Selective Dissemination and Retrieval of Information in Biomedical Engineering*

by

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Philadelphia, Pa. 19106

There are at least three significant problems in supplying information to scientists and engineers working on biomedical engineering projects. (a) By definition, the field is multi-disciplinary. It draws upon at least two separate literatures--that of engineering and physics and that of biomedicine. (b) Since it is a relatively new field, it does not yet have a significant formal literature of its own--only a few obvious journals such as the American Journal of Medical Electronics, some new terminology, but that's about it. In the next few years, I would not be surprised to see publications like the Journal of Pacemaker Research or the Journal of the Artificial Organ Society--if they don't already exist. (c) A third factor is that which complicates the life of all scientists today. On the one hand, there is the small but diffuse literature of biomedical engineering. On the other hand, there is the vast literature that is or may be of interest to biomedical scientists. Consequently, any good system of information retrieval in biomedical engineering must have the entire literature as its point of departure. And that is one of the basic assumptions of the systems I shall tell you about today.

*Presented at the 18th Annual Conference on Engineering in Medicine and Biology, Philadelphia, Pa.; November 12, 1965.

Assume you are an engineer or scientist working on Pacemakers. I think you will agree that it would not be unreasonable to assume that you might know about the 1958 work of W. L. Weirich on "Control of Complete Heart Block by use of an artificial Pacemaker and a Synocardial Electrode" (1). Or you might know about the paper by P. M. Zoll on "Long term electric stimulation for Stokes-Adams Disease" in 1961 (2). With either name or the citation for either paper, here is a typical example of one weekly ASCA (Automatic Subject Citation Alert) report (Figure 1) you would have received during 1965. You would receive 52 similar reports each week.

On occasion, you would receive a report like this one (Figure 2). There are weeks when nothing is published that is directly relevant to your work.

In Figure 3, you see a partial list of the papers that would have been called to your attention from January to March, 1965, and in Figure 4, those for April to June, 1965. Note that while many of the papers shown are obviously concerned with Pacemakers, others are not--at least not simply by reading their titles.

You may ask, "What is so exciting about this little demonstration?" The answer is this--we were able to provide this specialized selection and dissemination of information on Pacemakers without the intervention of a scientist or a scientifically trained indexer.

Now I should like to turn to the opposite side of the information coin--retrospective searching. For example, find the 1964 literature on Pacemakers. In Figure 5, there is a partial list of the 1964 papers that cite the Zoll paper. These are found in the 1964 Science Citation Index (SCI). The search was done for me by a clerk. The search time required was almost completely the time required to copy and type the citations as listed in the SCI Source Index. The same search can also be done by computer, but why use a sledge hammer to derive a thumbtack. This

search is typical of thousands that can be done in your medical or engineering libraries provided they subscribe to the SCI service. SCI appears quarterly and cumulates annually.

The next example will illustrate the use of citation indexing in tracing literature on a concept that is not well established in medical terminology--the application of fibre optics. Starting with a paper by W. P. Siegmund in 1962 presented at the Sixth Annual Meeting of the Avionics Panel of AGARD (Figure 6), I found, through the SCI, two quite different types of papers--one by Blincow in the IEEE Transactions on Nuclear Science on "Light Collection from Long Thin Scintillator Rods and Optical Coupling" (Figure 7), and another by Heck in the Journal of Applied Physiology on "A Technique for Differential Photoelectric Plethysmography of Brain and Ear" (Figure 8).

In a similar fashion, beginning with a U. S. Patent #3,033,071 issued to Hicks on "Fiber Optical Field Flattening Devices" (Figure 9), I was alerted to a subsequent Patent issued to Woodcock and also assigned to American Optical Company on a "Method and Apparatus for Forming Tapered Fiber Optical Image Transfer Devices." This could have been done in several ways, one of which would include a patent assignee question in an ASCA profile.

As a final example, one might wish to know whether the 1963 work of Levy and Lillehei on "Apparatus, Application, and Indication for Fibrilatory Cardiac Arrest" had been extended further. In the ASCA report for November 5, we find a paper by Lillehei and co-workers which cites the earlier work in this fast moving field (Figure 10). The new paper concerns "Aortic Valve Replacement Utilizing Sutureless (Magovern) Prosthesis with Particular Reference to Pathologic Anatomy and Choice of Prosthesis."

One may legitimately ask whether the conventional methods of indexing literature would have provided comparable results. If the conventional indexes like Index Medicus and Engineering Index were either sufficiently timely or comprehensive, they

might adequately cover a topic such as artificial Pacemakers. Indeed, you can find a long and useful list of papers on that topic in Index Medicus which employs subject-trained specialists. However, a search for information on fiber optic probes is hopeless. You will find no indexing heading for it in Index Medicus. If one knew, in advance, that it had been used in plethysmography, then one could scan the dozens of articles listed on that topic but most of them do not concern the use of fiber optics. And this is precisely the point. A conventional thesaurus-controlled index does not employ new terminology until it has been used frequently enough to justify its usage. But it is precisely during this critical period, during the growth of new concepts and fields, that one needs a means of rapid access to pertinent information regardless of the terminology or language employed.

These examples were selected to show you how to use citation methods in solving your problem of efficiently utilizing the literatures of engineering, science and medicine. A proper blend of time, cost, and manpower factors must be considered when evaluating information retrieval systems. We believe the SCI and ASCA systems provide that proper blend. For each of the question citations mentioned above, the total yearly cost of ASCA service would be $2.00. That's about four cents per week. However, the minimum profile is 50 search units which covers a lot of ground. We invite your evaluation.

References

1. W. L. Weirich, et al., "Control of Complete Heart Block by Use of an Artificial Pacemaker and a Synocardial Electrode," Circ. Research 6, 410 (1958)

2. P. M. Zoll, et al., "Long Term Electric Stimulation of the Heart for Stokes Adams Disease," Annals of Surgery 154, 330 (1961)

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AUTOMATIC SUBJECT CITATION ALERT

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994 ACCOUNT NUMBER
117 UNITS USED
882 UNITS REMAINING

REPORT FOR 29 OCT 65

83,441 citations from current scientific literature and current patents were processed for *ASCA* this week

→ THE ITEM BY ZOLL PM ANN SURG 154 330 61
CITED BY CHALNOT P FRISCH R MATHIEU P
J CARD SURG 6 204 65 3R N3 68681
TREATMENT OF AURICULO-VENTRICULAR BLOCK BY INTERNAL PACEMAKERS (20 CASES)

THE ITEM BY WEISS P J GEN PHYSIOL 41 1 57
CITED BY LAIRD AK TYLER SA BARTON AD
GROWTH 29 233 65 22R N3 68790
DYNAMICS OF NORMAL GROWTH

THE ITEM BY HEYN AN TEXTILE RES J 23 782 53
CITED BY PETERLIN A
MAKROM CHEM 87 152 65 25R OCT 68577
SMALL ANGLE SCATTERING BY A 3 COMPONENT SYSTEM

→ THE ITEM BY WEIRICH WL CIRCULAT RES 6 410 58
CITED BY SCHWEDEL JB
J CHRON DIS 18 891 65 M 4R N9 68830
ROLE OF PACEMAKER

a s c a

FIGURE 1

FOR OATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( )
AND SEE ORDERING INSTRUCTIONS ON BACK OF FORM.

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REPORT FOR 22 OCT 65

79,260 citations from current scientific literature and current patents were processed for *ASCA* this week

THIS WEEK THERE WERE NO CITATIONS TO THE ITEMS IN YOUR PROFILE
ACCT NO 994

FIGURE 2

FOR OATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( )
AND SEE ORDERING INSTRUCTIONS ON BACK OF FORM.

SCIENCE CITATION INDEX SEARCH

January to March 1965

THE ITEM BY ZOLL PM ANN SURG 154 330 61

CITED BY ELLIS FH MANNING PC CONNOLLY DC
MAYO CLIN P 39 945 64 25R N12 60294
TREATMENT OF STOKES-ADAMS DISEASE

MARION P GOUNOT J ESTANOVE JF ESTANOVE S
J CARD SURG 5 657 64 M 24R N6 60937
INTRACORPOREAL CARDIAC STIMULATORS FOR MORGAGNI-ADAMS-STROKES DISEASE - (144 PATIENTS OPERATED ON BY 9 FRENCH TEAMS)

ROBINSON DS FALSETTI HL WHEELER DH MILLER DB
AMIDON EL
AM J CARD 15 397 65 10R N3 62198
VENTRICULAR FIBRILLATION ASSOCIATED WITH 2 FUNCTIONING IMPLANTED CARDIAC PACEMAKERS

SENNING A
J CARD SURG 5 651 64 M 33R N6 60937
PROBLEMS IN USE OF PACEMAKERS

WINTERS WL TYSON RR SOLOFF LA
ANN INT MED 62 208 65 22R N2 61708
CARDIAC PACEMAKING .1. CLINICAL EXPERIENCE

FIGURE 3

SCIENCE CITATION INDEX SEARCH

April to June 1965

THE ITEM BY ZOLL PM — ANN SURG — 154 330 61

CITED BY ABLAZA SGG; BLANCO G; MARANHAO V; GOLDBERG H
ARCH SURG 90 694 65 — 8R N5 64238
TOTAL REPLACEMENT OF AORTIC VALVE IN A PATIENT WITH INTERNAL PACEMAKER - REPORT OF A CASE

SOWTON E
BR HEART J 27 311 65 — 27R N3 64891
ARTIFICIAL PACEMAKING AND SINUS RHYTHM

SURAWICZ B; CHLEBUS H; REEVES JT; GETTES LS
J AM MED A 191 1049 65 — 14R N13 62827
INCREASE OF VENTRICULAR EXCITABILITY THRESHOLD BY HYPERPOTASSEMIA - POSSIBLE CAUSE OF INTERNAL PACEMAKER FAILURE

THE ITEM BY WEIRICH WL — CIRCULAT RES — 6 410 58

CITED BY HALLEN A; NORDLUND S; WARVSTEN B
ACT SOC MED 70 17 65 — 15R N1/2 63929
PACEMAKER TREATMENT IN ADAMS-STOKES SYNDROMA

FIGURE 4

SCIENCE CITATION INDEX SEARCH

1964

Partial List

THE ITEM BY ZOLL PM ANN SURG 154 330 61

CITED BY

ALLEN P ROBERTSO.R TRAPP WG
CAN MED A J 91 547 64 5R N10 56925
INDICATIONS FOR TREATMENT OF COMPLETE ATRIOVENTRICULAR DISSOCIATION

BUTTIGLI.JB COLES JC GERGELY NF
CAN MED A J 91 331 64 9R N7 56361
ARTIFICIAL CARDIAC PACEMAKERS

CENTER S NATHAN D WU CY DUQUE D
J THOR SURG 48 513 64 13R N4 57746
2 YEARS OF CLINICAL EXPERIENCE WITH CLINICAL PACER

CHARDACK WM
ANN NY ACAD 111 893 64 19R A3 54467
MYOCARDIAL ELECTRODE FOR LONG-TERM PACEMAKING

DAVIES JG SOWTON GE
PHYS MED BI 9 257 64 R 62R N3 55533
CARDIAC PACEMAKERS

KANTROWI.A
ANN NY ACAD 111 1049 64 22R A3 54467
IMPLANTABLE CARDIAC PACEMAKERS

LAWRENCE GH KING RL PAINE RM SPENCER MP HUGHES ML
J AM MED A 190 1093 64 18R N13 60025
COMPLETE HEART BLOCK -- PATIENT SELECTION & RESPONSE TO IMPLANTATION OF ELECTRONIC PACEMAKER

MYERS GH PARSONNE.V ZUCKER IR LOTMAN HA
AM J MED EL 3 233 64 7R N4 60031
BIOLOGICALLY-ENERGIZED CARDIAC PACEMAKERS

NAKAMURA FF NADAS AS
N ENG J MED 270 1261 64 18R N24 54181
COMPLETE HEART BLOCK IN INFANTS & CHILDREN

FIGURE 5

FIBER OPTICS: PRINCIPLES, PROPERTIES and DESIGN CONSIDERATIONS

by

Walter P. Siegmund

American Optical Company

Southbridge, Massachusetts

U. S. A.

ABSTRACT

The basic principles of fiber optics are reviewed and the properties of a variety of fiber optics materials are described. Important design considerations are discussed with respect to the application of these materials to various optical problems. To illustrate these design considerations a number of specific optical problems and their possible solution by means of fiber optics are described.

Presented at

6th Annual Meeting of the Avionics Panel

AGARD

(NATO)

Paris, France

July 1962

SIEGMUND WP *62*6 ANN M AV PAN AGARD

BLINCOW DW IEEE NUCL S 64 NS11 38

HECK AF J APP PHYSL L 64 19 1236

FIGURE 6

LIGHT COLLECTION FROM LONG THIN SCINTILLATOR RODS AND OPTICAL COUPLING

D. W. Blincow
J. R. Webster
Giannini Controls Corporation
Duarte, California

SUMMARY

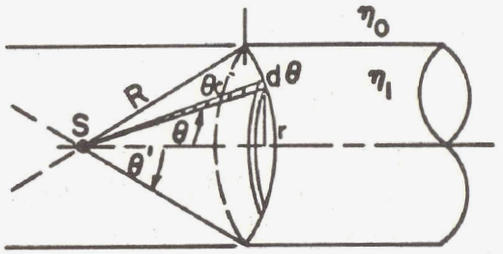
In nuclear detection, it is often advantageous to detect the nuclear events occurring at widely separated points and to route this information to a central location. This problem was encountered in the design of a nuclear gaging system for the reaction control tanks of the Apollo vehicle. An evaluation of system requirements showed that a design using a multiplier phototube and an array of scintillator rods offered optimum efficiency, weight and accuracy. This approach demands that the scintillator rods act both as gamma detectors and as light pipes to conduct the light to the phototube. An investigation of the light conducting properties of various scintillator materials as a function of rod length, diameter, shape and surface conditions is herein reported.

The light piping properties of several materials and geometries have been explored both experimentally[1,2] and theoretically[3,4]. Scintillation materials have been used as light pipes in several instances,[5,6] although usually where environmental conditions make more direct means infeasible (for instance, where intense magnetic fields would effect the phototube).

Where: $\theta' = 90 - \theta_c$

I_o = Total light emitted

I' = Light entrapped in one direction



S=SCINTILLATION EVENT

$$\frac{I}{I_o} = \frac{\int_0^{\theta'} 2\pi R r \, d\theta}{4\pi R^2} = \frac{1-\cos\theta'}{2}$$

Fig. 1—Light entrapped from Scintillation event.

REFERENCES

1. Kapany, N. S., J. Optical Society of America, 47, 413-22, May 1957; "Fiber Optics I, Optical Properties of Certain Dielectric Cylinders".

2. Harris, C.C. and Bell, P.R., IRE Transactions on Nuclear Science, Nov. 1956; "Transmission Characteristics of Light Pipes".

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7. Potter, R.M., NYO-9033, Institute of Optics, University of Rochester, Rochester 20, N. Y.; "A Theoretical and Experimental Study of Optical Fibers".

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FIGURE 7

A technique for differential photoelectric plethysmography of brain and ear

ALBERT F. HECK AND VERLAN R. HALL
Department of Neurophysiology, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C.

HECK, ALBERT F., AND VERLAN R. HALL. *A technique for differential photoelectric plethysmography of brain and ear.* J. Appl. Physiol. 19(6): 1236–1239. 1964.—A technique for implantation and apparatus for obtaining a circulatory pulse volume wave from the surface of the cerebral cortex of animals in both acute and chronic experimental situations are described. Fiber optic light guides are placed through burr holes on the brain surface and the skull closed with cement, thus restoring the Munro-Kellie principle. Heatless light is conducted into the brain and changes in optical density of this tissue due to vascular pulsation are converted to wave forms by a photoelectric pickup. Trauma and tissue reaction are minimal. Attachment of a similar plethysmograph to the ear by means of Teflon button receptacles allows differential recording of plethysmograms from either vascular bed.

fiber optics photoelectric technique Munro-Kellie principle

light has been, thus far, restricted to extracorporeal studies of circulation in the skin for various reasons: size of the transducer, associated problems of surgical implantation and tissue trauma, instability of the implant and displacement from the vascular bed to be monitored, effects upon the vascular bed of heat generated by an incorporated light source, replacement of transducer components once chronic implantation has been made.

The purpose of this paper is to describe a technique which minimizes or eliminates these limitations by employing flexible fiber optic guides (10) for conduction of heatless light into and out of the body. The technique was developed for use in differential studies of vasomotor phenomena occurring simultaneously in various vascular beds and the effects of changes in other physiologic variables (e.g., blood pressure, venous pressure, blood volume, pCO_2) on these phenomena.

Apparatus consists of the following components: *1*) a d-c powered light source of variable intensity; *2*) an afferent fiber optic light guide (LG 2, American Optical Co.); *3*) an efferent fiber optic guide; *4*) a photocell (Clarex CL 704L) housed

REFERENCES

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15. WOOD, E. H., E. H. LAMBERT, E. J. BALDES, AND C. F. CODE. Effects of acceleration in relation to aviation. *Federation Proc.* 5: 327–344, 1946.
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FIGURE 8

United States Patent Office

3,033,071
Patented May 8, 1962

1

3,033,071
FIBER OPTICAL FIELD FLATTENING DEVICES
John W. Hicks, Jr., Fiskdale, Mass., assignor to American Optical Company, Southbridge, Mass., a voluntary association of Massachusetts
Filed June 3, 1958, Ser. No. 739,535
5 Claims. (Cl. 88—1)

This invention relates to fiber optical devices and has particular reference to improved fiber optical means for transferring optical images from one location to another and method of making the same.

In conventional optical systems which embody optical lenses or various components formed of lenses or the like, there exists the well-known problem of attempting correct or compensate for [illegible]

2

the above character which is adapted to transfer substantially all of the light received thereby from a first predetermined image plane, directly to a second predetermined image plane.

Other objects and advantages of the invention will become apparent from the following description when taken in conjunction with the accompanying drawings in which:

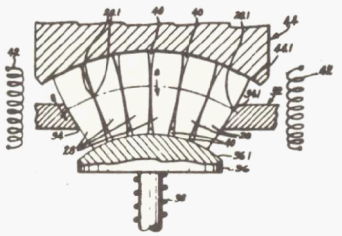
FIG. 1 is a greatly enlarged longitudinal cross-sectional view of a light-conducting fiber of the type which is used in the manufacture of the fiber optical devices of the invention;

FIG. 2 is a diagrammatic illustration of means for forming a fiber optical structure [illegible] the character

3 033 071 --------*62*HICKS ---------- US

WOODCOCK RF 3128167 US P 64

3,128,167
METHOD AND APPARATUS FOR FORMING TAPERED FIBER OPTICAL IMAGE TRANSFER DEVICES
Richard F. Woodcock, South Woodstock, Conn., assignor to American Optical Company, Southbridge, Mass., a voluntary association of Massachusetts
Filed Nov. 28, 1960, Ser. No. 72,189



1. A method of forming a tapered fiber-optical image-transfer device comprising the steps of providing a plurality of light-conducting members each of which has a slight convexity intermediate its ends, assembling said members in side-by-side relation to form a bundle in which adjacent members contact each other at points of said convexity, enclosing at least part of the periphery of said bundle for initially contacting those members at the periphery of said bundle at least at points of said convexity and for defining a section of said bundle which tapers inwardly from points of said convexity, heating said members to a fusing temperature, and causing at least some of said members to move in the direction of said taper for compacting said members into intimately fused relation progressively along the lengths of said member from points of said convexity.

FIGURE 9

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REPORT FOR 5 NOV 65

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THE ITEM BY KOUWENHOVEN WB J AM MED ASS 173 1064 60
CITED BY
( ) LANCET 2 730 65 E 10R N7415 68687
TREATMENT OF CARDIAC ARREST

THE ITEM BY PIPBERGER HV ANN INT MED 57 776 62
CITED BY SCOTT RC
( ) AM HEART J 70 535 65 R 216R N4 68775
LEFT BUNDLE BRANCH BLOCK-A CLINICAL ASSESSMENT

THE BOOK BY INGRAM WR HANDBOOK PHYSIOLOGY 2 951 60
CITED BY SPENCER PSJ
( ) BR J PHARM 25 442 65 29R N2 69069
ACTIVITY OF CENTRALLY ACTING AND OTHER DRUGS AGAINST TREMOR AND HYPOTHERMIA INDUCED IN MICE BY TREMORINE

THE ITEM BY TEXTILE INDUSTRIES 126 126 62
CITED BY LEAGUE GF
( ) 3211185 US 65 P 9R OCT 12
CL139/185 LOOM SHUTTLE BINDER HAVING REPLACEABLE BINDER LEATHER

THE ITEM BY TEXTILE COLOURIST 629 40
CITED BY BERGER A CIB LTD
( ) 3211512 US 65 P 10R OCT 12
CL8/18 PARAFFIN OIL DYE ASSISTANT AND WOOL DYEING THEREWITH

THE ITEM BY LEVY MJ SURGERY 53 205 63
CITED BY LILLEHEI CW LILLEHEI RC CASTANED.AR FERLIC RM
( ) J THOR SURG 50 482 65 22R N4 69004
AORTIC VALVE REPLACEMENT UTILIZING SUTURELESS (MAGOVERN) PROSTHESIS - WITH PARTICULAR REFERENCE TO PATHOLOGIC ANATOMY AND CHOICE OF PROSTHESIS

ACCT NO 994

FIGURE 10

FOR OATS SERVICE MARK ITEMS WHERE INDICATED ABOVE ( )
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