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Published:
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For two-letter codes and other abbreviations, refer to the "Guid-ance Notes on Codes and Abbreviations" appearing at the begin-ning of each regular issue of the PCT Gazette.

(54) Title: SYNONYM EXTENSION OF SEARCH QUERIES WITH VALIDATION
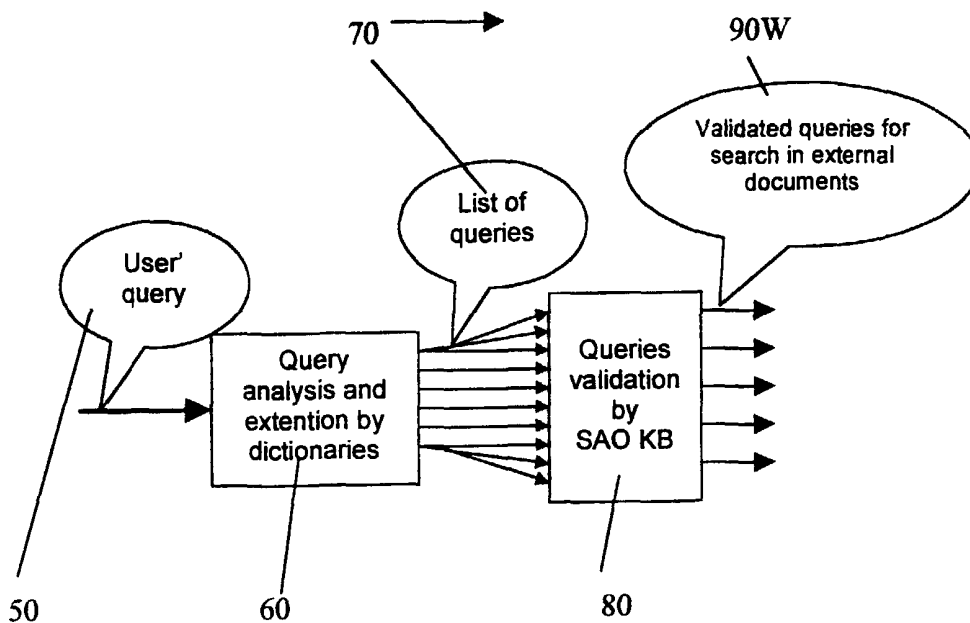
(57) Abstract: A computer search involves expanding a user query (50) with two synonym dictionaries - actions and objects- (60) and then validating the expanded queries (70) in a subject -action-object knowledge database (80) in a discipline corresponding to the query. The latter is prepared from natural language texts and contains fields with subjects, actions, objects, and "main parts of objects" extracted from the object.

TITLE

5   ## SYNONYM EXTENSION OF SEARCH QUERIES WITH VALIDATION

RELATED APPLICATIONS

10   This is a continuation-in-pat of copending U.S. Patent Application
Serial No. 60/199,659 filed April 25, 2000 and copending U.S. Patent
Application Serial No. 60/199,920 filed April 26, 2000. This application is
related to copending U.S. Patent Application Serial No. 60/199,658 filed
April 25, 2000 and copending U.S. Patent Application Serial No.
15   60/199,921 filed April 26, 2000. This application is also related to
copending U.S. Patent Application Serial No. 09/541,192 filed April 3,
2000, which is a continuation application of copending US Patent
Application Serial No. 09/345,547, filed June 30,1999 which is a
continuation-in-part of copending U.S. Patent Application Serial No.
20   09/321,804 filed May 27, 1999. These applications are herewith
incorporated herein by reference.

FIELD OF THE INVENTION

25   This invention relates to computer based search systems, and
particularly to narrowing searches for the user's convenience.

BACKGROUND OF THE INVENTION

30   Usually computer-based document-search processors use
keywords. The result of a keyword search is often an enormous amount of
information, the majority of which is irrelevant to user's requirements.

The precision of a search can be increased, if the user formulates the query as a problem, for example, "produce aluminum layer", or "heat water", or "oxidize silicon wafer". But such formulations severely decrease

5   the quantity of found information because the search will not find expressions such as "form Al layer" that are similar to "produce aluminum layer", or expressions such as "increase temperature of water" that are similar to "heat water", or expressions such as "perform oxidation of silicon substrate" that are similar to "oxidize silicon wafer".

10

It is possible to provide a complete and more exact search with help of a dictionary of search synonyms e.g. in the form of Al layer = produce aluminum layer..., etc. But estimates show that volume of entries in such a dictionary would be huge – more than 10^7 expressions to describe

15   different problems in just technical fields. Expansion into other (nontechnical) disciplines will lead to multiple expansion of this dictionary (up to 10^{11} expressions).

An object of the invention is to improve search systems.

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SUMMARY OF EMBODIMENTS OF THE INVENTION

An embodiment of the invention involves expanding the user query with help of two synonym dictionaries-actions and object, and then

25   validating every result from the obtained queries with help of a Subject-Action-Object Knowledge Database (SAO KB), containing fields with subjects, actions, objects, and "main parts of objects" extracted from the object. The SAO KB is prepared from natural language texts with the help of a semantic processor such as that disclosed in US Patent No. 6,167,370.

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These and other embodiments, objects, and advantages of the invention will become evident from the following description of

exemplary embodiments when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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Figure 1 is a block diagram of a system using a software program and embodying the invention.

Figure 2 is a flow chart illustrating the operation of the program

10   embodying the invention.

Figure 3 is a more detailed flowchart illustrating the operation of the program.

15   Figure 4 is a view of a screen in a monitor depicting the program and inviting entry of a query.

Figure 5 is a view of a screen in a monitor depicting the program and inviting entry of a query.

20

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The following are incorporated herein by reference:

25   I. System and on-line information service presently available at www.cobrain.com and the publicly available user manual therefor.

II. The software product presently marketed by Invention Machine Corporation of Boston, Massachusetts, USA, under it's trademark

30   "KNOWLEDGIST" and the publicly available user manual therefor.

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III. US Patent No. 6,167,370.

IV. U.S. Patent Application Serial No. 09/541,182 filed April 3,
2000.

5

V. The software product presently marketed by Invention Machine
Corporation of Boston, Massachusetts, USA under its Trademark
"TECHOPTIMIZER" and the publicly available user manual therefor.

10   VI. U.S. Patent No. 5,901,068.

In Figure 1 a preferred software system and method embodying the
invention is in the form of a program. The program resides in a personal
computer 12 that includes a CPU 14, a monitor 16, a keyboard/mouse 18,
15   and a printer 20 and is in the form of a program. The program may be
stored on a portable disk and inserted in a disk reader slot 22 or on a fixed
disc in the computer or on a ROM. According to another embodiment the
program resides on a server and the user accesses the program with a
standard communication port 23 over a communications network via LAN,
20   WAN, or the Internet. The port 23 also serves for accessing information
from databases on the Internet. Computer 12 can be conventional and be
of any suitable make or brand. A printer 20 provides a hard copy of a
session where desired. Other peripherals and modem/network interfaces
are provided as desired.

25

Figure 2 is a flowchart illustrating the operation of an embodiment.
Here a user's query 50 passes to a query analysis and extension phase 60
to produce a list of queries 70. A queries validation unit 80 using an SAO
KB validates the query list to produce a desired list of validated queries 90
30   for search in external documents.

5

A more detailed diagram of query extension appears in Figure 3. Here, the program invites a user to enter a query 110 on a semantic search screen of a monitor 16 as shown in Figure 4. The user' query data 120 passes to query analysis module 130. Query analysis module 130 divides

5   the user's query data 120 into action data 150 and object data 160. The simplest method of such division relies on list of verbs. For example, we can extract action "heat" from an initial query: "heat aluminum layer", because "heat" is present in the list of verbs; the remainder of query: "aluminum layer" is then recognized as an object.

10

Action data 150 are transmitted to module 180 of action expansion (or action expansion module). Action expansion is accomplished on the basis of an action dictionary 140, containing the six parts:

- List of verbs divided into groups, containing the verbs with similar
15   sense (heat-warm, produce-create-generate, etc.);

- List of "verb-nouns" expressions synonymous with other verb (heat-increase temperature-rise temperature, etc.)

- List of "verbsA" including the verbs –perform, carry out, realize, and other verbs with similar sense;

20   - List of "nouns" including the following groups – "verb - relevant verbal noun" (heat-heating; produce-production, etc.)

- List of "verbsB" including the verbs –produce, create, form, and other verbs of similar sense;

- List of "participle2" including the following groups – "verb -
25   relevant participle2" (heat-heated; produce-produced, etc.).

The action expansion module 180 forms four lists from action module 150 and actions dictionary 140:

- List of verbs relevant to action in module 200;

30   - List of "verbsA - verbal noun" expressions relevant to action in module 210;

6

- List of "verbsB - participle2" expressions relevant to action in module 220;

- List of "verb - noun" expressions relevant to action in module 230.

5   For example, module 180 takes the action "heat" and forms the
following lists:
        List of verbs relevant to action in module 200 – "heat, warm";
        List of "verbsA - verbal noun" expressions relevant to action in
        module 210 – "perform – heating", "carry out – heating", "realize –
10   heating", etc.;
        List of "verbsB - participle2" expressions relevant to action in module
        220 – "produce – heated", "create – heated", "form – heated", and
        etc.
        List of "verb - noun" expressions relevant to action in module 230 –
15   "increase - temperature", rise – temperature", and etc.

        The object data 160 pass to the module 190 of object expansion (or
object expansion module 190). Object expansion is accomplished on basis
of a dictionary of object synonyms 170, containing groups of objects
20   having similar sense (aluminum layer - Al layer, laser radiation – coherent
radiation, etc.).

        The object expansion module 190 forms lists of expressions
synonymous with the objects in module 240 from the objects in module
25   160 and a dictionary of object synonyms in module 170. For example,
object expansion in module 190 uses the object "aluminum layer" to form
the following list: aluminum layer, Al layer, aluminium layer, etc.

        All the lists in modules 200, 210, 220, 230, and 240 are transmitted
30   into validation module 250. A validation module 250 forms search queries
from the lists in modules 200, 210, 220, 230, and 240 and accomplishes
the search in an SAO KB 260 according to these queries.

The SAO KB 260 is prepared from natural language texts with help
of a semantic processor as described in the aforementioned US Patent
Application Serial No. 09/345,547 filed April 3, 2000 (Reference IV
above) as well as in US Patent No. 6,167,370 (Reference III above). The
SAO KB 260 contains the following fields: subjects, actions, objects, and
"main parts of objects" extracted from the object. For example, the
semantic processor converts the sentence: "A thin aluminum layer is
heated by reflected laser radiation" into following fields of the SAO KB
260:

     Subject – "reflected laser radiation";

     Action – "heat";

     Object – "thin aluminum layer";

     Main part of object – "aluminum layer";

The volume of entries in the SAO KB 260 should be about 10^6
SAOs or more. The natural language texts can belong to various
disciplines such as (science, engineering, culture, business, etc.). A
customized SAO KB can also be used. Texts for a customized SAO KB
should be selected from a single discipline. If the user query and
customized SAO KB belong to similar disciplines, query expansion will be
more complete and precise. According to an embodiment the SAO KB
260 is prepared from natural language texts in a specific discipline or a
group of related disciplines.

Validation module 250 performs search queries according to the
following rules. Here the sequence is not relevant although all are
performed:

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1)   [All verbs from list of verbs relevant to action 200 through OR] AND [all expressions from list of synonymous to object expressions 240 through OR];

5   the search of verbs is accomplished in the ""action" field of the SAO KB 260, and search of expressions from list of synonymous to object expressions is accomplished in "main part of object" field of SAO KB 260;

2)   [All verbs from list of "verbsA" through OR] AND [all nouns from list of "verbsA - verbal noun" expressions relevant to 10   action 210 through OR] AND [all expressions from list of synonymous to object expressions 240 through OR];

the search of verbs is accomplished in the ""action" field of the SAO KB 260, search of verbal nouns from "verbsA - verbal noun" expressions is accomplished in the "main part of object" field of the SAO KB 260; and 15   search of expressions from list of synonymous to object expressions is accomplished in the "object" field of SAO KB 260;

3)   [All verbs from list of "verbsB" through OR] AND [all participles2 from list of "verbsB-participle2" expressions relevant to action 220 through OR] AND [all expressions from list of 20   synonymous to object expressions 240 through OR];

the search of verbs is accomplished in the "action" field of the SAO KB 260, the search of participles2 from list of "verbsB-participle2" expressions is accomplished in the "object" field of SAO KB; and the search of expressions from the list of synonymous to object expressions is 25   accomplished in the "main part of object" field of the SAO KB.

4)   [All verbs from list of "verb - noun" expressions relevant to action 230 through OR] AND [all nouns from list of "verbs - noun" expressions relevant to action 230 through OR] AND [all

9

expressions from list of synonymous to object expressions 240
through OR];

the search of verbs is accomplished in the "action" field of the SAO KB
260, the search of nouns from the "verbs - noun" expressions is

5   accomplished in the "main part of object" field of the SAO KB; and search
of expressions from list of synonymous to object expressions is
accomplished in the "object" field of the SAO KB 260;

For example, it is possible to obtain the following search queries

10   from "heat aluminum layer" (for simplification, not all the verbs and
expressions from the dictionaries are used):

- {[heat OR warm] in "action" field of SAO KB} AND {[aluminum
layer OR Al layer] in "main part of object" field of SAO KB};

15

- {[perform OR realize] in "action" field of SAO KB} AND
{[heating] in "main part of object" field of SAO KB} AND
{[aluminum layer OR Al layer] in "object" field of SAO KB};

20   - {[produce OR create] in "action" field of SAO KB} AND
{[aluminum layer OR Al layer] in "main part of object" field of
SAO KB} AND {[heated] in "object" field of SAO KB};

- {[increase OR rise] in "action" field of SAO KB} AND
25   {[temperature] in "main part of object" field of SAO KB} AND
{[aluminum layer OR Al layer] in "object" field of SAO KB}.

The search queries are used by validation module 250 for searching
in SAO KB 260. The module 250 counts the quantity of found SAOs for
30   every query. If an SAO isn't found, the query is considered non-valid.
Then the validation module 250 forms the list of validated SAOs 280

10

comprising the SAOs found according to the above-mentioned queries in
SAO KB 260. Module 310 shows the user validated SAOs, as illustrated in
Figure 5 which is a view of a screen displaying data from the program.

5   Furthermore, the validation module 250 can form the list of
validated AOs (action-object) 270 from the list of validated SAOs 280. For
that, module 250 removes subjects from all validated SAOs and all words
from objects, except those contained in search queries. A list of validated
AOs 270 can be used in module 300 of search (or search module 300) for
10   searching external information sources 290.

           Two examples (for simplification, using only the actions
dictionary; with the volume of an SAO KB= 5×10^6 SAOs) are shown in
following table.

15

User query – form magnetic film. Queries after expansion		Results of search in SAO KB with frequencies			Queries after validation	
Form	Magnetic Film	Form	Magnetic Film	3724	Form	Magnetic Film
Produce	Magnetic Film	Produce	Magnetic Film	262	Produce	Magnetic Film
Obtain	Magnetic Film	Obtain	Magnetic Film	220	Obtain	Magnetic Film
Provide	Magnetic Film	Provide	Magnetic Film	211	Provide	Magnetic Film
Make	Magnetic Film	Make	Magnetic Film	126	Make	Magnetic Film
Grow	Magnetic Film	Grow	Magnetic Film	87	Grow	Magnetic Film
Fabricate	Magnetic Film	Fabricate	Magnetic Film	42	Fabricate	Magnetic Film
Give	Magnetic Film	Give	Magnetic Film	42	Give	Magnetic Film
Create	Magnetic Film	Create	Magnetic Film	24	Create	Magnetic Film
Manufacture	Magnetic Film	Manufacture	Magnetic Film	15	Manufacture	Magnetic Film
Prepare	Magnetic	Prepare	Magnetic	14	Prepare	Magnetic

	Film		Film			Film
Generate	Magnetic Film	Generate	Magnetic Film	11	Generate	Magnetic Film
Synthesize	Magnetic Film	Synthesize	Magnetic Film	6	Synthesize	Magnetic Film
Emit	Magnetic Film	~~Emit~~	Magnetic Film	0		
Radiate	Magnetic Film	~~Radiate~~	Magnetic Film	0		
Give Off	Magnetic Film	~~Give Off~~	Magnetic Film	0		
Emanate	Magnetic Film	~~Emanate~~	Magnetic Film	0		
Construct	Magnetic Film	~~Construct~~	Magnetic Film	0		
Yield	Magnetic Film	~~Yield~~	Magnetic Film	0		
Acquire	Magnetic Film	~~Acquire~~	Magnetic Film	0		
Derive	Magnetic Film	~~Derive~~	Magnetic Film	0		
User query – produce laser radiation. **Queries after expansion**		**Results of search in SAO KB with frequencies**			**Queries after validation**	
Form	Laser Radiation	Emit	Laser Radiation	834	Emit	Laser Radiation
Produce	Laser Radiation	Generate	Laser Radiation	271	Generate	Laser Radiation
Obtain	Laser Radiation	Produce	Laser Radiation	173	Produce	Laser Radiation
Provide	Laser Radiation	Provide	Laser Radiation	81	Provide	Laser Radiation
Make	Laser Radiation	Form	Laser Radiation	19	Form	Laser Radiation
Grow	Laser Radiation	Make	Laser Radiation	10	Make	Laser Radiation
Fabricate	Laser Radiation	Radiate	Laser Radiation	9	Radiate	Laser Radiation
Give	Laser Radiation	Obtain	Laser Radiation	5	Obtain	Laser Radiation
Create	Laser Radiation	Yield	Laser Radiation	5	Yield	Laser Radiation
Manufacture	Laser Radiation	~~Grow~~	Laser Radiation	0		
Prepare	Laser	~~Fabricate~~	Laser	0		

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	Radiation		Radiation				
Generate	Laser Radiation	~~Give~~	Laser Radiation	0			
Synthesize	Laser Radiation	~~Create~~	Laser Radiation	0			
Emit	Laser Radiation	~~Manufact ure~~	Laser Radiation	0			
Radiate	Laser Radiation	~~Prepare~~	Laser Radiation	0			
Give Off	Laser Radiation	~~Synthesi ze~~	Laser Radiation	0			
Emanate	Laser Radiation	~~Give Off~~	Laser Radiation	0			
Construct	Laser Radiation	~~Emanate~~	Laser Radiation	0			
Yield	Laser Radiation	~~Construc t~~	Laser Radiation	0			
Acquire	Laser Radiation	~~Acquire~~	Laser Radiation	0			
Derive	Laser Radiation	~~Derive~~	Laser Radiation	0			

Results with zero frequencies are deleted. These examples show
that use of validation based on the SAO KB 260 provides an exact and
relevant expansion of a user query. At the same time, used dictionaries
5   have acceptable values.

The invention refines a synonym expansion of a user query by
comparison of automatically generated set of synonym queries in the form
"action - object" with actually existing "action - object" relations of an
10   SAO KB. This results in a set of relevant synonyms for queries to provide
exact and complete search results

It will be understood that various other display symbols, emblems,
colors, and configurations can be used instead of those disclosed for the
15   exemplary embodiments herein. Also, various improvements and
modifications can be made to the herein-disclosed exemplary
embodiments without departing from the spirit and scope of the present

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invention. The system and method according to the inventive principles herein are necessarily not dependent upon the precise exemplary hardware or software architecture disclosed herein.

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What is claimed is:

1. A computer system for searching a database,
5   comprising:

an input section responsive to user entry of a user query;

an expansion section responsive to the input section, for
10   expanding the user query to include synonyms of action words and
object words in the user query;

a validation section responsive to said expansion section,
and arranged for interaction with a subject-action-object
15   knowledge database (SAO KB) containing fields with subjects,
actions, objects, for selecting only those queries having
corresponding expressions in the SAO KB; and

an output section for transmitting the selected queries for
20   searching in the database.

2. A computer system as in claim 1, wherein said entry
section includes an analysis portion for separating actions from
objects.
25
3. A computer system as in claim 1, wherein said expansion
section interacts with an action dictionary of synonyms.

4. A computer system as in claim 1, wherein said validating
30   section includes an output portion for outputting validated results
and rejecting non-validated results

5. A computer system as in claim 1, wherein said expansion section interacts with an action dictionary of synonyms, said action dictionary of synonyms having:

5   a list of verbs with similar sense;

a list of "verb-noun" expressions synonymous with other verbs;

10   a list of "verbsA" including the verbs –perform, carry out, realize, and other verbs with similar sense;

a list of "verb - relevant verbal nouns";

15   a list of "verbsB" including the verbs –produce, create, form, and other verbs with similar sense;

a list of "participle2" words including "verb - relevant participles".

20

6. A computer system as in claim 5, wherein said expansion section includes an action expansion portion responsive to said action dictionary of synonyms and to an action word for forming:

25

a list of verbs relevant to an action;

a list of "verbsA - verbal noun" expressions relevant to an action;

30   a list of "verbsB - participle2" expressions relevant to an action;

a list of "verb - noun" expressions relevant to an action.

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7. A computer system as in claim 1, wherein said expansion section interacts with a dictionary of object synonyms.

5   8. A computer system as in claim 1, wherein said expansion section interacts with a dictionary of object synonyms, said action dictionary of object synonyms containing groups of objects having similar sense and an object expression portion to form lists of expressions synonymous from an object and the

10   dictionary of objects synonyms.

9. A computer system as in claim 1, wherein said validation section includes the fields: subjects, actions, objects, and "main parts of objects" and classifies the query on the basis of the fields

15   in response to the expansion section and in response to the SAO KB.

10. A computer system as in claim 6, wherein said wherein said expansion section interacts with a dictionary of object

20   synonyms, said action dictionary of object synonyms containing groups of objects having similar sense and an object expression portion to form lists of expressions synonymous from an object and the dictionary of objects synonyms, and said validation section includes the fields: subjects, actions, objects, and "main parts of

25   objects" and classifies the query on the basis of the fields in response to the expansion section and in response to the SAO KB.

11. A method for composing a computer search, comprising:

30

expanding a user query with action synonyms and with object synonyms to obtain expanded queries;

17

obtaining results and validating the results obtained from

the expanded queries by comparing the expanded queries with a

subject-action-object knowledge database (SAO KB) containing

5   fields with subjects, actions, objects, so as to validate only

expanded queries having corresponding expressions in the SAO

KB;

outputting validated results to obtain search results.

10

12. A method as in claim 11, wherein said processing an

entry includes separating actions from objects.

13. A method as in claim 11, wherein said expanding step

15   includes interaction with an action dictionary of action synonyms.

14. A method as in claim 16, wherein said validating step

includes outputting validated results and rejecting non-validated

results.

20

15. A method as in claim 11, wherein said expanding step

includes interaction with an action dictionary of synonyms, said

action dictionary of synonyms having:

25   a list of verbs with similar sense;

a list of "verb-noun" expressions synonymous with other

verbs;

30   a list of "verbsA" including the verbs –perform, carry out,

realize, and other verbs with similar sense;

18

a list of "verb - relevant verbal nouns";

a list of "verbsB" including the verbs –produce, create,
form, and other verbs with similar sense;

5

a list of "participle2" words including "verb - relevant
participles".

16. A method as in claim 15, wherein said expanding step

10   includes an action expansion responsive to said action dictionary of
synonyms and to an action word for forming:

a list of verbs relevant to an action;

15   a list of "verbsA - verbal noun" expressions relevant to an action;

a list of "verbsB - participle2" expressions relevant to an action;

a list of "verb - noun" expressions relevant to an action.

20

17. A method as in claim 11, wherein said expanding step
includes interacting with a dictionary of object synonyms.

18. A method as in claim 11, wherein said expanding step

25   includes interacting with a dictionary of object synonyms, said
action dictionary of object synonyms containing groups of objects
having similar sense, and an said expanding step includes forming
object expression synonyms from an object and the dictionary of
objects synonyms.

30

19. A method as in claim 11, wherein said validation step
includes generating the fields: subjects, actions, objects, and "main

19

parts of objects" and classifying the query on the basis of the fields in response to the expanding step and in response to the SAO KB.

20. A method as in claim 16, wherein said expanding step
5   includes interacting with a dictionary of object synonyms, said dictionary of object synonyms containing groups of objects having similar sense and an object expression portion to form lists of expressions synonymous from an object and the dictionary of objects synonyms, and said validation step includes generating the
10   fields: subjects, actions, objects, and "main parts of objects" and classifying the query on the basis of the fields in response to the expanding step and in response to the SAO KB.

21. A system as in claim 1, wherein said SAO KB contains
15   data prepared from texts in a discipline corresponding to the discipline of the query.

22. A method as in claim 1, wherein said SAO contains data prepared from texts in a discipline corresponding to the
20   discipline of the query.

23. A system as in claim 1, wherein said SAO KB contains only data prepared from texts in a discipline corresponding to the discipline of the query.
25

24. A method as in claim 1, wherein said SAO contains only data prepared from texts in a discipline corresponding to the discipline of the query.
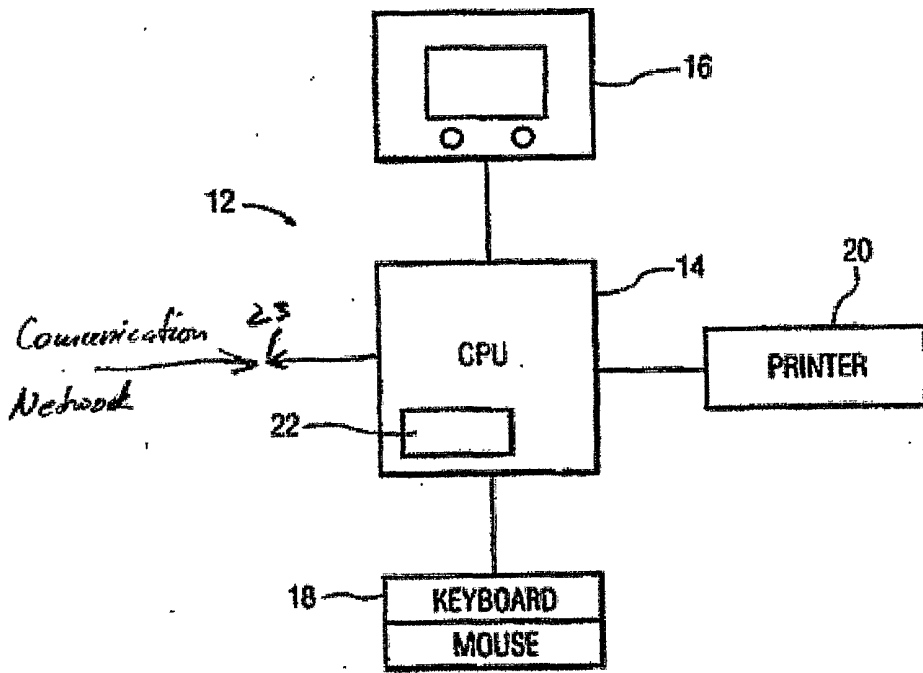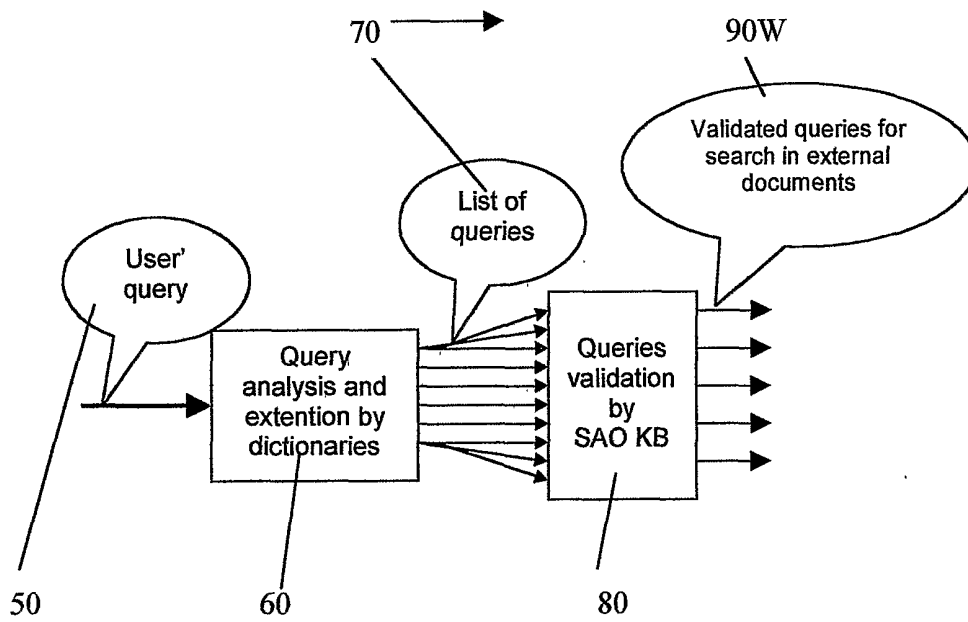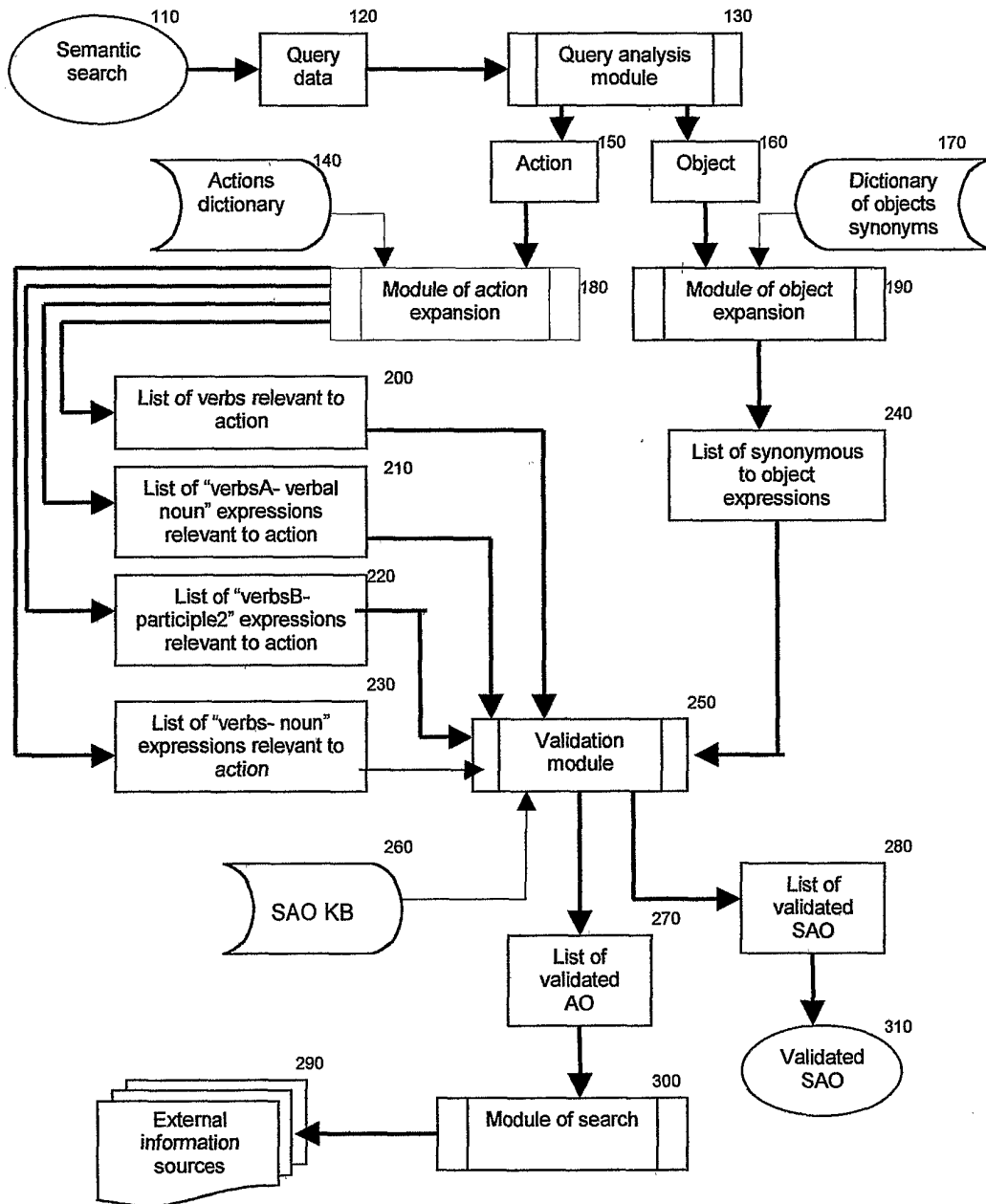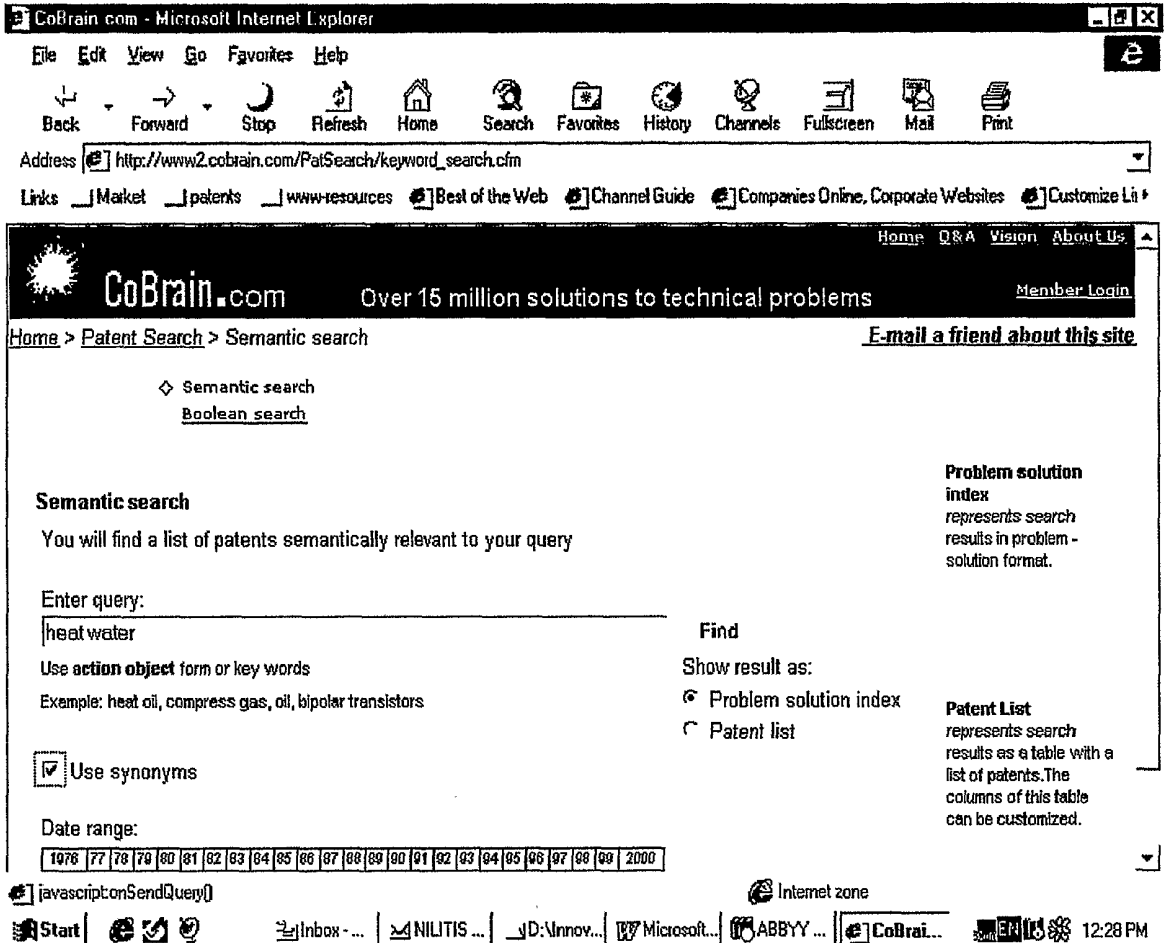
30

1/4

FIGURE 1

FIGURE 2

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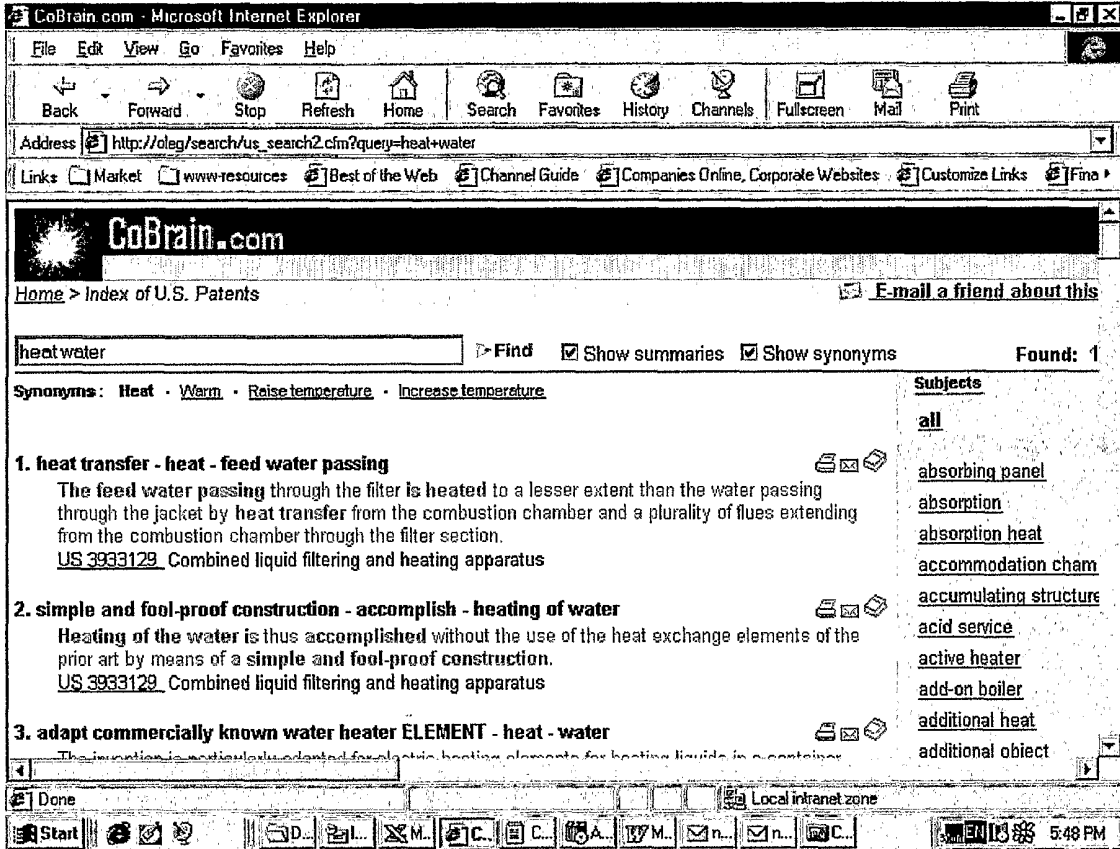
FIGURE 3

FIGURE 4

FIGURE 5

INTERNATIONAL SEARCH REPORT

	International application No.
	PCT/US01/13133

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7)   :G06F 17/30
US CL   :707/3
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
   U.S. :   707/3, 4, 5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
   WEST, EAST, NPL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, P	US 6,101,492 A (JACQUEMIN et al.) 08 August 2000, See abstract.	1-24
Y	US 6,038,560 (WICAL) 14 March 2000, See abstract.	1-24

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 JUNE 2001	17 JUL 2001

Name and mailing address of the ISA/US	Authorized officer
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