Weld-in-Search —A Computerised Welding Information Storage & Retrieval System

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Abstract: ***The voluminous knowledge on welding which has been accumulated over the years, requires a systematic storage and retrieval technique for dissemination and future research. Computer today has made possible such quick processing of information. A procedure has been developed at the Welding Research Institute, BHEL, Trichy to store and retrieve welding information using a computer. The envisaged system involves the utilisation of a controlled language consisting of a few select keywords which represent the information contained in a particular report or publication. This paper describes the features of the system developed at WRI and the basis for the selection of Descriptors and the Documentation techniques. The application of the Weld-in-search system and the scope for future development have also been highlighted.***

Introduction

Welding being a vast subject encompasses applications in almost all fields of fabrication. From the joining of two micro wires for an electronic circuit to the fabrication of high pressure vessels, welding plays a vital role. To understand the subject and for further developments in the field, a back reference to the research which have been already done is required. Sometimes, this back reference is so voluminous and specialised that ordinary reference systems do not meet the requirements and the researcher finds himself handicapped due to lack of sufficient information.

The need for improved information systems has been made necessary in recent years by the steady growth in size and complexity of data. Several factors contribute to a situation in which it is clear that traditional methods for handling the volume of information involved are inadequate. One of these is the bulk and the growth rate of information which is very specialized in nature and unique in character. It is the modern trend that people are trying to acquire a new level of knowledge and expertise for their daily occupations.

In view of these developments, it is not surprising that documentation and information retrieval may develop as separate desciplines which would cut across traditional boundaries of scientists and non-scientists, technicians and laymen, academicians and practitioners. The trend also shows that the entire science may be dealt with by librarians and computer experts hand-in-hand to provide information how-so-ever specialized in nature.

Till recently, information retrieval has been through ordinary methods only. Conventional procedures like indexing with subject or author may be claimed good if the quanta of information is small and grouping or sub-grouping is possible. But with the development of knowledge sphere and continuous addition of books, research reports, data etc., even the sub-groups are so voluminous that their manual handling is a tedious

* Welding Information Searching system

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job. In a literature search conducted by manual methods, the user refers to the subject, title, author or other catalogues. Using words, subjects, names, places, dates, language or others criteria, he identifies books, reports, and other materials which can be expected to contain the information desired. This way, he makes a 'hit' (a hit is an item which the user selects and which he believes may contain some of the information he wants). A hit may or may not actually contain the desired information. As the user looks through the catalogues, he makes notes of the titles, call numbers, authors and other relevant data about the works, building up a short make-shift 'bibliography' as he goes along. Searches through so many catalogues and making a note of them is a tiring and tedious job which involves consumption of precious time.

The Weld-in-Search System

Weld-in-search system is exclusively used for finding out the literature of interest in welding and its related fields. The basic principle is the same as that used in manual searches. Instead of maintaining catalogues with title and author's name only (in some cases with abstracts), here the catalogue includes other relevant informations like source of publication and date of publication. The important and distinct feature of the system is that the information conveyed in the article, report or book, is coded in so called 'keywords' or 'descriptors'. These keywords are chosen in such a way that they convey the gist of the information contained in that particular article.

The success of the Weld-in-search system depends mainly on the initial indexing of the information. Obviously this will require personnel having thorough back-ground and knowledge of the various aspects of welding. This becomes essential because the science of welding involves various disciplines like Mech. Engg., Elect-Engg., Electronics Engg., & Metallurgical Engg. Indexers at times should be able to decide the selection of most appropriate words that will convey the information most effectively.

The advantage of this type of keyword system is that this can be extended to any other field like machining, foundry, forging etc. The only requirement for such a change will be the development of a Thesaurus to include keywords in that field. The development of a Thesaurus is possible by a concentrated effort from experts of the field.

Selection of Key Words

At the time of storage, key words are selected based on their relation to a broader or a narrower term with respect to the subject. As there may be more than one word to indicate the same information, only a single word is standardised to cover all the related terms. A thesaurus has been prepared by the International Institute of Welding to cover the terms appearing in welding. This helps to document the information in a controlled language. The body of the thesaurus contains two types of words—those actually used for retrieval (keywords) and 'lead-in-terms' which are as such not used for indexing but lead to a term which is to be indexed. Such 'lead-in-terms' are synonyms or near synonyms of accepted keywords. These two types of words are arranged in hierarchical relations, either of the 'part-whole' type or 'family-tree' type. This has been illustrated in Annexure-1—reproduced from the tnesaurus. Let us consider the word 'FATIGUE TESTS' in the list. It is clear that this is a keyword and is used for (UF) 'Resonance testing' which is a 'lead-in-term'. There is a keyword 'MECHANICAL TESTS' which is classified under Broader Term (BT). These two terms bear a part-whole type relationship with each other. The terms 'BEND TESTS', 'FATIGUE LOADING' etc. which are headed under Related Terms (RT) help in further defining the idea conveyed by the term 'FATIGUE TESTS'.

While choosing the keywords for an article following points are to be kept in mind:

(a) Welding process/es discussed
(b) Material or materials used
(c) Sub classification/s of (a) and/or (b)
(d) Items to be welded or applications.

Out of these four categories a maximum of twelve keywords are normally chosen (this limit of twelve is fixed based on the availability of space in magnetic tapes for optimum use). Keywords or descriptors need not compulsorily be chosen from the contents of the matter. The subject matter may or may not contain the keywords with which it is described. They are so chosen that a glance at these keywords tells the information conveyed in the article.

An example here will illustrate the idea. We consider an article titled 'A new high efficiency welding procedure using finely divided filler metal' written by Mr. Robert J. Dehaecle, published in the Welding Journal, October 1971. In this article, the author highlights submerged arc welding process to give more deposition rate and better mech. properties by adding the filler metal in power form. This article is stored in the input tape as shown in Annexure-2. Studying the keywords allotted, we find that there is a key word

'SAW' which gives the idea that the article discusses about submerged arc welding process. Retrieval of this article for submerged arc welding would not have been possible by manual search through title index.

Retrieval System

At the time of retrieval, the information seeker may not give exact keywords. He will give only some vague idea about the subject and possibly the process on whch he wants the information. It becomes the responsibility of the retriever to find out the 'keywords' which might have been used while storing the article. Once these are known then it is the job of the computer to read the whole of the tape, find and print out the title, author/s and source in which this information is contained. This has been illustrated in the flow chart shown in Annexure-3.

A typical computer output is illustrated in Annexure-4. In this, enquiry was made on Mechanical properties of SAW. A scrutiny of the output shows that the words 'SAW & Mechanical Properties' appear in all the listed articles. The same article would be extracted if an enquiry is made on any other keyword contained in the output.

This sort of listing from the computer output will make a temporary index which will help in tracing the original information.

The system is fully capable of storing and retrieving the information if used with due care and keeping in view the limitations where computer will fail. Size is no bar for the system for the speed of computing or scanning is very high. Provisions are available for additions, deletions and alterations in information.

The keywords, though carefully chosen do not always convey the complete information on a given subject. Hence to derive maximum benefit from the system, it is better to feed in minimal keywords during retrieval. Of course, many irrelevant articles may also be extracted which is a limitation of this system. Perhaps a refinement may be added to the systems at the indexing stage by giving a weightage factor to each keyword. This weightage factor will tell the relative importance of a particular keyword in describing the document for which it was chosen. At the time of retrieval, the retriever would attach a similar weightage factor to the keyword used to formulate the request. If, in the request, the keyword had high rating, it would most likely retrieve the document which would otherwise be ignored.

The accuracy of the system can be measured by calculating either of the two ratios called Precision Ratio and Recall Ratio. Precision ratio is the ratio of total of relevant documents to the total actually retrieved. Recall ratio is the ratio of relevant items not retrieved to the sum of relevant items not retrieved and total number retrieved.

Benefits

The importance of this system lies more in the following area; whenever a problem arises or is to be attempted, the output is obtained from the computer through the use of keywords. After perusing through the output information, it may be found that the solution is already available in the as-cooked condition or in the nearly cooked condition. Only a little more effort is required to get at the final solution suiting to our own conditions. The other offshoot could be, that there may be yet another improved approach to solving the problems. Without this type of system and the complete information, the researcher may have to start right from scratch and the growth rate of development will be affected to a very great extent. Precious time and efforts could be saved, at the same time effecting superior solution. These types of systems could be highly beneficial in all research fields of work.

Scope for Future Development

The success of the system is associated with other available auxiliaries and equipments which should be able to cope with the requirements of such a fast and voluminous data handling system. Some of the developments which may be of significance are mentioned here. It is possible to link with the terminal a microfilm reader. If the terminal is used to request a document from the library collection, then the document kept on microfilm could be fetched automatically for display on the film reader. Although this seems an extravagent way of storing information, some form of micro-storage must be the answer to the bulk problem. Magnetic cards are a more modest form of microstorage which has proved quite successful. It is preferable to have the books themselves available on shelves, provided that information about them can be conveyed to the user at his terminal. Microfilm readers have the advantage that they can be used to provide a hard copy if required. Another welcome development will be the perfection of optical character reading equipment, so that whole equipment, could be fed into the computer and read automatically and certainly the perfection of reliability in this area would help to eliminate much of the effort in both storage and retrieval.

As the weld-in-search system follows keywords indexed in the International Welding Thesaurus, the documentation of the information is of International Level and can be shared with other Welding Research Institutes which are engaged in storing the information through these keywords. The exchange of information with other members of International Institute of Welding will promote welding technology in India and a significant Indian contribution could be possible to the total welding efforts.

Conclusion

It may be said that the system introduces speed, consistency, sleekness and added service to the user at the expense of extra editing work involved during the initial stage. The system is as good as the indexing system employed. Performance of this system depends on the care and intelligence shown by the indexer and retriever and is hard to measure. For the best utilisation, the same keywords are required to be used both by the indexer and retriever right along the lines.

Acknowledgement

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Reference

1. Computer systems in the Library—By Swihant & Henley.

2. Computer based Library and Information System—By Henley J. P.

3. International Welding Thesaurus—Welding Institute.

4. Documentation & Information Services in Welding Technology. Bryant & Stephens, Metal Construction & British Welding Journal—August, 1972.

ANNEXURE 1

FAILURE (9)

ST/ BRITTLE FRACTURE
EXPLOSIONS
FRACTURES

RT/ BUCKLING
CRACKING
DEFORMATION
DISTORTION
FATIGUE LOADING
FATIGUE STRENGTH
OVERLOADING

False echoes

USE/ ERRORS
ULTRASONIC TESTING

FANS (15F)

UF/ Blowers
Electric fans

RT/ ELECTRIC APPLIANCES

Fatigue damage

USE/ FATIGUE STRENGTH

Fatigue gauges

USE/ FATIGUE LOADING
MEASURING INSTRUMENTS

Fatigue limit

USE/ FATIGUE STRENGTH

FATIGUE LOADING (9)

UF/ Cyclic loading
Fatigue gauges +
NT/ VARIABLE LOADING
BT/ LOADING

RT/ DYNAMIC LOADING
FAILURE
FATIGUE STRENGTH
FATIGUE TESTS
RESONANCE
STATIC LOADING
STRESS DISTRIBUTION
THERMAL CYCLING
VIBRATION

Fatigue properties

USE/ FATIGUE STRENGTH

FATIGUE STRENGTH (10)

UF/ Corrosion fatigue +
Cumulative damage
Damage (fatigue)
Fatigue damage
Fatigue limit
Fatigue properties
Thermal fatigue +

NT/ LOW CYCLE FATIGUE

BT MECHANICAL PROPERTIES

RT/ FAILURE
FATIGUE LOADING
FATIGUE TESTS
STRESS DISTRIBUTION
THERMAL CYCLING
VIBRATION

FATIGUE TESTS (8)

UP/ Resonance testing

BT/ MECHANICAL TESTS

GT/ TESTING
RT/ BEND TESTS
FATIGUE LOADING
FATIGUE STRENGTH
RESONANCE
VARIABLE LOADING

FCA WELDING (1)
(Flux cored arc welding)

UF Co_2 flux welding
Flux cored arc welding
Flux cored Co_2 welding
Innershield welding
Nonshielded flux cored arc welding
Self shielded arc welding

BT ARC WELDING

GT/ WELDING

RT/ BARE METAL ARC WELDING CORED FILLER WIRE
NONSHIELDED WELDING

FEEDBACK CONTROL (5)

BT/ AUTOMATIC CONTROL
CONTROLS
RT/ AUTOMATION
GUIDANCE SYSTEMS
MECHANISATION
REMOTE CONTROL

FERRITE (12A)

GT/ FERROUS METALS
RT/ AUSTENITE
BAINITE

FERRITE (Contd.)

RT/ FERRITIC STAINLESS STEELS
MARTENSITE
MICROSTRUCTURE
PEARLITE

FERRITIC STAINLESS STEELS (12A)

UF/ Chromium steels*
BT/ STAINLESS STEELS
STEELS

GT/ FERROUS METALS

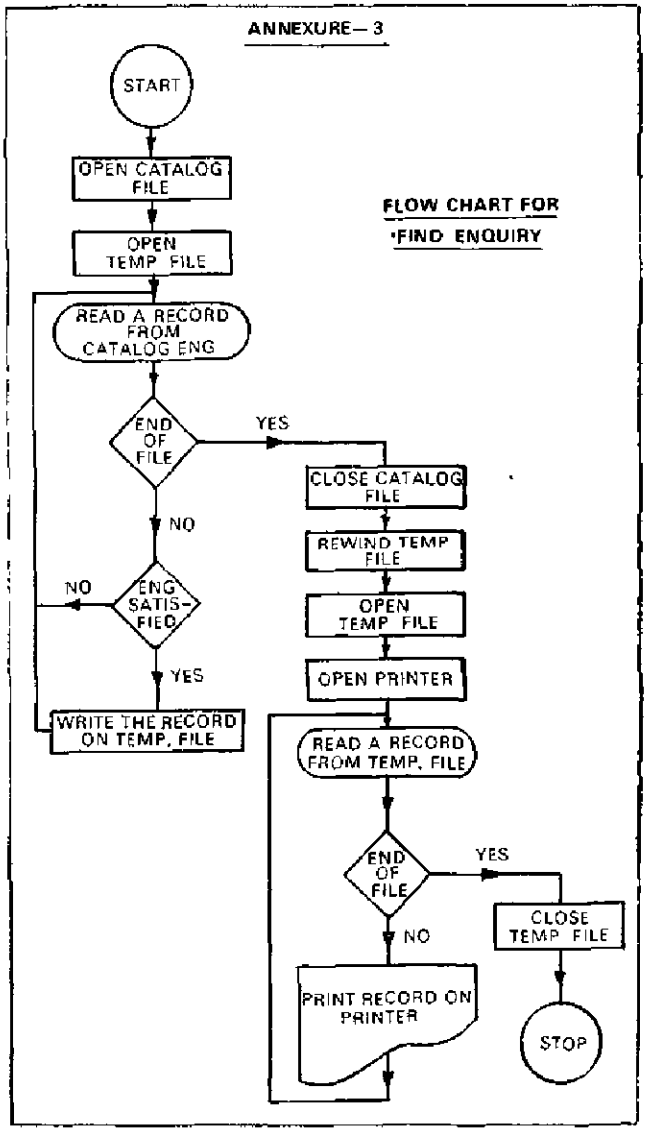
RT/ FERRITE

FERROUS METALS (12A)
(Use more specific term if possible)

ST/ AUSTENITE
AUSTENITIC STAINLESS STEELS

(contd.)

ANNEXURE— 3



FLOW CHART FOR
'FIND ENQUIRY

(Annexure 1 contd)

FERROUS METALS (Contd)

ST/BAINITE
CARBON MANGANESE STEELS
CARBON STEELS
CAST IRON
CLAD STEELS
CRYOGENIC STEELS
FERRITE
FERRITIC STAINLESS STEELS
FINE GRAINED STEELS
GALVANISED STEELS
HIGH ALLOY STEELS
IRON
IRON ALLOYS
KILLED STEELS
LOW ALLOY STEELS
MARAGING STEELS
MARTENSITE
MARTENSITIC STAINLESS STEELS
MICROALLOYED STEELS
MILD STEEL
NICKEL STEELS
NODULAR IRON
PEARLITE
PH STAINLESS STEELS
QT STEELS
RIMMING STEELS
SEMIKILLED STEELS
STAINLESS STEELS
STEELS

STRUCTURAL STEELS
TOOL STEELS
UNALLOYED STEELS
VERY LOW CARBON STEELS
WEATHERING STEELS
WROUGHT IRON

RT/ CREEP RESISTING MATERIALS
FREE MACHINING MATERIALS
HEAT RESISTING MATERIALS
NONFERROUS METALS

FIBRE OPTICS **(8)**

UF/ Fibrescopes
BT/ OPTICS
RT/ FIBRES
VISUAL INSPECTION

Fibre reinforcement

USE/ COMPOSITE MATERIALS

ANNEXURE—2

FORTRAN CODING SHEET

PROGRAMME NAME · DATA PROGRAMMER. DATE. SHEET NO: OF

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049096I A NEW HIGH EFFICIENCY WELDING PROCEDURE USING FINELY DEVIDED FILLER
049096Z METAL
049096J ROBERT J PEHAECK
049096Y WJ V05 01 N0 1 0 10 71
049096E WELDING SAW ALLOY STEEL ALLOYING ELEMENTS
049096G PROCESS PARAMETERS QUALITY CONTROL NOT MECH PROPERTIES
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ANNEXURE—4

ARTICLES ON MECH PROPERTIES OF SAW

042048 WELDABILITY OF HI PROOF STAINLESS STEELS
MURRAY J D HAGUE F
WMF V037 N0012 12 69
WELDING | STAINLESS STEELS EFFECTS OF N2 | MAW
COMPARISON | MECH PROPERTIES | SAW | MIG

045074 REACTOR WELDING WITH BEAD AXIS PERPENDICULAR TO JOINT AXIS*
BUNN WB BERGER C F
WJ V049 N0003 03 70
WELDING | SAW | MAW | NUCLEAR REACTOR
PROCESS PARAMETERS | NDT | RT
QUALITY CONTROL
MECH PROPERTIES | ENERGY INPUT | CHEM ANALYSIS | DEVELOPMENTS

049095 A NEW HIGH EFFICIENCY WELDING PROCEDURE USING FINELY DIVIDED FILLER METAL*
ROBERT J DEHAECK
WJ V0k0 N0010 10 71
WELDING | SAW | ALLOY STEEL | ALLOYING ELEMENTS
PROCESS PARAMETERS | NDT | MECH PROPERTIES
QUALITY CONTROL

053093 CLASSIFICATION AND SYMBOLISATION OF BARE STEEL WIRE ELECTRODES*
FLUXES FOR SUBMERGED ARC WELDING OF STRUCTURAL STEEL*
AUTHOR UNKNOWN
WW V010 N001* 002 1*2 72
WELDING | SAW | STRUCTURAL STEEL CLASSIFICATION MECH PROPERTIES | CONSUMABLES COMPOSITION

054100 INFLUENCE OF THE CRYOLITE MODULUS ON THE PROPERTIES OF FLUX FOR THE SUBMERGED ARC WELDING OF ALUMINIUM*
BAGRYANSKII KV | KORNEEV A D | ZUSIN V YA
WP V019 N0002 02 72
WELDING | SAW | ALUMINIUM | CRYOLITE
FLUX | MECH PROPERTIES

054182 EFFECT OF ELECTROMAGNETIC AGITATION OF THE WELD POOL ON THE STRUCTURE AND PROPERTIES OF JOINTS IN VT65 ALLOY*
KUZNETSOV D V
WP V019 N0005 05 72
WELDING | VITAS ALLOY | SAW | WELD POOL
AGITATION | ELECTRO-MAGNETIC | MICROSTRUCTURES | MECH PROPERTIES

054205 METALLURGICAL CHARACTERISTICS OF MULTI LAYER SUBMERGED ARC WELDING OF LOW ALLOY BOILER STEELS*
POTAPOV N N | LYNBAVSKII K V
WP V019 N0006 06 72
WELDING | SAW | LOW ALLOY STEELS | MULTILAYER
METALLURGY | COMPOSITIONS | OXYGEN CONTENT | MECH PROPERTIES

054395 SUBMERGED ARC WELDING AND SURFACING WITH HOT WIRE ADDITIONS*
VAN DYKE L | WITTSTOCK
WJ V051 N0005 05 72
WELDING | SAW | TECHNIQUE | HOT WIRE
PROCESS | PROCEDURES PARAMETERS | COMPOSITION | MECH PROPERTIES
COMPARISON | SURFACING | CLADDING | STAINLESS STEEL