Abstract

A computer program for automatic identification of "full-form" case citations in legal literature (e.g., Rutherford v. Geddes, 4 Wall. 220, 18 L. Ed. 343; Southland Industries, Incorporated v. Federal Communications Commission, 1938, 69 App. D.C., 82, 99 F. 2D 117) has been developed at the University of Pittsburgh and is now operational.

The level of performance of this program known as "The Citation Identifier" is high. In a recent computer run, The Citation Identifier scanned the full texts of 191 randomly selected decisions of U.S. Court of Appeals (some 400,000 words of running text) and located correctly 2,220 full-form citations out of a total of 2,227 (that is better than 99% of the total). Only seven misses and three false drops occurred.

Of 2,220 full-form citations which were located correctly, 1944 (87%) were identified perfectly. In addition, there were 276 partial identifications containing two types of errors: (1) partial identifications in which some citation terms were mistakenly lopped off by the program (so-called "short hits"), and (2) partial identifications which contained words that were improperly included in the citations (so-called "long hits").

Both types of errors are for the most part easily correctable and can be largely eliminated by suitable changes in the program.

The Citation Identifier operates rather rapidly. In a recent test run, the total time required to process some 400,000 running words of text was approximately fifteen and a half minutes. This speed could be further increased by suitable changes in the computer program.

An extension of the Citation Identifier to reduced-form citations (e.g., "The Geddes decision," "the Southland Industries case") is now in preparation.

Motivation for Automatic Identification of Case Citations in Legal Literature.

Efficient administration of justice has often been hampered by the slowness and inefficiency of ordinary methods of legal information handling.

Because lawyers, judges, government attorneys, legislators, and others find access to necessary legal data often slow and inefficient, they are frequently unable to act with the speed and the effectiveness which the circumstances may demand of them. Thus, for example, members of the legal profession are often unable to procure, promptly, exhaustive and accurate data concerning legal precedents of various court decisions. This has often hampered the initiation of legal actions, slowed down the preparation of defense and offense, delayed the preparation of new laws, and otherwise interfered with the efficiency of legal processes.

However, wise automation of certain critical areas of legal information processing could alleviate considerably the present crisis in legal documentation. For example, a set of

computer programs capable of exhaustive, accurate, rapid, and economical identification of legal precedents in legal literature would do much to eliminate from legal documentation one of its most serious bottlenecks.

Since many or most legal precedents are referred to in legal literature by means of full-form and reduced-form case citations, (e.g., respectively, "Healy v. Penna. RR. Co., supra" and "the Healy case"), automatic identification of both forms of case citations would go far in the direction of automatic identification of legal precedents in legal literature.

However, a perusal of legal texts shows that automatic identification of full-form citations is both much simpler than that of reduced-form citations and also a prerequisite for efficient identification of the latter.

Therefore, construction of a set of programs for automatic identification of legal precedents in legal literature has begun with the construction of a computer program for automatic identification in legal texts of full-form legal citations.

State of the Art and the Genesis of The Citation Identifier.

Practical work in legal automatic information retrieval has until now revolved mainly around: (1) the preparation of concordances to legal texts, (2) KWIC indexing of legal texts, and (3) matching of legal texts with the key terms of queries and interest profiles. These well-established automatic information retrieval activities have met with considerable success.[1,2]

In addition, a sizable amount of time and energy has been devoted to automatic construction from computer-readable legal texts of legal indexes and legal thesauri by means of various statistical techniques.[3,4] However, to the best of our knowledge, these interesting procedures have not been incorporated into any practical legal information systems.

No previous attempts at automatic identification of case names in legal texts have come to our attention; however, this general type of activity has been extensively discussed by Casimir Borkowsi and derives directly from his efforts aimed at automatic identification in texts of classes of words and of word strings referring to various types of individuals, objects, processes, acts, relations, groups, etc.[5,6,7,8,9]

The Citation Identifier was first undertaken by Borkowski and his students in the Department of Computer Science of the University of Pittsburgh, in early 1968 as part of a workshop section of a graduate course in automatic text processing. Research and development procedures adapted by Borkowski and his group were approximately as follows:

A set of challenging but nevertheless resolvable problems in automatic text processing was presented to the class, discussed, and resolved in a general way. A detailed solution of one of the problems, namely, automatic identification of full-form case citations, was then worked out, flowcharted and programmed in a high-level programming language (PENELOPE)[10] for the IBM 360/50 computer of the University of Pittsburgh.

Computer-readable legal texts were made available to the class by Aspen Systems Corporation (formerly, the Health Law Center of the University of Pittsburgh), and both the teacher and the students want to take this opportunity to thank Aspen Systems for these data.

Since the termination of the original classroom workshop project, The Citation Identifier was reprogrammed in OS/360 assembly language for Aspen's IBM 360/40 by Sperling Martin, one of the students, who is also with Aspen Systems Corporation.

The effectiveness of this recent version of The Citation Identifier constitutes, along with an outline of its present structure, the subject matter of this paper.

Structure of The Citation Identifier

Our rules for automatic identification of citations are essentially simple. Full-form case citations in legal texts are recognized by means of a straightforward identification procedure whose main steps are listed below:

1. Copy a sentence from a computer-readable document into an area in computer memory (hereafter, "the Search Area"). Then, starting at the beginning of the Search Area.

2. Search the text from left to right for an occurrence of "v.". NOTE: The presence of "v." (for "versus") within a sentence is taken to indicate the presence in that sentence of a full-form case citation.

3. (A) If "v." is not found, return to 1. above for next instruction.

(B) If "v." is found, record its Search Area location and go to 4. below for next instruction.

4. Starting at the location of "v." search the sentence from right to left for the first occurrence of a string of characters which matches either:

(A) A string of characters which is on a list of so-called "Left Delimiters of a Case Citation" (hereafter, "LD") (see NOTE 1. below),

or else

(B) A string of characters which is on a list of so-called "Potential Left Delimiters of a Case Citation" (hereafter, "PLD") (see NOTE 2. below).

NOTE 1: Entries on LD list (of which there are approximately one hundred) are: (a) words such as: "also", "although", "cites", "cited", "in", "note", "see", "since", "when", etc., (b) abbreviations such as: "c.f.", "e.g.", "viz." etc., and (c) punctuation marks such as: colon, semicolon, sentence period (i.e. a period followed by two or more spaces), a question mark, etc.

NOTE 2: The only two entries on PLD list are the word "of" and the comma punctuation mark.

5. (A) If the character string to the left of "v." was matched by an entry on LD list, then:

(a) flag as the beginning of the case citation the first word to the right of that character string,

(b) return to the location of "v." in the Search Area,

(c) go to 9. below for the next instruction.

NOTE: The first occurrence of a string of characters to the left of "v." which matches an entry on Left Delimiters List is interpreted as the first element outside the case citation. In other words, we seek to locate the first occurrence of a string of characters which is not within the well-formed formula for the "left member" of a full-form case citation, or -- to put it yet another way -- we are on the lookout for the first string of characters which is in the complement of the set of all formulas for the left members of case citations.

(B) If the character string to the left of "v." was matched by an entry on PLD list, go to 6. below.

6. (A) If the character string in the sentence was matched by the entry "of" on PLD list, then (a) note its location in the sentence, and (b) check whether the text word which is to its immediate left is matched by an entry on the list of so-called "Resolvers 1" (see NOTE 1. below) and go to 7. below for the next instruction.

(B) If the character in the sentence was matched by the entry "," (i.e. a comma) on PLD list, then check whether the text word which is to its immediate right is on the list of so-called "Resolvers 2" (see NOTE 2. below) and go to 8. below for the next instruction.

NOTE 1: List of Resolvers 1 contains words such as "authority", "citation", "law", "reasoning", "rule", etc.

NOTE 2: List of Resolvers 2 contains words such as "Incorporated"

and "Limited", abbreviations such as "Inc.", and "Ltd.", and abbreviations of names of states: "Ariz.", "Ark.", "Cal.", etc.

7. If the string of characters in text was matched by an entry on List of Resolvers 1, then:

(A) (a) flag as the beginning of case citation the first word to the right of the word "of",

(b) return to the location of "v." in the Search Area,

(c) go to 9. below for the next instruction;

otherwise

(B) Starting at the location of the comma, continue executing the instruction 4. above.

8. (A) If the string of characters in text was not matched by an entry on List of Resolvers 2, then:

(a) flag as the beginning of case citation the first word to the right of the comma,

(b) return to the location of "v." in the Search Area,

(c) go to 9. below for the next instruction;

otherwise

(B) Starting at the location of the comma, continue executing the instruction 4. above.

9. Starting at the location of "v." search the sentence from left to right for either:

(A) The first occurrence of a sentence period,

or

(B) A string of characters which is a number,

or

(C) A string of characters which matches an entry on the list of so-called "Bibliography Terms" (hereafter, "BT") (see NOTE 1. below).

NOTE 1: Entries on BT list (of which there are approximately one hundred and fifty) are:

(A) Words and phrases such as: "affirmed", "ante", "at page", "certoriari denied", "certoriari granted", "Docket", "infra", "super", "supra", etc.

(B) Abbreviations such as: "aff'd", "A.L.R.", "app.", "Atl.", "A.2d", "Cranch.", "Cir.", "C.C.", "F.Supp.", etc., and the names of states referred to in 6. above.

NOTE 2: During this part of the program, an automation is made to scan the "right member" of the citation to check its well-formedness. During this scan, we are on the lookout for all strings which are in the set of well-formed formulas for right members of full-form citations. The right boundary marker is placed to the left of the first character string which is believed not to be part of the well-formed formula for the right member.

10. (A) If the sentence period is encountered, then

(a) flag as the end of the citation the string of characters to its immediate left,

(b) print the citation and go to 1. above for the next instruction.

(B) If a string of characters in the text was either identified as a number or else was matched by an entry on BT list, then go to 11. below for the next instruction.

11. Continue searching the text from left to right for either the first occurrence of the sentence period or a string of characters which matches an entry on BT list.

12. (A) If a sentence period is encountered, go to 10. (A) (a) above for the next instruction.

(B) If the string of characters in the text was either identified as a number or was matched by an entry on BT list, then continue executing 11. above;

otherwise

(a) flag as the last element of the case citation, the word to the left of that character string,

(b) print the citation,

(c) remain at present location in the Search Area and go to 2. above for the next instruction.

Effectiveness of The Citation Identifier

The assembly language version of The Citation Identifier as reported here was developed and tested out on Aspen Systems Corporation's IBM 360/40. Legal texts used in the test were the decisions of the United States Court of Appeals (Third Circuit).

In a recent computer run, The Citation Identifier scanned 191 randomly selected court decisions (45,942 lines of texts, that is some 400,000 words of running text) and located correctly 2,220 full-form citations out of a total of 2,227 (that is better than 99% of the total).

Of 2,220 full-form citations which were located correctly, 1,944 (87%) were identified perfectly. In addition, there

were 276 partial identifications containing two types of errors:

1. "Short hits", i.e. full-form case citations in which some citation terms were mistakenly lopped off by the program. The number of such partial identifications was 208 (e.g., "Carlino v. Zimblarte, 1927, 60" for "Carlino v. Zimblarte, 1927, 60 Ontario Law Reports 269"),

and

2. "Long hits", i.e. full-form case citations which contained terms which were improperly included in the citations. The number of such partially correct identifications was 82 (e.g., "Gulf v. Schlumberger is an ordinary civil action").

The Citation Identifier operates rather rapidly. The total time required to process over 400,000 running words of text and print out 2,220 full-form citations was approximately fifteen and one half minutes.

TABLE I

Results of the Experiment

Item:	Number:
Full-text documents in the sample	191
Running words of texts	over 400,000
Full-form case citations in the sample	2,227
Full-form case citations located correctly	2,220
Full-form case citations missed	7
False drops	3
Perfect identifications	1,944
Partial identifications	276*
Short hits	208
Long hits	82
Job time (in minutes)	under 16

Of 276 partial identifications,* 31 were caused by typographic errors; 18 and 140, respectively, were due to lack of appropriate entries on the lists of Left Delimiters and Bibliographic Terms, and 9 and 12, respectively, to lack of entries on Resolvers 1 and Resolvers 2 lists. The misses, false drops, and the remainder of partial identifications (approximately 75) were caused by various incorrect assumptions incorporated

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* Because some partial hits contained both short and long hits, the total of short hits and long hits is greater than the number of partial identifications.

into the basic identification routines. Thus, for example, the assumption that all right members of full-form citations terminate in strings of numbers and bibliographic terms has caused seven misses and nineteen long hits (e.g., the following string of words was identified as a single citation, "McCullough v. Cosgrave cited its previous opinion in Los Angeles Brush Corp. v. James, 1927, 272 U.S. 701").

Similarly, the assumption that the presence of "v." in a sentence indicates the presence in that sentence of a full-form case citation resulted in false drops such as: "C. L. McClain Fuel Corp. v. appellant's contention that the case at bar falls within this testimony".

Some changes in the structure of the main identification procedure are now in preparation. A preliminary evaluation indicated that they should lead to further significant improvements in the accuracy and the speed of the program. A preliminary evaluation indicates that by increasing the number of list entries by about a factor of four, we would reduce the number of partial hits by about a factor of three. Among required new entries which will be added to the list are: frequently mispelled words and abbreviations, left delimiters, bibliographic terms, etc.

We would estimate that the introduction into The Citation Identifier of all modifications suggested above would reduce by a factor of five or six the number of partial identifications.

Discussion and Interpretation

We would like to emphaize the fact that the task which we set for ourselves was the solution of a limited, practical problem. Consequently, we did not think it appropriate to commit ourselves to any strong theoretical view of ordinary language and sought instead to discover what minimal assumptions and what information may be pertinent to our unprepossessing experiments in automatic text processing.

Simple hypotheses concerning automatic identification in texts of case citations were selected by us with the intention of finding out how many correct identifications and how many errors they would produce. It was and it remains our plan to amend these hypotheses on a continuous basis in the light of the results obtained. We are, of course, striving for stronger theoretical underpinnings; however, for the time being, we find it appropriate to operate with the least amount of preconceived opinion and of theoretical commitment.

Automatic classification of words and phrases in texts of the type described here can be viewed as a particularly simple case of machine translation from ordinary language. However, the goal of The Citation Identifier is not translation into natural language but into classificatory language. In other words, our program attempts a relatively simple many-to-one type of reduction (i.e. classification) rather than the extremely complex many-to-many transformation of the "MT" type.

More generally, it may be useful to view ordinary language as a macro-language containing certain special-purpose micro-languages (or "mini-languages") -- each with its own structure which relative to the total structure of language is quite simple. It may be of considerable practical and theoretical interest (a) to investigate the structures and the interrelations of such mini-languages and (b) to construct computer programs for identifying in texts the words and the word strings belonging to such mini-languages.

An ability to produce and identify automatically words and word strings belonging to various special-purpose categories (i.e. mini-languages, each with its own set of grammatical rules) should be very useful in information retrieval because they play an important role in various systems for extracting and distributing information.

Because many word strings which the algorithms such as this one attempt to identify have simple structure ("phrase structure"), they can be recognized with a reasonable degree of accuracy by means of simple computational techniques.

The Citation Identifier is the first of a series of programs for automatic and semiautomatic processing of computer-readable legal texts. An extension of The Citation Identifier to reduced-form citations (e.g., "the Geddes decision", "the Geddes case") is now in preparation. In addition, The Citation Analyzer, a computer program for automatic classification of full-form case citations is also in preparation.

Several uses suggest themselves for a computer program capable of identifying cheaply, rapidly, accurately, and exhaustively case citations in legal literature. They seem to fall into five broad and overlapping categories:

1. Automatic indexing and classification of legal literature,

2. Establishing counts of occurrences of case citations in case law and in statutory law,

3. Determining how case citations co-occur with other words and phrases in legal texts (this may lead eventually to correlating case citations with points-of-law),

4. Tracing associations between case citations and construction of lists, tables, and graphs which display such associations,

5. Providing an automatic or semiautomatic service for answering questions concerning documents in which a particular case or group of cases was cited.

Systems for automatic identification of citations in texts and subsequent automatic extraction of case citations from texts may be useful to many groups, among them:

1. Lawyers, judges, government attorneys, and other members of the legal profession,

2. Members of various legislatures,

3. Officials in various branches of the federal, state, and municipal governments,

4. Administrators in business, industry, foundations, labor, finance, insurance, transportation, etc.,

5. Sociologists and political scientists,

and many others.

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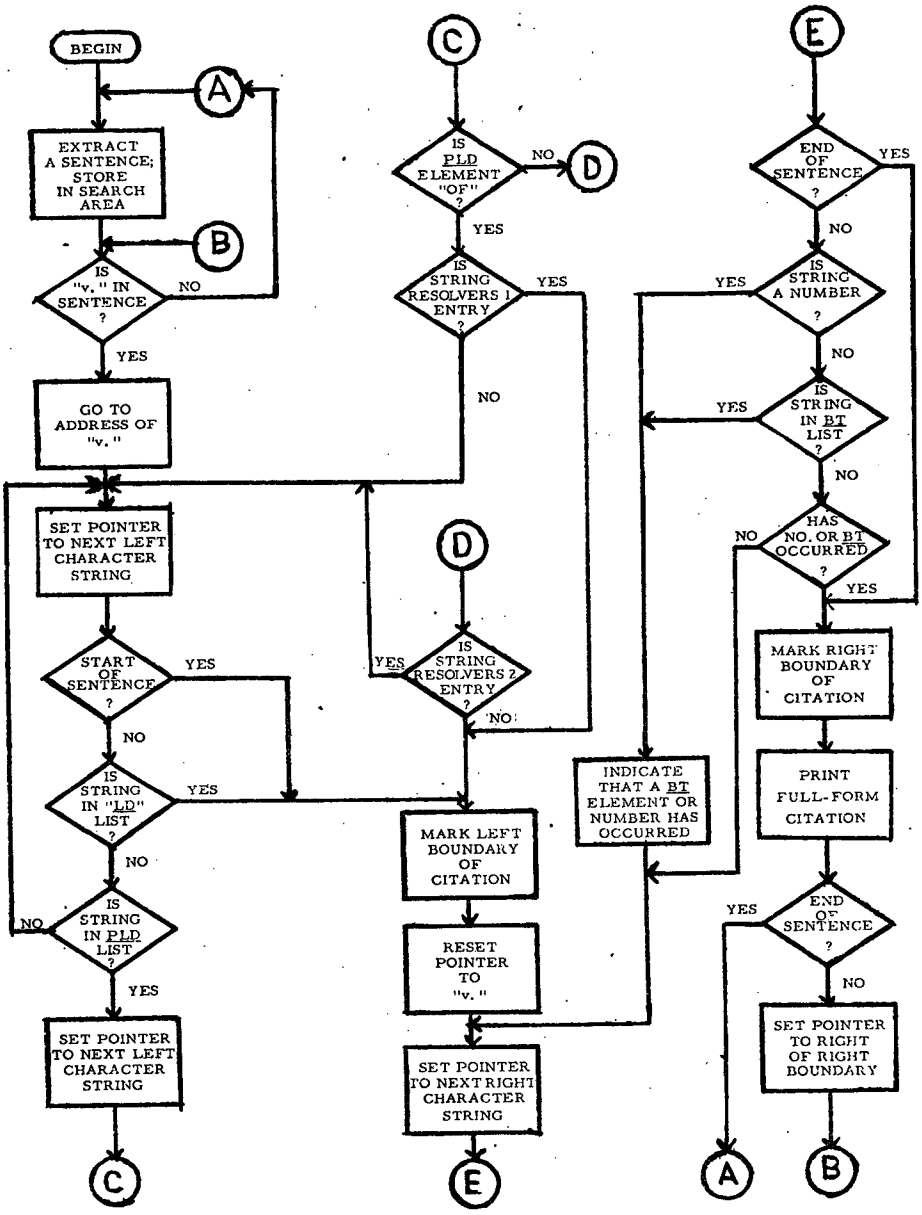

FIG. 1 FLOWCHART OF THE CITATION IDENTIFIER

179 F.2d 695 (3rd Cir. 1950) National Labor Relations Board v. Spiewak

National Labor Relations Board v. Spiewak et al. , in No. 9875.

Counsel, Arnold Ordman, Washington, D.C. (David P. Findling, Associate Gen. Counsel, A. Norman Somers, Asst. Gen. Counsel, Marcel Mallet-Prevost, Washington, D.C. , on the brief) , for petitioner.

Counsel, Gerald H. Chambers, New Yrok City (Chambers and Chambers, New York City, on the brief) , for respondents.

Sitting, BIGGS, Chief Justice, and MARIS, GOODRICH, McLAUGHLIN, O-CONNELL, KALODNER and HASTIE, Circuit Judges.

McLAUGHLIN, Circuit Judge.

This is a petition by the National Labor Relations Board for enforcement of its order against respondents following proceedings under Section 10 of the National Labor Relations Act, 49 Stat. 449, U.S.C.A. Title 29, Sec. 160.

Respondents are garment manufacturers. During the period with which we are

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the Association prior to the wildcat strike. There is a pattern indicated by the named incidents that takes them out of the category of unimportant casual conversation between the individuals concerned, as illustrated by Quaker State Oil Refining Corp. v. N.L.R.B. , 3 Cir. , 119 F.2d 631, 633, or the type of episodes outlined in N.L.R.B. v. Public Service Co-ordinated Transport et al. 3 Cir. , 177 F.2d 119, which obviously had no effect in either preventing or

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from membership, even where such action had been based on the employee's dual unionism. Colgate-Palmolive-Peet Co. v. N.L.R.B. , 338 U.S. 355, 70 S.Ct. 166. But the conduct of Newfield and Klein bore no relationship to that type

* * *

under Section 8 (1) of the Act. It rendered the 1944 contract invalid. Labor Board v. Electric Cleaner Co. , 315 U.S. 685, 694, 62 S.Ct. 846, 86 L.Ed. 1120. Cf. Wallace Corp. v. Labor Board, 323 U.S. 248, 65 S.Ct. 238, 89 L.Ed. 216.

* * *

though respondents had the contract right to discharge employees participating in the illegal strike, (N.L.R.B. v. Sands Mfg. Co. , 306 U.S. 332, 59 S.Ct. 508, 83 L.Ed. 682; N.L.R.B. v. Fansteel Corp. , 306 U.S. 240, 249, 59 S.Ct. 490, 83 L.Ed 627; Matter of Scullin Steel Co. , 65 N.L.R.B. 1294; Matter of Joseph Dyson and Sons, 72 N.L.R.B. 445) , Spiewak's subsequent testimony points out that in his above answer he was not referring to such

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employees. It is this which distinguishes the instant situation from the Stackpole and Republic cases (N.L.R.B. v. Stackpole Carbon Co. , 3 Cir. , 105 F.2d 167; Republic Steel Corporation v. N.L.R.B. , 3 Cir. , 107 F.2d 472) where the employer was denied the right to withhold reinstatement of employees who had participated in minor acts of violence in furtherance of a strike.

* * *

result in the light of the particular facts of this phase of the matter.

N.L.R.B. v. Wytheville Knitting Mills, 3 Cir. , 175 F.2d 238, 240, presented a somewhat similar situation, though in that case there was no

* * *

department into confusion. National Labor Relations Bd. v. Edinburg Citrus Ass-n, 5 Cir. , 1945, 147 F.2d 353. In such circumstances these employees

* * *

We do not think it comes within the language of Section 10 (e) of the Act reading: " No objection * * * not * * * urged before the Board, its member, agent, or agency, shall be considered by the COURT * * * " (See N.L.R.B. v. Cheney California Lumber Co. , 327 U.S. 385, at pages 388 and 389, 66 S.Ct. 553, 90 L.Ed. 739; May Department Stores Co. v. N.L.R.B. , 326 U.S. 376, footnote at page 386, 66 S.Ct. 203, 209, 90 L.Ed. 145; Marshall Field and Co. v. N.L.R.B. , 318 U.S. 253, 255, 63 S.Ct. 585, 87 L.Ed. 744; N.L.R.B. v. Baldwin Locomotive Works, 3 Cir. , 128 F.2d 39, at page 50) Even if it were judged to be under that section, the exception to 10 (e) would apply. That exception reads: " * * * unless the failure or neglect to urge such objection

G. 2 TEXT PORTIONS OF A DOCUMENT CONTAINING FULL-FORM CASE CITATIONS (UNDERLINED) OCESSED BY THE CITATION IDENTIFIER---SEE THE RESULTS OF PROCESSING IN FIG. 3.

TITLE: 179 F.2d 695 (3rd Cir. 1950) National Labor Relations Board v. Spiewak

CITE: National Labor Relations Board v. Spiewak et al. , in No. 9875

CITE: Quaker State Oil Refining Corp. v. N.L.R.B. , 3 Cir. , 119 F.2d 631, 633

CITE: N.L.R.B. v. Public Service Co-ordinated Transport et al. , 3 Cir. , 177 F.2d 119

CITE: Colgate-Palmolive-Peet Co. v. N.L.R.B. , 338 U.S. 355, 70 S.Ct. 166.

CITE: Labor Board v. Electric Cleaner Co. , 315 U.S. 685, 694, 62 S.Ct. 846, 86 L.Ed. 1120

CITE: Wallace Corp. v. Labor Board, 323 U.S. 248, 65 S.Ct. 238, 89 L.Ed. 216

CITE: N.L.R.B. v. Sands Mfg. Co. , 306 U.S. 332, 59 S.Ct. 508, 83 L.Ed. 682

CITE: N.L.R.B. v. Fansteel Corp. , 306 U.S. 240, 249, 59 S.Ct. 490, 83 L.Ed 627

CITE: N.L.R.B. v. Stackpole Carbon Co. , 3 Cir. , 105 F.2d 167

CITE: Republic Steel Corporation v. N.L.R.B. , 3 Cir. , 107 F.2d 472

CITE: N.L.R.B. v. Wytheville Knitting Mills, 3 Cir. , 175 F.2d 238, 240

CITE: National Labor Relations Bd. v. Edinburg Citrus Ass-n, 5 Cir. , 1945, 147 F.2d 353

CITE: N.L.R.B. v. Cheney California Lumber Co. , 327 U.S. 385, at pages 388

CITE: May Department Stores Co. v. N.L.R.B. , 326 U.S. 376, footnote at page 386, 66 S.Ct. 203, 209, 90 L.Ed. 145

CITE: Marshall Field and Co. v. N.L.R.B. , 318 U.S. 253, 255, 63 S.Ct. 585, 87 L.Ed. 744

CITE: N.L.R.B. v. Baldwin Locomotive Works, 3 Cir. , 128 F.2d 39, at page 50

FIG. 3 CITATIONS IDENTIFIED BY THE CITATION IDENTIFIER IN THE DOCUMENT ILLUSTRATED BY FIG.2 (THE UNDERLINED CITATION IS AN EXAMPLE OF A "SHORT HIT"---SEE THE CONTEXT OF THE CITATION IN FIG. 2)