting points lead to the same result.

6.3 Distinguishing feature

Claim 1 differs from US20240387899A1 only in feature D: at a reference temperature, the open flow areas of the entrance restrictions differ from one another and are selected according to the position of the respective channel along the inlet manifold.

6.4 Technical effect and objective technical problem

Feature D compensates for the static pressure distribution along the inlet manifold, so that the channels receive a balanced flow at the reference temperature. The thermally responsive elements then correct only local deviations caused by hot zones. In the draft claim, the static grading and the thermal response act at the same restriction but independently: the grading sets the starting point, the element adds an opening that depends only on the local temperature.

> **Objective technical problem:** how to compensate, in the cooling plate of US20240387899A1, for the position-dependent flow distribution along the inlet manifold that exists independently of the local temperature.

6.5 Assessment of combinations

The skilled person seeking to solve this problem would turn to flow-equalisation measures for parallel coolant paths fed from a manifold. US4578324A, from the same field of cell cooling, teaches exactly this: orifices whose size increases along the manifold away from the pump, so that all cooling paths receive equal flow. US2015053385A1 confirms the same measure in general heat-exchanger design.

The prior art also gives a clear motivation to combine. DE102015014690A1 names the position-dependent cooling difference along the supply line as a known problem ([0003]). CN117223154A describes graded inlet diameters as known in battery cooling and adds thermal regulation because grading alone cannot equalise the temperatures ([0007]–[0008]). US20240387899A1 itself names the inlet-opening size as the flow characteristic to be set ([0019]; claim 5), and its flap partly blocks the inlet when cold ([0021]); grading this cold-state opening by channel position is routine design.

Each measure produces its own known effect: the grading balances the static distribution and the element responds to local temperature. No effect beyond the sum of these is identified in the draft claim or the CP-2 description, so the combination is a juxtaposition of known measures.

Combination	Basis	Assessment
US20240387899A1 + US4578324A	Same field; position-graded orifices along the manifold supply D (and J)	**Strong objection**
CN106602175A + US4578324A	Alternative starting point; same secondary document	**Strong objection**
US4578324A + US20240387899A1	Starting point matching the problem as stated in the application; US20240387899A1 supplies E and F	**Strong objection**
US20240387899A1 + CN117223154A	Graded inlet diameters acknowledged as known in battery cooling ([0007]); motivation in [0008]	**Supporting objection**

Conclusion on inventive step: Claim 1 in its current form is exposed to an inventive-step objection, principally on the combination of US20240387899A1 with US4578324A. Patentability depends on an amendment that introduces a feature beyond this juxtaposition (Section 8.2).

6.6 Dependent claims and fallback positions

Each dependent feature is disclosed or suggested in the retrieved art; feature L (battery module) is found in US20240387899A1 and all battery-field documents. None of them provides a reliable fallback position on its own.

Ref	Dependent feature	Closest disclosure	Status	Fallback
G	Two joined (e.g. brazed) aluminium sheets	CN106602175A: aluminium-alloy plate shell ([0017])	**PARTIALLY DISCLOSED**	Low
H	Bimetal or SMA tongue partly covering the entrance	US20240387899A1: bimetal flap partly blocking the inlet ([0021], [0045])	**DISCLOSED**	Low
I	Non-zero minimum open area at all temperatures	CN117223154A: leak hole (claims 5–6; [0033]); US20240387899A1 [0021]	**DISCLOSED**	Low
J	Open areas increasing with distance from the inlet port	US4578324A: orifices increasing away from the pump (claim 5); CN117223154A [0007]	**DISCLOSED**	Low
K	No externally powered valve or electronic control	US20240387899A1 ([0045]); CN122576505A (claim 1)	**DISCLOSED**	Low

07 / Additional retained publications

The candidate register contains 49 retained documents. Nine are charted in Section 5. The 19 publications below are further Y-level documents, or were reviewed in full text, and represent the same feature groups. The remaining 21 candidates (category A) are listed with their reasons in the search log annex.

Reviewed in full text

Publication	Applicant / date	Relevant disclosure	Features	Cat.	Treatment
CN121546232A	CATL 17 Feb 2026	Collector cavity and diverter with through-holes; shape-memory adjusting mechanism closes the through-hole at a channel port and opens above a threshold. Different thresholds for different adjusting portions (claim 16); adjustable channel in the middle region (claim 5).	A, B, C, E, F; no D	**Y**	Same feature set as US20240387899A1. Claim 16 relevant to the amendment options in Section 8.2.
CN121726593A	聊城市吉星新能源科技有限公司 24 Mar 2026	Bimetal strip per cooling tube, linked to a plug at the tube's inlet chamber; passive.	B, C, E, F; A partly; no D	**Y**	Confirms per-channel passive regulation; no grading.
CN118040144A	Nanjing Infy Power 14 May 2024	Per-cell dynamic valve: inert gas in a temperature-sensing cavity moves a membrane and plug in the through-hole feeding that cell's plate.	C, E, F; no D	**Y**	Confirms per-cell locally coupled regulation; no grading.
CN118486957A	Liande Electronic Technology (Changshu) 13 Aug 2024	Multi-stage channel groups with flaps at each channel inlet driven by the flow force.	A, B, C; D partly; no E	**A**	Hydraulic, not thermal, self-adjustment.

Assessed at abstract level

Publication	Applicant, publication date	Relevant disclosure	Features	Cat.
Group 1 — thermally responsive flow elements (feature group of Sections 5.1–5.3)				
US20240047782A1	CATL, 8 Feb 2024	Flow-regulation component in the cooling channel opening from a first to a larger second opening with temperature.	C, E	**Y**
CN119725843A	Chongqing Fudi Battery Research Institute, 28 Mar 2025	Valve between the inlet pipe and the flow-channel piece driven by a temperature-sensing elastic piece.	C, E	**Y**
EP4826834A1	LG Energy Solution, 21 Oct 2026	Base-plate main and sub channels with a bimetal blocking member in each sub channel.	E; B, C, F partly	**Y**
CN122843602A	北京中友伟皓科技发展有限公司, 29 Sep 2026	Shape-memory flow-guide grille at each cell-channel inlet, opening on heating. Immersion cooling.	C, E, F	**Y**

Publication	Applicant, publication date	Relevant disclosure	Features	Cat.
CN222300730U	Hunan Institute of Engineering et al., 3 Jan 2025	Self-adaptive units on heat-dissipation plates regulating individual channel flow by battery temperature.	A, E, F	**Y**
CN121332029A	广东恒韬新能源科技有限公司, 13 Jan 2026	Shape-memory valve sheets enlarging the channel cross-section at local hot spots.	E, F	**Y**
CN121663028A	State Grid Shaanxi Electric Power Research Institute, 13 Mar 2026	Adjusting seals at selected channel positions varying the cross-section with local temperature.	E, F	**Y**
Group 2 — position-dependent restriction and flow equalisation (feature group of Section 5.5)				
CN122716487A	易事特集团股份有限公司, 8 Sep 2026	Branch inlet channels with flow resistance increasing along the direction of gravity.	B, C, D	**Y**
US2021091432A1	Jing-Jin Electric Technologies, 25 Mar 2021	Throttle pipe with restriction orifice in each module inlet for equal pressures.	C; B, D partly	**Y**
CN116454480A	Wang Yachao, 18 Jul 2023	Inlet collecting panel with an orifice plate whose hole density increases progressively.	B, D	**Y**
DE102009013651A1	Continental Automotive, 23 Sep 2010	Distributor with flow-delimitation unit giving different cooling to cell ranges.	B, D	**Y**
DE112014001406T5	Danfoss Silicon Power, 3 Dec 2015	Distributor units with adjustable flow-restriction devices between inlet and outlet distributors.	B, C; D partly	**Y**
US20230085947A1	Toyoda Gosei, 23 Mar 2023	Parallel passages between common inflow and exhaust; fixed cross-sections larger under hotter battery regions. Static sizing by expected temperature, not by position.	A, B; D partly	**Y**
Group 3 — analogous field: electronics cooling (feature group of Section 5.1)				
US2014204532A1	Parker-Hannifin, 24 Jul 2014	Electronics cooling: each microjet nozzle deforms above the threshold temperature of the component it cools.	C, E, F	**Y**
CN115734567A	Xinxiang Aviation Industry (Group), 3 Mar 2023	Electronics cold plate: shape-memory sheets at the positions of heat-generating parts deform to change the flow.	E, F	**Y**

Abstract-level entries reflect the review of titles, abstracts and representative drawings recorded in the candidate register. None of the 19 publications discloses features D and E together.

08 / Conclusions and recommendations

8.1 Overall assessment

The patent literature search and analysis compared draft claim 1 of FlowBalance CP-2 with nine closest documents in full text and with a further 19 retained publications. The decisive features are the position-dependent base open areas (D) and the thermally responsive, locally coupled restriction (E, F).

Novelty of claim 1 is established over the documents retrieved: no document discloses features D and E together.

Inventive step of claim 1 in its current form is open to objection. US20240387899A1 (Audi) discloses all features except D, and US4578324A, from the same field, supplies D for the same purpose of flow equalisation along a manifold. The motivation to combine is documented in DE102015014690A1 and CN117223154A. The dependent features G–L are each found in the retrieved art.

The invention therefore has a credible route to protection, but the claim needs to be re-centred on a feature that goes beyond the juxtaposition of static grading and local thermal response.

8.2 Claim-drafting recommendations

Priority	Recommended direction	Nearest prior art	Assessment
High	One element, two functions: the thermally responsive element's own graded rest position (geometry or pre-set) defines the position-dependent base open area at each channel.	US20240387899A1 [0021] (uniform cold-state position); JPS62237676A (manifold-level element)	Most promising; requires description support and a supplementary search
Medium	Position-graded thermal characteristic: opening temperature or stroke of the elements graded along the inlet manifold together with the base grading.	CN121546232A claim 16 (different thresholds for different portions)	Partly known; must be tied to manifold position and to D
Medium	Demonstrated interaction: base areas sized so that all elements work in the same part of their stroke, with data showing a lower channel-to-channel temperature spread than either measure alone.	No document reports such an interaction	Value depends on comparative data from the inventor
Supporting	Integrated construction: tongue formed from the plate sheet at the channel entrance in the brazed two-sheet plate (G + H).	US20240387899A1 (flaps on partition walls)	Useful as a dependent claim; requires a supplementary search

Whatever direction is chosen, the description should explain the technical effect of the combined feature and, ideally, include test or simulation data comparing the combined arrangement with static grading alone and with thermal elements alone.

8.3 Next steps

- **Targeted supplementary search** on the amended feature before filing, using the same databases and routes, with emphasis on the Chinese utility-model and invention collections where most recent filings lie.
- **Inventor input:** confirm which amendment direction reflects the actual design and provide comparative data for the technical effect.

- **Post-filing monitoring** of publications for 18 months after filing to cover applications not yet published at the cut-off (Section 2.4).
- **Optional non-patent literature check** if the amended feature is a design principle likely to appear in thermal-management journals or conference papers.

8.4 Final reporting note

This report is an illustrative patent intelligence deliverable prepared to demonstrate a structured approach to patent literature searching, technical screening and feature-based patentability assessment.

The analysis is based on the defined FlowBalance CP-2 draft claims and the patent publications retrieved up to 25 October 2026. It is not a legal opinion; the final assessment of novelty and inventive step rests with the examining office.

The complete search log, including query strings, route-level screening decisions, the abstract review and the candidate register, accompanies this report as a separate Excel annex.

Appendix A / Document and data references

The following references make the evidence traceable. Publication links identify the patent documents; the full texts reviewed are the published specifications.

Publication	Reviewed evidence	Publication reference	Language
US20240387899A1	Claims 1–17; [0015]–[0049]; Figs. 1–4	https://patents.google.com/patent/US20240387899A1/en	English
CN106602175A	Claims 1–8; [0009]–[0017], [0026]; Figs. 1–2	https://patents.google.com/patent/CN106602175A/en	Chinese
DE102015014690A1	Claims 1–7; [0003]–[0004]; Fig. 2	https://patents.google.com/patent/DE102015014690A1/en	German
KR20260078277A	Claims 1–10; [0011], [0046]–[0059]; drawings	https://patents.google.com/patent/KR20260078277A/en	Korean
CN122576505A	Claims 1–10; [0034]–[0049]; Fig. 4	https://patents.google.com/patent/CN122576505A/en	Chinese
CN117223154A	Claims 1–7; [0006]–[0008], [0033]; Fig. 1	https://patents.google.com/patent/CN117223154A/en	Chinese
US4578324A	Claims 1–9; col. 4; Figs. 2, 7	https://patents.google.com/patent/US4578324A/en	English
US2015053385A1	Claims 1–5; [0023]; Fig. 2	https://patents.google.com/patent/US2015053385A1/en	English
JPS62237676A	Specification; Figs. 1–2	https://patents.google.com/patent/JPS62237676A/en	Japanese
CN121546232A	Claims 5 and 16; description	https://patents.google.com/patent/CN121546232A/en	Chinese
CN121726593A	Claims; description	https://patents.google.com/patent/CN121726593A/en	Chinese
CN118040144A	Claims; description	https://patents.google.com/patent/CN118040144A/en	Chinese
CN118486957A	Claims; description	https://patents.google.com/patent/CN118486957A/en	Chinese

Search dataset: CP-2 search log (S1–S13, including S1b, S3a and S9b), search cut-off 25 October 2026; result counts as reported by Google Patents, Espacenet and WIPO PATENTSCOPE; exports of all refined, citation and review routes; consolidated abstract review of 245 families; candidate register of 49 documents.

Appendix B / Disclosure status and category key

The following keys explain the disclosure statuses, document categories and evidence types used in this report.

Disclosure status

Status	Meaning	Treatment in this report
DISCLOSED	The feature is directly and unambiguously disclosed in the document.	Counts towards anticipation; used in combinations.
PARTIALLY DISCLOSED	The feature is disclosed in part, in a different arrangement or in general terms only.	Does not anticipate; considered for inventive step.
NOT DISCLOSED	The feature is absent from the document.	Basis of a distinguishing feature.
NOTE	Interpretation point that is not itself a claim feature.	Informs the weighting of the other features.

Document categories

Category	Meaning	Use in this report
X	Document that on its own anticipates the claim or renders it obvious.	None identified for claim 1.
Y	Document relevant to inventive step in combination with one or more other documents.	Nine charted documents and 18 publications in Section 7.
A	Document defining the general state of the art, not considered particularly relevant.	CN118486957A and 21 further register entries.

Evidence and source types

Evidence type	Description	Treatment in this report
Invention definition (illustrative)	Fictional FlowBalance CP-2 draft claims with features A–L.	Technical baseline for the feature-by-feature comparison.
Patent publication (full text)	Published specifications, claims and drawings of the 13 shortlisted documents.	Basis of the charts in Section 5 and the full-text entries in Section 7.
Patent publication (abstract level)	Titles, abstracts and representative drawings from the search exports.	Basis of the candidate register and of the abstract-level entries in Section 7.
Technical interpretation	Problem-solution analysis of novelty and inventive step.	Professional pre-filing assessment; not a legal opinion.

Interpretation note: the categories reflect the relevance of each document to draft claim 1 as defined in Section 2.2. An amended claim requires the categories to be reviewed against the new feature.