Appendix for Online Publication

A Data Appendix

A.1 Construction of patent datasets

A.1.1 Base data

The construction of the core patent-level dataset used in this paper begins with the USPTO historical master file (Marco et al. 2015), which provides a master list of granted patents with grant dates, patent class/subclass (USPC), and two-digit NBER category (Hall et al. 2001). In building this paper's dataset, I restrict the sample to patents granted between January 1, 1920 and December 31, 1979 – although most of the paper invokes only a subset of these. For all granted patents in this set, I obtain additional patent characteristics from the following sources:

- FreePatentsOnline.com (FPO): serial numbers, filing dates, and the network of forward and backward citations (front-page citations only)
- Derwent Innovation database (DI): (mostly) standardized assignee names[1]

A small subset of patents are missing filing dates and assignees. Table A.1 shows the number patents with missing data, by decade of grant. For the period sampled in this paper (1930-1960), approximately 2.4% of patents are missing a filing date and 2.5% missing an assignee (note: these percentages calculated for patents granted between 1930 and 1960, whereas the paper uses the sample of patents known to have been filed between 1930 and 1960).

Table A.1: Number of patents with missing data, by decade

		No filing date		No assignee data	
Decade of grant	**Patents**	**Number**	**Percent**	**Number**	**Percent**
1920-1929	414901	25738	6.2%	25918	6.2%
1930-1939	442842	11102	2.5%	11221	2.5%
1940-1949	307630	5470	1.8%	5546	1.8%
1950-1959	425985	12461	2.9%	12661	3.0%
1960-1969	567761	11203	2.0%	11363	2.0%
1970-1979	689027	2	0.0%	73	0.0%
Total	2848146	65976	2.3%	66782	2.3%

Notes: Table shows counts of patents with missing data, and their fraction of all patents, by decade (of grant).

Because secrecy orders were issued to patent applications, they are identified by serial number. For the purposes of this paper, it is thus critical to have accurate data on serial numbers. The

[1]Note that serial numbers, filing dates, and the network of patent citations were also retrieved from the Derwent database for comparison against the FPO data, as a validation exercise. The two data sources overwhelmingly agreed, and where they disagreed, spot checks revealed that FPO was consistently the more accurate of the two, and when there was an error in the FPO data, it typically reflected the occasional typographical error on the printed patent publication itself, such as two flipped digits, or a digit one unit off the correct value. Given their reliability, the data for this paper thus use serial numbers, filing dates, and citations from FPO.

application-level data (serials and filing dates) from FPO were therefore manually reviewed and validated for the period around the secrecy order program, by checking patents with serial numbers or filing dates which are out of sequence. The important feature of the USPTO's application numbering system for my purposes here is that applications are organized into application "series", which span several years, and identified by a serial number within that series, generally issued in the order in which patent applications arrive at the USPTO, with serial numbers never exceeding six digits. Application series increment, and serial numbers reset, at the beginning of a year in which the serial numbers from the previous series are expected to surpass 1,000,000. Series 2 begins January 1, 1935 and ends December, 1947 and is the focus of this data cleaning effort. I take all patents identified by FPO as belonging to Series 2 and sort these patents by serial. I then look for patents where the previous and next serial have the same filing date but the given patent has a different filing date, and then manually validate the serial and filing date for these patents. Out of over 370,000 patents in Series 2, corrections were made to 279 serials and 188 filing dates. Although these corrections are valuable for matching patents to secrecy orders, the low error rate for this sample also indicates that such errors are not widespread in the data.

A.1.2 Harmonizing assignee names

Although the assignee names from DI are largely already standardized, closer examination reveals that there are still variants on individual assignee names (e.g., BELL TELEPHONE LABOR INC with $> 10,000$ patents, and BELL TELPHONE LAB INC, BELL TEL PHONE LAB INC, and BELL TEIEPHONE LAB INC with 1 patent each). I undertake several procedures to further harmonize assignee names. I begin by sorting a unique list of assignees in alphabetical order, and for each assignee recording other nearby assignees up to 9 positions before and after in the sorted list. I then calculate the edit distance between the given assignee name and each of these nearby assignee names. When this edit distance is less than 25% of the length of the longer name in each pair, I flag that pair as a candidate for manual review. I then review all such matches for several categories of assignees, and standardize names when a match is found:

- Assignees with ≥ 15 patents between 1930 and 1960
- Assignees with at least 1 secrecy order
- Assignees which were OSRD contractors
- Assignees identified as government agencies (see next section)
- Assignees identified as universities or hospitals (see next section)
- Assignees which were synthetic rubber manufacturers
- Assignees which were spinouts from Standard Oil

This process is repeated (because each round of harmonization may bring new assignees into the set with $\geq$15 patents between 1930 and 1960) until no new matches are found.

This harmonization is neither perfect nor exhaustive, but it is believed to be effective for the purposes of this paper. It is also worth noting that for the vast majority of assignee names which were standardized by this procedure, there was clearly a primary spelling for that assignee in the original DI data, with hundreds or thousands of associated patents in the case of large assignees, and at worst a handful of secondary spellings with one or two associated patents – such that the actual effects of both (i) performing this harmonization for the priority assignees above, and of (ii) *not* performing it for non-priority assignees, are likely minimal.

A.1.3 Determining assignee types

Assignees are then classified into four categories – firms, universities and hospitals, government agencies, and individuals – through a combination of rule-based and manual classification. I begin by classifying assignees as firms when the assignee name includes any of roughly 120 words which indicate firms (e.g., CO, CORP, INC, LTD, SPA, GMBH, etc., as well as technical words such as AERO, AUTO, CHEM, ENG, MACHINE, OIL, PROD, TECH, WORKS; full list available on request). I then manually classify remaining assignees with $\geq$15 patents between 1930 and 1960, as well as assignees whose name includes any of the following strings:

- COLLEGE, INST, UNIV, HOSP, RES FOUND
- US, CANADA, UK, FRANCE, GERMANY, SWITZERLAND, AUSTRALIA, JAPAN, ISRAEL, and assorted other countries
- ATOM (to identify international atomic energy commissions)

Assignees with $>$ 200 patents in the 1920-1979 period which are thus far unclassified are then classified as firms. Any remaining unclassified assignees are classified as individuals.

This classification procedure was developed over several years, and although – like the name harmonization – it is neither perfect nor exhaustive, random spot checks suggest it is overwhelmingly effective at categorizing assignees into the right bins. In total, 60.1% of patents with an assignee in the 1920-1979 sample are assigned to a firm, 0.2% to a university, 0.8% to a government agency, and 39.1% to an individual (numbers sum to $>$100% because 5% of patents have multiple assignees, and 0.2% have assignees in multiple categories).

A.1.4 Identifying patents of OSRD contractors

As part of a broader data collection effort around U.S. science during World War II, I retrieved information on R&D contracts let by Office of Scientific Research and Development (OSRD), the

primary R&D contracting agency during the war, from its archival collection at the U.S. National Archives and Records Administration (NARA). A complete list of contractors was compiled from contract lists and contractor directories. These contractors were then manually matched to the harmonized assignee names, making it possible to identify patents by government R&D contractors versus non-contractors. Contractors spanned all sectors of the economy but were primarily firms and universities. Given that universities were not heavy filers of patents in this period, the vast majority of patents by OSRD contractors are by firms.[2]

A.1.5 Identifying patents with secrecy orders

Patent applications with secrecy orders were identified from the archival records of three U.S. government agencies: (i) the Office of Scientific Research and Development (OSRD), whose records yielded 4,837 serials with a secrecy order; (ii) the Office of Production Research and Development (OPRD), which yielded 2,047 serials; and (iii) the U.S. Army Office of the Judge Advocate General (JAG), which yielded 5,976 serials. These sets partly overlap, and collectively they identify a total of 8,475 patent applications which were at some point ordered secret.[3] According to other contemporary records from the JAG office, a total of 11,182 secrecy orders were issued through June 14, 1945, when the war – and the secrecy program – were winding down and few new secrecy orders were being issued. The data thus identify roughly 75% of all secrecy orders. Undermeasurement is not a significant concern, particularly because it will only tend to attenuate comparisons between patents known to have been issued a secrecy order versus those not so observed. Of these 8,475 identified serials with secrecy orders, 6,352 (75%) were eventually granted.[4]

[2]The OSRD contract and contractor data can be found at:

- "Index to Contracts, 1941-1947" in RG 227 (Records of the Office of Scientific Research and Development), located in Stack Area 130, Row 20, Compartment 11, Shelf 1, Boxes 1-5. Online catalog entry at https://catalog.archives.gov/id/6882818.
- "Contractor Lists, 1940-1946" in RG 227 (Records of the Office of Scientific Research and Development), located in Stack Area 130, Row 20, Compartment 11, Shelf 4, Boxes 1-2. Online catalog entry at https://catalog.archives.gov/id/16955595.
- "Contract Ledgers, 1941-1946" in RG 227 (Records of the Office of Scientific Research and Development), located in Stack Area 130, Row 22, Compartment 18, Shelf 2-3, Boxes 1-6. Online catalog entry at https://catalog.archives.gov/id/6920064.

[3]These counts tally serials of utility patent applications only. Design patents account for a small fraction of patenting and of secrecy orders (<100 total) and are excluded from the paper.

[4]The OSRD records which yielded data on secrecy orders can be found at:

- "D-1 Forms Used by the War Division of the Patent Office, 1942-1946" in RG 227 (Records of the Office of Scientific Research and Development), located in Stack Area 130, Row 20, Compartment 34, Shelf 3, Boxes 1-3. Online catalog entry at https://catalog.archives.gov/id/6882835.
- "Correspondence Relating to Secrecy Orders, 1942-1945" in RG 227 (Records of the Office of Scientific Research and Development), located in Stack Area 130, Row 20, Compartment 42-43, Shelf 7 and 1-3, Boxes 1-27. Online catalog entry at https://catalog.archives.gov/id/16955603.

The OPRD records which yielded data on secrecy orders can be found at:

- "Index to Patent Applications, 1945-1945" in RG 179 (Records of the War Production Board), Office of Production Research and Development, located in Stack Area 570, Row 64, Compartment 12, Shelf 4. Online catalog entry at https://catalog.archives.gov/id/567665.

The OSRD records contain two sources of data on secrecy orders: a 27-box collection of secrecy determination forms ("Form D-1"), which were used to evaluate patent applications for secrecy, and miscellaneous agency correspondence discussing the secrecy order program and patent applications affected by it. Together with wartime administrative histories of the agencies involved, the D-1 forms and internal correspondence from the OSRD records provide a rich picture of how P.L. 700 was implemented at the USPTO, and how the review process was executed.

Recall from the historical background section of the paper that when a patent application arrived at the patent office, it was assigned to an examining division, and the primary examiner for that division would forward applications he or she viewed as a candidate for a secrecy order to the Patent Office War Division (POWD), where representatives from various other agencies (namely: the Army and Navy Patent Advisory Board, the War Production Board, the OSRD, and/or the Petroleum Administration for War) would review these applications and make a recommendation for or against secrecy. For every application sent to the POWD, a D-1 form was drawn up with identifying information including the serial, filing date, title, inventor, assignee, patent attorney, patent office examining division and primary examiner, and date of receipt at the POWD (see Figures A.1 and A.2 for examples). The application was then read by the relevant reviewers, who would each sign or stamp the form with their recommendation. Often, reviewers would defer to other reviewers' judgments (typically, to the armed services). If all reviewers declined to recommend secrecy, the application would be "disapproved" (for secrecy) and sent back to Washington; if any reviewer requested secrecy, the application was issued a secrecy order.

There are approximately 24,000 D-1 forms in the OSRD records. I had these forms scanned and transcribed via double entry with verification (under which discrepancies in the transcription are manually reviewed). Given the importance of these data, and that the original print on some of these forms is hard to read, I had them transcribed via the same procedure a second time by a distinct contractor. I then personally reviewed all differences between the two transcriptions and performed numerous checks to validate the data, making corrections as needed, and sometimes even catching typographical errors on the original forms themselves (these checks include: (i) ensuring serials are consistent with filing dates, (ii) ensuring that date of receipt is after filing date, (iii) ensuring that date of review is after date of receipt (although there are a few cases where it appears the application arrived at the POWD already-recommended for secrecy), (iv) harmonizing primary examiner name spellings and ensuring that examiner names and examining divisions were paired

The JAG records which yielded data on secrecy orders can be found at:

- "Records Pertaining to Patent Applications under Secrecy Orders Tendered to the Federal Government, 1941-1945" in RG 153 (Records of the Office of the Judge Advocate General), located in Stack Area 270, Row 2, Compartment 28, Shelf 6, Boxes 1-2. Online catalog entry at https://catalog.archives.gov/id/26335074.
- "Records Relating to Patents Tendered to the Federal Government Under Secrecy Orders, 1941-1949" in RG 153 (Records of the Office of the Judge Advocate General), located in Stack Area 270, Row 2, Compartment 28, Shelf 7, Box 1. Online catalog entry at https://catalog.archives.gov/id/17396215.
- "Patent cases, 1941-1952" in RG 153 (Records of the Office of the Judge Advocate General), located in Stack Area 270, Row 2, Compartment 28, Shelf 6, Box 1. Online catalog entry at https://catalog.archives.gov/id/17382698.

in a consistent way). Although most of the contents of each form were transcribed, currently the only data being used in this paper are the serial and the recommendation.

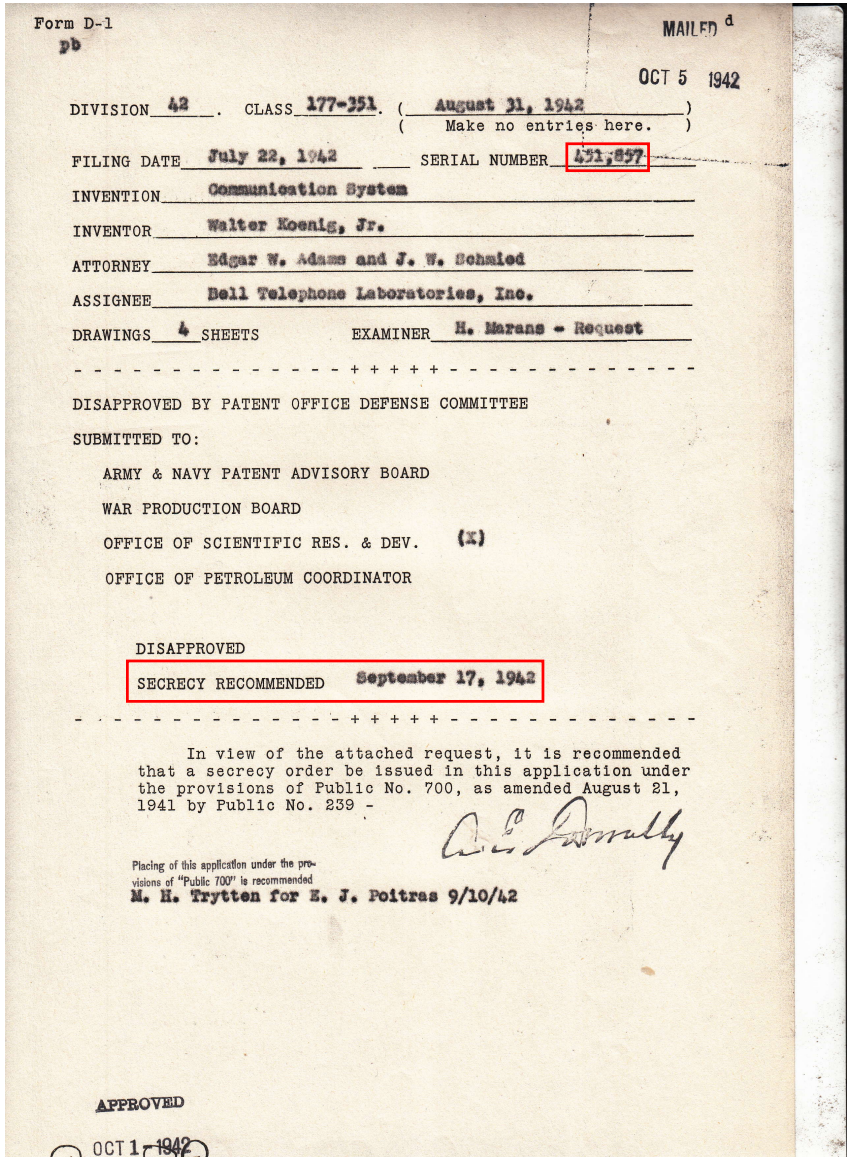
Of these $\approx 24,000$ forms, 23,690 were for utility patent applications, covering 22,549 unique serials (some patent applications were evaluated multiple times), of which 3,557 were issued a secrecy order. Given that many more secrecy orders are known to have been issued during the war than are in this record set, it does not comprise an exhaustive list of applications formally reviewed for secrecy, let alone issued a secrecy order, but knowing patents which were evaluated for secrecy but disapproved allows us to specify a more refined control group than just the set of all patents which were not secret. Presumably, the applications covered by these forms are those which were reviewed by an OSRD representative, but the precise sampling conditions are not known. Unfortunately, no additional D-1 forms could be located in other NARA collections.

In addition to these forms, OSRD agency correspondence related to secrecy orders identifies 1,484 serials with a secrecy order. Most of this correspondence consists of letters between OSRD staff members notifying about the issuance of a secrecy order. The two sets of serials overlap, however, resulting in a total of 4,837 secrecy orders identified in OSRD records.

The next source of information on secrecy orders is an eight-box set of index cards in the archived records of the Office of Production Research and Development (OPRD), an agency whose mission was to promote the development of new materials and efficient methods for war production during World War II. According to documentation in the records, one set of index cards served as an index to patent applications "on which secrecy orders were imposed by the War Production Board and its predecessor agencies during the period 1941 to August 30, 1945." A second set indexed patent applications "on which no secrecy orders were issued... after examination by the War Production Board." A total of 2,047 unique serials appear in the set with secrecy orders, and 2,021 in the set without them. For unknown reasons, 135 serials appear in both sets. These serials are presumed to have been issued a secrecy order at some point in the war.

The final source of data on secrecy orders is a set of files from the records of the U.S. Army Judge Advocate General's office (JAG), which received patent applications with secrecy orders which were tendered to the government for its use, pursuant to the statutory terms of P.L. 700. These records contain lists of tendered inventions (see Figure A.3 for an example). The records also contain extensive agency correspondence that identifies additional serials with secrecy orders. In total, the lists of tendered inventions identify 5,957 unique serials with a secrecy order, and the correspondence identifies 928 serials. As with the other agencies, the two sets of serials overlap, resulting in a total of 5,976 secrecy orders found in JAG records.

Figure A.1: Sample secrecy determinations from OSRD records with secrecy recommended



Form D-1
pb

MAILED d
OCT 5 1942

DIVISION 42 . CLASS 177-351. (August 31, 1942)
(Make no entries here.)

FILING DATE July 22, 1942 SERIAL NUMBER 431,857

INVENTION Communication System

INVENTOR Walter Koenig, Jr.

ATTORNEY Edgar W. Adams and J. W. Schmied

ASSIGNEE Bell Telephone Laboratories, Inc.

DRAWINGS 4 SHEETS EXAMINER H. Marans - Request

DISAPPROVED BY PATENT OFFICE DEFENSE COMMITTEE

SUBMITTED TO:

ARMY & NAVY PATENT ADVISORY BOARD

WAR PRODUCTION BOARD

OFFICE OF SCIENTIFIC RES. & DEV. (X)

OFFICE OF PETROLEUM COORDINATOR

DISAPPROVED

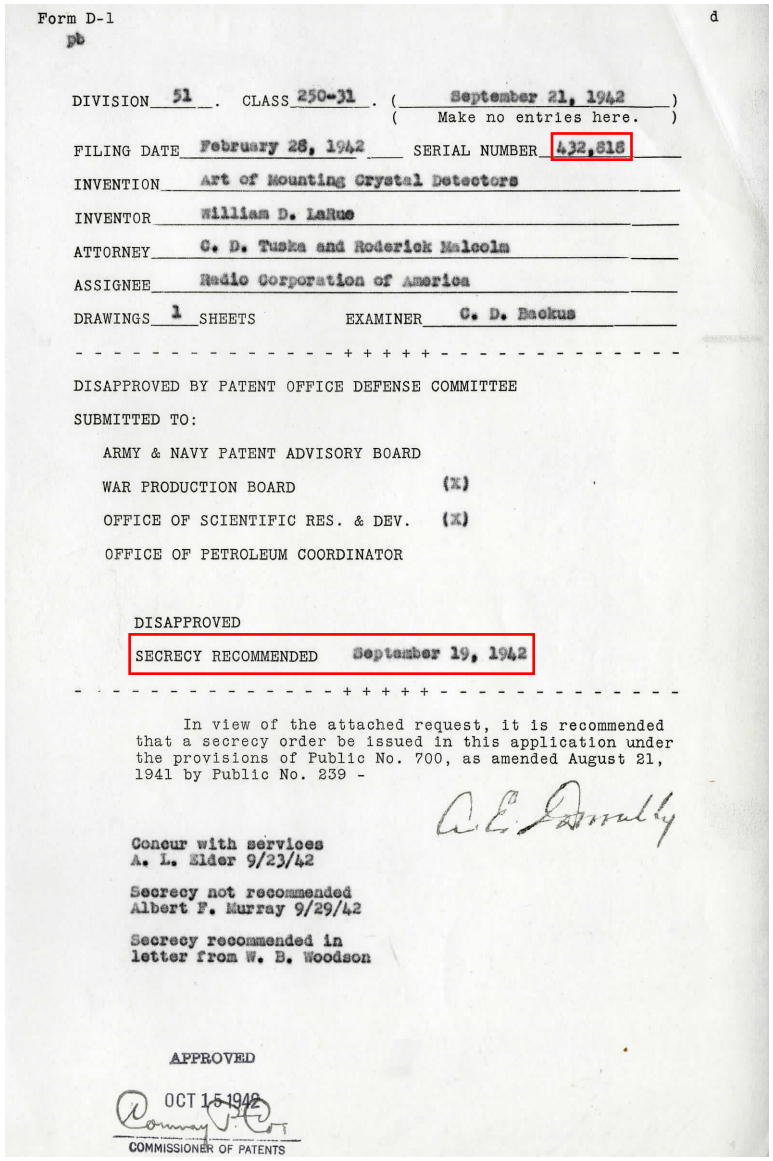
SECRECY RECOMMENDED September 17, 1942

In view of the attached request, it is recommended that a secrecy order be issued in this application under the provisions of Public No. 700, as amended August 21, 1941 by Public No. 239 -

Placing of this application under the provisions of "Public 700" is recommended
M. H. Trytten for E. J. Poitras 9/10/42

APPROVED

OCT 15 1942



Form D-1
pb

d

DIVISION 51 . CLASS 250-31 . (September 21, 1942)
(Make no entries here.)

FILING DATE February 28, 1942 SERIAL NUMBER 432,818

INVENTION Art of Mounting Crystal Detectors

INVENTOR William D. LaRue

ATTORNEY C. D. Tuska and Roderick Malcolm

ASSIGNEE Radio Corporation of America

DRAWINGS 1 SHEETS EXAMINER C. D. Backus

DISAPPROVED BY PATENT OFFICE DEFENSE COMMITTEE

SUBMITTED TO:

ARMY & NAVY PATENT ADVISORY BOARD

WAR PRODUCTION BOARD (X)

OFFICE OF SCIENTIFIC RES. & DEV. (X)

OFFICE OF PETROLEUM COORDINATOR

DISAPPROVED

SECRECY RECOMMENDED September 19, 1942

In view of the attached request, it is recommended that a secrecy order be issued in this application under the provisions of Public No. 700, as amended August 21, 1941 by Public No. 239 -

Concur with services
A. L. Elder 9/23/42

Secrecy not recommended
Albert F. Murray 9/29/42

Secrecy recommended in
letter from W. B. Woodson

APPROVED

OCT 15 1942

COMMISSIONER OF PATENTS

MAILED

AUG 13 1945

FORM D-1S Feb '44

DIVISION 54 . CLASS 315-12 . REC'D IN WAR DIV. July 16, 1945
(Examiner Leave Blank)

FILING DATE July 14, 1944 SERIAL NUMBER 544,947

INVENTION ELECTRON-OPTICAL APPARATUS

INVENTOR Christian G. Larsen

ATTORNEY Edwin H. Martin

ASSIGNEE Farnsworth Television and Radio Corporation

DRAWINGS 1 SHEETS EXAMINER O. S. Strachan

DISAPPROVED BY PATENT OFFICE WAR COMMITTEE

SUBMITTED TO ADVISORY AGENCIES

SECRECY (DISAPPROVED
(RECOMMENDED August 6, 1945

Submitted for:

A & N P A B
A
S.C.

N

O S R D

P & W

W P B

RECOMMENDATION, SIGNATURE, AGENCY & DATE
Every expert examining the indicated application must sign this form, and should indicate an express recommendation as to secrecy.

Placing of this application under the provisions of "Public 700" is recommended
J.W.Greer 7-23-45

In view of the attached request, it is recommended that a secrecy order accompanied by permit A be issued in this application under the provisions of Public No. 700, as amended.

Edward G. Haggett Jr.
Patent Office War Division

Approved, Date AUG 11 1945

Conder C Fleury
Assistant Commissioner of Patents

Form D-1
ebf

COPY

MAILED d

JAN 12 1944

DIVISION 20 . CLASS 154-43 . (December 3, 1943)
(Make no entries here.)

FILING DATE December 14, 1942 SERIAL NUMBER 468,993

INVENTION IMPACT RESISTANT PLASTIC PRODUCT

INVENTOR Edwin R. Laning

ATTORNEY Albert Sperry

ASSIGNEE Joseph Stokes Rubber Co., Inc.,

DRAWINGS 1 SHEETS EXAMINER L. M. Brown

DISAPPROVED BY PATENT OFFICE DEFENSE COMMITTEE

SUBMITTED TO:

ARMY & NAVY PATENT ADVISORY BOARD X

WAR PRODUCTION BOARD X

OFFICE OF SCIENTIFIC RES. & DEV. X

OFFICE OF PETROLEUM COORDINATOR

DISAPPROVED

SECRECY RECOMMENDED December 21, 1943

In view of the attached request, it is recommended that a secrecy order be issued in this application under the provisions of Public No. 700, as amended August 21, 1941 by Public No. 239, and June 16, 1942 by Public No. 609.

C. E. Connally

Concur with services
D. Z. Beckler 12-7-43
J. P. Wilkins 12-8-43

Placing of this application under the provision of "Public 700" is recommended

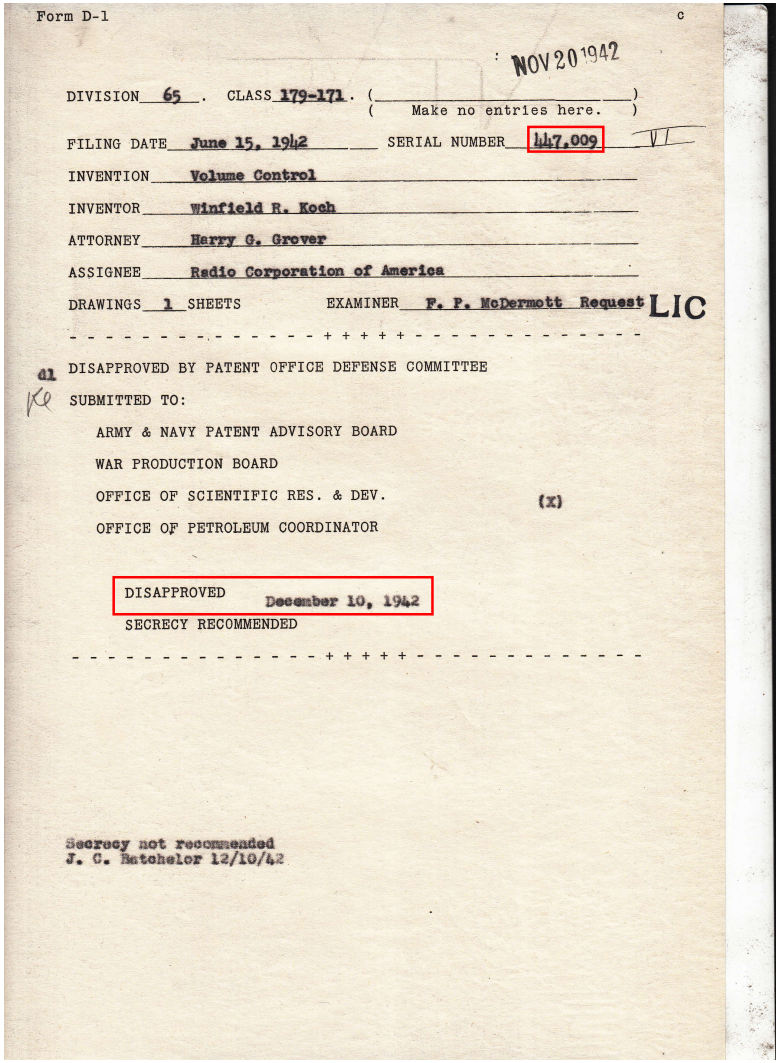
L. T. Phelan 12-13-43

Secrecy recommended in letter from
J. H. Byers 12-21-43
for F. E. Bailey

Secrecy not recommended
H. P. Grace Q.M.C.

APPROVED
JAN 11 1944
Conway P. Coe
COMMISSIONER OF PATENTS

Figure A.2: Sample secrecy determinations from OSRD records, with secrecy disapproved



Form D-1 c

NOV 20 1942

DIVISION 65 . CLASS 179-171 . ( )
(Make no entries here.)

FILING DATE June 15, 1942 SERIAL NUMBER 447,009 VI

INVENTION Volume Control

INVENTOR Winfield R. Koch

ATTORNEY Herry G. Grover

ASSIGNEE Radio Corporation of America

DRAWINGS 1 SHEETS EXAMINER F. P. McDermott Request LIC

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dl DISAPPROVED BY PATENT OFFICE DEFENSE COMMITTEE

KO SUBMITTED TO:

ARMY & NAVY PATENT ADVISORY BOARD

WAR PRODUCTION BOARD

OFFICE OF SCIENTIFIC RES. & DEV. (X)

OFFICE OF PETROLEUM COORDINATOR

DISAPPROVED December 10, 1942

SECRECY RECOMMENDED

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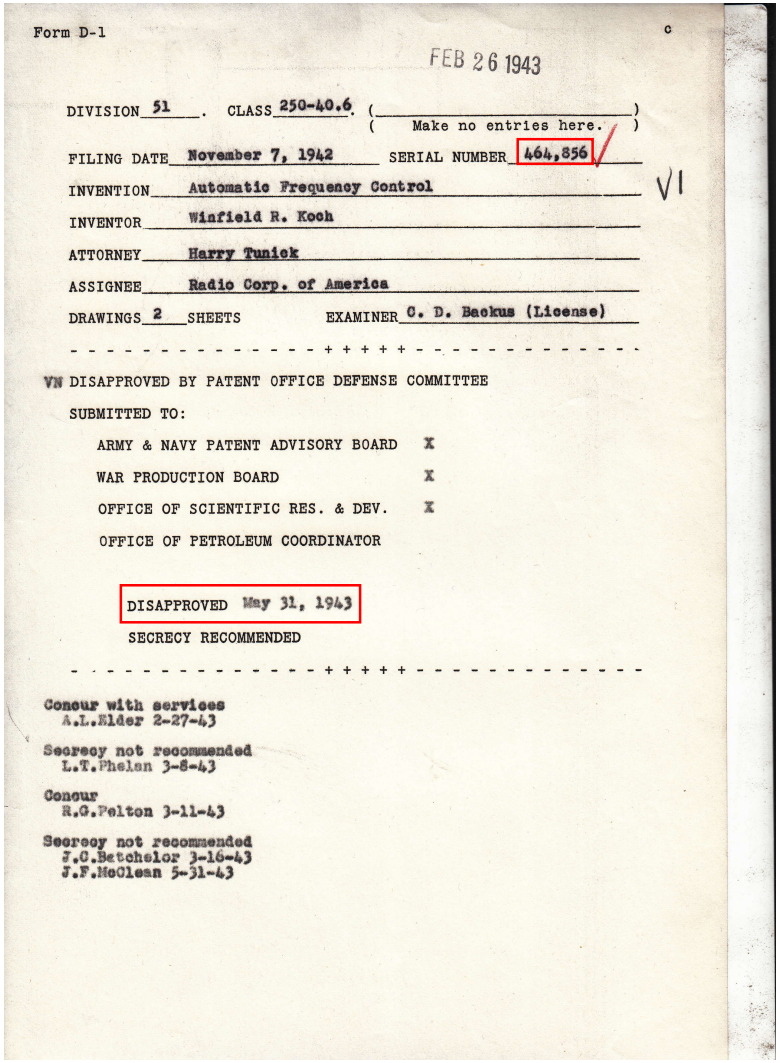
Secrecy not recommended
J. C. Batchelor 12/10/42



Form D-1 c

FEB 26 1943

DIVISION 51 . CLASS 250-40.6 . ( )
(Make no entries here.)

FILING DATE November 7, 1942 SERIAL NUMBER 464,856 VI

INVENTION Automatic Frequency Control

INVENTOR Winfield R. Koch

ATTORNEY Harry Tunick

ASSIGNEE Radio Corp. of America

DRAWINGS 2 SHEETS EXAMINER C. D. Backus (License)

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VN DISAPPROVED BY PATENT OFFICE DEFENSE COMMITTEE

SUBMITTED TO:

ARMY & NAVY PATENT ADVISORY BOARD X

WAR PRODUCTION BOARD X

OFFICE OF SCIENTIFIC RES. & DEV. X

OFFICE OF PETROLEUM COORDINATOR

DISAPPROVED May 31, 1943

SECRECY RECOMMENDED

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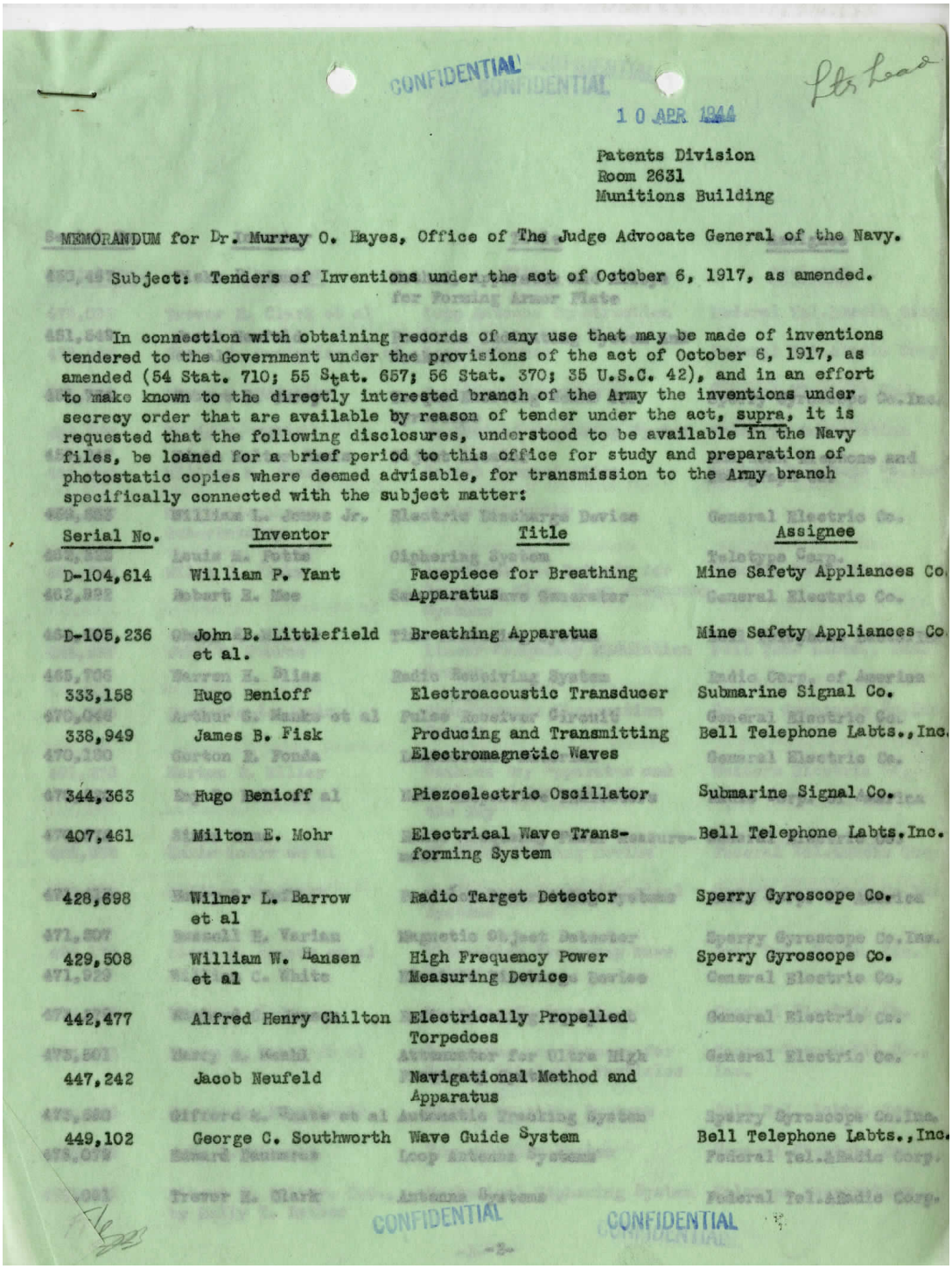
Concur with services
A.L.Elder 2-27-43

Secrecy not recommended
L.T.Phelan 3-8-43

Concur
R.G.Pelton 3-11-43

Secrecy not recommended
J.C.Batchelor 3-16-43
J.F.McClean 5-31-43

Figure A.3: Sample page from lists of tendered inventions in JAG records



CONFIDENTIAL

10 APR 1944

Patents Division
Room 2631
Munitions Building

MEMORANDUM for Dr. Murray O. Hayes, Office of The Judge Advocate General of the Navy.

Subject: Tenders of Inventions under the act of October 6, 1917, as amended.

In connection with obtaining records of any use that may be made of inventions tendered to the Government under the provisions of the act of October 6, 1917, as amended (54 Stat. 710; 55 Stat. 657; 56 Stat. 370; 35 U.S.C. 42), and in an effort to make known to the directly interested branch of the Army the inventions under secrecy order that are available by reason of tender under the act, supra, it is requested that the following disclosures, understood to be available in the Navy files, be loaned for a brief period to this office for study and preparation of photostatic copies where deemed advisable, for transmission to the Army branch specifically connected with the subject matter:

Serial No.	Inventor	Title	Assignee
D-104,614	William P. Yant	Facepiece for Breathing Apparatus	Mine Safety Appliances Co.
D-105,236	John B. Littlefield et al.	Breathing Apparatus	Mine Safety Appliances Co.
333,158	Hugo Benioff	Electroacoustic Transducer	Submarine Signal Co.
338,949	James B. Fisk	Producing and Transmitting Electromagnetic Waves	Bell Telephone Labts., Inc.
344,363	Hugo Benioff	Piezoelectric Oscillator	Submarine Signal Co.
407,461	Milton E. Mohr	Electrical Wave Transforming System	Bell Telephone Labts. Inc.
428,698	Wilmer L. Barrow et al	Radio Target Detector	Sperry Gyroscope Co.
429,508	William W. Hansen et al	High Frequency Power Measuring Device	Sperry Gyroscope Co.
442,477	Alfred Henry Chilton	Electrically Propelled Torpedoes	
447,242	Jacob Neufeld	Navigational Method and Apparatus	
449,102	George C. Southworth	Wave Guide System	Bell Telephone Labts., Inc.

CONFIDENTIAL CONFIDENTIAL

A.2 Textual analysis: new words in patent titles

The text-based analysis in this paper requires additional data on patents' content. For the pre-1976 period, patent text is not available in a clean, USPTO-issued machine-readable format. Google Patents makes available OCR full text for historical patents, but the quality of the character recognition is less than great and generally declines going further back in time, due to older documents and lower-quality typesetting, which increases the OCR error rate. Other data sources, including Derwent Innovation, also provide the full text of pre-1976 patents, but with the same limitations. To minimize concerns about how the OCR quality and spelling errors may influence the results of the paper, particularly given the focus on identifying and measuring the subsequent use of new words in the patent record, I therefore seek out a cleaner source of data.

Google also makes available, via the Google Cloud Platform and its BigQuery web service, additional textual and text-based patent data. I used this service to retrieve titles (which are cleanly transcribed) and top terms (according to Google, "the top 10 salient terms extracted from the patent's title, abstract, claims, and description) of patents granted from 1920-1979. For each patent, Google also provides a 64-element machine-learned component vector which can be used to compute pairwise similarity measures (according to Google: this component vector is "based on document contents and metadata, where two documents that have similar technical content have a high dot product score of their embedding vectors" and "trained on full text bag of words to predict CPCs using the WSABIE classification model" – in other words, a model designed to predict each patent's classification from its content and metadata). I take these vectors off-the-shelf and use them to calculate the measure of similarity invoked at the end of Section 4.[5]

New words (more specifically, new stems) are identified from patent titles as follows. After loading the patent titles, I remove numeric tokens, punctuation, and special characters. I then tokenize the remaining text in the title, splitting it into a list of constituent "words". I then loop over this list and drop (i) words which match a set of stop words, (ii) words with < 4 or > 25 characters, and (iii) words with a numeric character.[6] The remaining words are then stemmed by the NLTK toolkit and reduced to a set of unique stems for each patent. To restrict our focus to stems which are neither exceedingly common nor vanishingly rare, and to minimize the computational burden of the remaining steps, I further reduce these stems to those (i) used by at least 5 patents but no more than 20% of patents in the complete 1920-1979 sample, and (ii) used by at least one patent filed between 1940 and 1945, since the stems of interest will be from this set.

After reshaping the data to patent-stem pairs, the next step is to identify stems which were *first* used in a patent filed between 1940 and 1945 – that is, stems which are ostensibly new to the patent

[5] Patent titles are from the BigQuery *Patents* dataset (patents-public-data → patents → publications → title_localized; see https://console.cloud.google.com/bigquery?p=patents-public-data&d=patents&t=publications), and top terms and component vectors from the *Google Patents Research* dataset (patents-public-data → google_patents_research → publications → top_terms, embedding_v1; see https://console.cloud.google.com/bigquery?p=patents-public-data&d=google_patents_research&t=publications)

[6] Stop words used in this step are a combination of off-the-shelf stop words from the NLTK toolkit for Python, stop words from Iaria et al. (2018), and stop words from Younge and Kuhn (2016).

record when they are used in the title of a patent filed in the early 1940s. The 1920 to 1939 period is used to define a stock of "existing" stems; this interval is considered sufficient for constructing an existing stock of words, since it includes nearly one million patents and covers the 20+ most recent years of invention. The final step is to then reduce the data to stems which were first used in a patent filed in the 1940 to 1945 period. The empirical output from this procedure is a dataset of these stems and the patents using them between 1940 and 1979.

Table A.2 lists the most-heavily used new stems from the 1940 to 1945 period, highlighting in red those which were first appeared in the title of a secret patent, and in light red those which ever appeared in a secret patent. The term *semiconductor* entered the patent record during this period, as did *radar*, *ultrasonic*, *monomer* and *elastomer*, and *antibiotics* and *penicillin*. As this table demonstrates, the stemming procedure is also imperfect, as both "elastom" and "elastomer" enter this table, the former likely stemmed from "elastomer" itself, and the latter from words like "elastomerization". There is no perfect solution to this problem, as iterative stemming will often reduce words down to unrecognizable objects and cause unrelated words to get binned together into the same stem of stems. I thus limit the text cleaning procedure to one round of stemming, so that similar words (e.g., singular and plural variants of a noun) will be grouped into a common stem, at the same time recognizing the limitations of the methods.

Table A.2: Most heavily used new stems in patent titles, 1940-1945

	Stem	Subseq. uses (1940-1979)		Stem	Subseq. uses (1940-1979)
1.	semiconductor	6935	9.	antibiot	940
2.	disc	3260	10.	phosphon	894
3.	radar	2255	11.	elastomer	848
4.	ultrason	2017	12.	curabl	810
5.	monom	1366	13.	cryogen	771
6.	elastom	1237	14.	readout	672
7.	waveguid	1160	15.	penicillin	627
8.	electrophotograph	1158	16.	recognit	601

Notes: Red = Stem *first* used in title of secret patent. Light red = Stem *ever* used in title of secret patent.

This same procedure was repeated for patents' top terms, as well as for the union of titles and top terms. Although my focus in the paper is on titles only, the results throughout Sections 4 and 5 are similar when the analysis is based on these top terms. (The analysis was not repeated for the union of titles and top terms; because they each measure distinct features of patents, their union is a strange object and was not considered suitable for analysis.)

Other textual data sources

In addition to looking for these words in the patent record, the paper also studies two other corpora: Du Pont product catalogs, and the Google Books N-gram database.

The Du Pont Products Index (DPPI) was a Du Pont product catalog published at regular intervals, and is used to look for focal chemical terms in Du Pont literature as a proxy for the product market. The 1938 edition of the DPPI is available online from Hathitrust, and working with the Hagley Museum in Wilmington, Delaware, which houses the Du Pont archival collection, I had four other editions of the DPPI digitized: 1944, 1946, 1949, and 1955-56, all of which are now available as well. These catalogs were then converted to text using ABBYY FineReader 14, which is subject to similar limitations as the OCR of historical patents previously discussed, although the OCR quality is higher because the scans are higher-resolution and the source documents have cleaner typesetting. The implications of using OCRed text for this part of the paper, and some robustness checks explored in light of these issues, are discussed in the paper.[7]

As explained in the paper, I make use of the Google Books N-gram data, which are freely available for download, to measure the use of focal technical words in the broader public discourse.[8] These data provide annual usage of unique N-grams in the Google Books corpus. This paper uses the data on 1-grams (i.e., words), matching words from patent titles to words in this set (specifically, I identify all words in patent titles whose stem entered the patent record in a patent filed between 1940 and 1945, link these to words in the N-grams data, and measure their use by year, in levels and as a fraction of all words in the Google Books corpus in the given year).

[7] For the 1938 volume, see https://catalog.hathitrust.org/Record/001042925; for the 1944, 1946, 1949, and 1955-56 volumes, see https://digital.hagley.org/islandora/search/%22Du%20Pont%20Products%20Index%22?type=edismax&f%5B0%5D=-RELS_EXT_isMemberOfCollection_uri_ms%3A%28%22info%3Afedora/islandora%3Aead%22%29.

[8] Data and documentation available at http://storage.googleapis.com/books/ngrams/books/datasetsv2.html.

B Historical Appendix

This appendix provides supplementary material to accompany the discussion of the secrecy order program in Section 1 of the paper. Figure B.1 shows the text of Public Law 700, enacted July 1, 1940, which authorized the USPTO to issue secrecy orders. Figures B.2 to B.4 show examples of secrecy order notification letters mailed to inventors. Figure B.5 shows an announcement of the General Rescinding Order printed in the USPTO Official Gazette (the USPTO's weekly newsletter, accessible by subscription) on September 18, 1945.

Figure B.1: Public Law 700

[CHAPTER 501]

July 1, 1940
[H. R. 10058]
[Public, No. 700]

AN ACT

To amend the Act relating to preventing the publication of inventions in the national interest, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of Congress approved October 6, 1917 (40 Stat. 394, ch. 95, U. S. C., title 35, sec. 42), be amended to read as follows:

Withholding of patents in national interest.

"Whenever the publication or disclosure of an invention by the granting of a patent might, in the opinion of the Commissioner of Patents, be detrimental to the public safety or defense he may order that the invention be kept secret and withhold the grant of a patent for such period or periods as in his opinion the national interest requires: *Provided*, That the invention disclosed in the application for said patent may be held abandoned upon it being established before or by the Commissioner that in violation of said order said invention has been published or disclosed or that an application for a patent therefor has been filed in a foreign country by the inventor or his assigns or legal representatives, without the consent or approval of the Commissioner of Patents.

Proviso. Deemed abandoned if published, etc.

Right of patentee to sue for compensation.

"When an applicant whose patent is withheld as herein provided and who faithfully obeys the order of the Commissioner of Patents above referred to shall tender his invention to the Government of the United States for its use, he shall, if and when he ultimately receives a patent, have the right to sue for compensation in the Court of Claims, such right to compensation to begin from the date of the use of the invention by the Government: *Provided*, That the Secretary of War or the Secretary of the Navy or the chief officer of any established defense agency of the United States, as the case may be, is authorized to enter into an agreement with the said applicant in full settlement and compromise for the damage accruing to him by reason of the order of secrecy, and for the use of the invention by the Government."

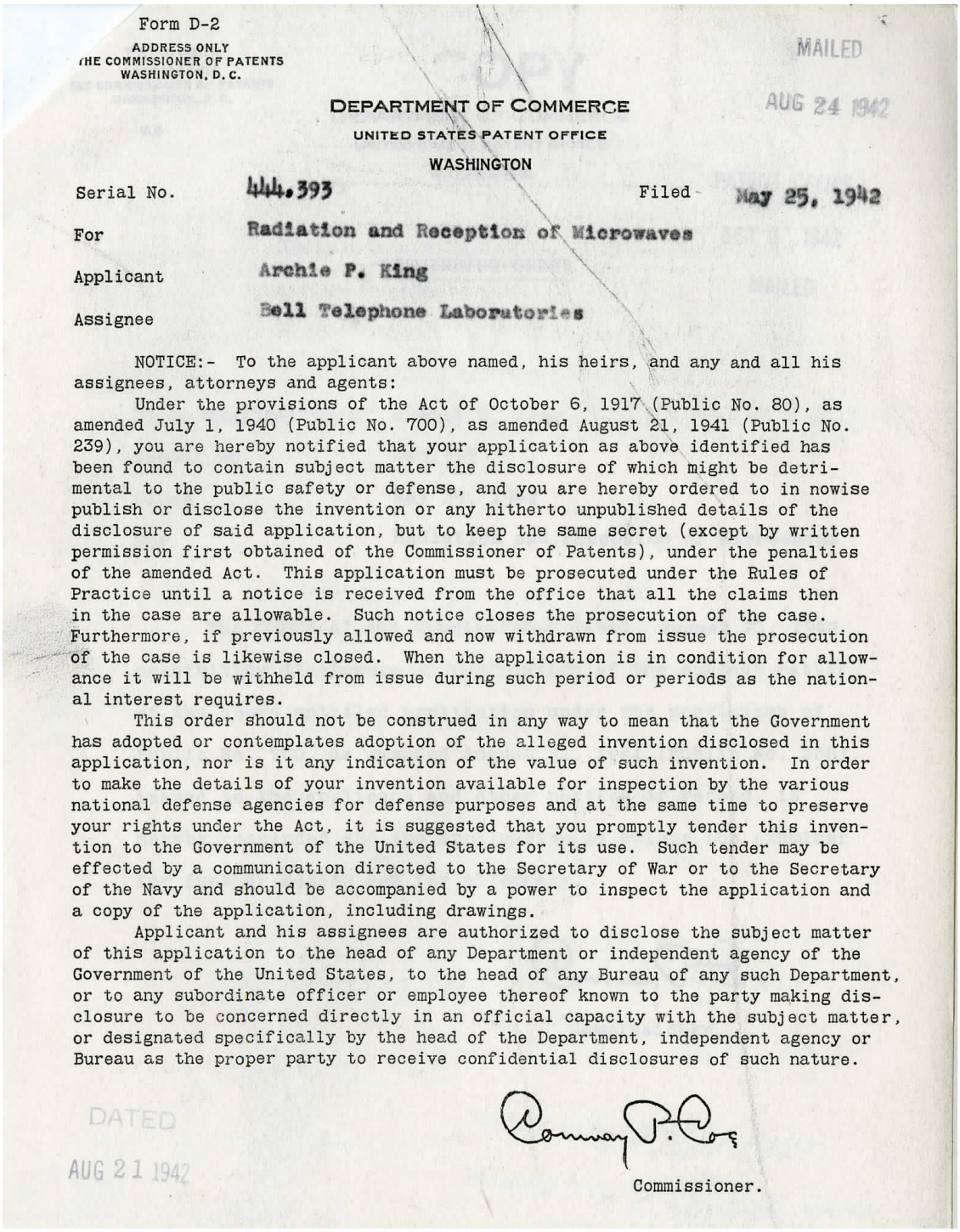
Proviso. Settlement with applicant for damage, etc.

Effective date; period in force.

SEC. 2. This Act shall take effect on approval and shall remain in force for a period of two years from such date.

Approved, July 1, 1940.

Figure B.2: Example Secrecy Order: Bell Labs



Form D-2

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

MAILED

AUG 24 1942

DEPARTMENT OF COMMERCE

UNITED STATES PATENT OFFICE

WASHINGTON

Serial No. 444,393 Filed May 25, 1942

For Radiation and Reception of Microwaves

Applicant Archie P. King

Assignee Bell Telephone Laboratories

NOTICE:- To the applicant above named, his heirs, and any and all his assignees, attorneys and agents:

Under the provisions of the Act of October 6, 1917 (Public No. 80), as amended July 1, 1940 (Public No. 700), as amended August 21, 1941 (Public No. 239), you are hereby notified that your application as above identified has been found to contain subject matter the disclosure of which might be detrimental to the public safety or defense, and you are hereby ordered to in nowise publish or disclose the invention or any hitherto unpublished details of the disclosure of said application, but to keep the same secret (except by written permission first obtained of the Commissioner of Patents), under the penalties of the amended Act. This application must be prosecuted under the Rules of Practice until a notice is received from the office that all the claims then in the case are allowable. Such notice closes the prosecution of the case. Furthermore, if previously allowed and now withdrawn from issue the prosecution of the case is likewise closed. When the application is in condition for allowance it will be withheld from issue during such period or periods as the national interest requires.

This order should not be construed in any way to mean that the Government has adopted or contemplates adoption of the alleged invention disclosed in this application, nor is it any indication of the value of such invention. In order to make the details of your invention available for inspection by the various national defense agencies for defense purposes and at the same time to preserve your rights under the Act, it is suggested that you promptly tender this invention to the Government of the United States for its use. Such tender may be effected by a communication directed to the Secretary of War or to the Secretary of the Navy and should be accompanied by a power to inspect the application and a copy of the application, including drawings.

Applicant and his assignees are authorized to disclose the subject matter of this application to the head of any Department or independent agency of the Government of the United States, to the head of any Bureau of any such Department, or to any subordinate officer or employee thereof known to the party making disclosure to be concerned directly in an official capacity with the subject matter, or designated specifically by the head of the Department, independent agency or Bureau as the proper party to receive confidential disclosures of such nature.

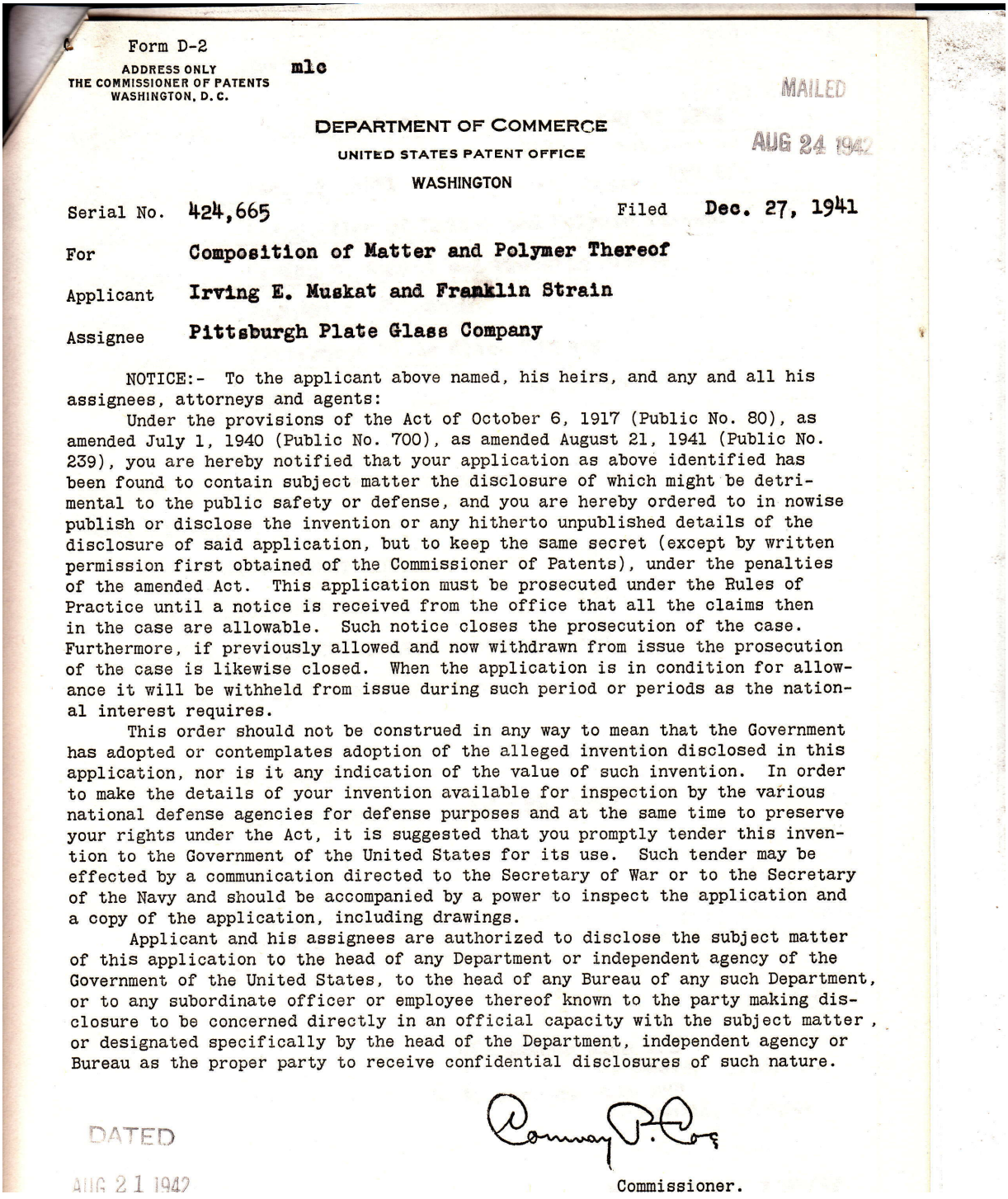
DATED

AUG 21 1942

Conway P. Coe

Commissioner.

Figure B.3: Example Secrecy Order: Pittsburgh Plate Glass Co.



Form D-2

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

mlc

MAILED

AUG 24 1942

DEPARTMENT OF COMMERCE

UNITED STATES PATENT OFFICE

WASHINGTON

Serial No. 424,665 Filed Dec. 27, 1941

For Composition of Matter and Polymer Thereof

Applicant Irving E. Muskat and Franklin Strain

Assignee Pittsburgh Plate Glass Company

NOTICE:- To the applicant above named, his heirs, and any and all his assignees, attorneys and agents:

Under the provisions of the Act of October 6, 1917 (Public No. 80), as amended July 1, 1940 (Public No. 700), as amended August 21, 1941 (Public No. 239), you are hereby notified that your application as above identified has been found to contain subject matter the disclosure of which might be detrimental to the public safety or defense, and you are hereby ordered to in nowise publish or disclose the invention or any hitherto unpublished details of the disclosure of said application, but to keep the same secret (except by written permission first obtained of the Commissioner of Patents), under the penalties of the amended Act. This application must be prosecuted under the Rules of Practice until a notice is received from the office that all the claims then in the case are allowable. Such notice closes the prosecution of the case. Furthermore, if previously allowed and now withdrawn from issue the prosecution of the case is likewise closed. When the application is in condition for allowance it will be withheld from issue during such period or periods as the national interest requires.

This order should not be construed in any way to mean that the Government has adopted or contemplates adoption of the alleged invention disclosed in this application, nor is it any indication of the value of such invention. In order to make the details of your invention available for inspection by the various national defense agencies for defense purposes and at the same time to preserve your rights under the Act, it is suggested that you promptly tender this invention to the Government of the United States for its use. Such tender may be effected by a communication directed to the Secretary of War or to the Secretary of the Navy and should be accompanied by a power to inspect the application and a copy of the application, including drawings.

Applicant and his assignees are authorized to disclose the subject matter of this application to the head of any Department or independent agency of the Government of the United States, to the head of any Bureau of any such Department, or to any subordinate officer or employee thereof known to the party making disclosure to be concerned directly in an official capacity with the subject matter, or designated specifically by the head of the Department, independent agency or Bureau as the proper party to receive confidential disclosures of such nature.

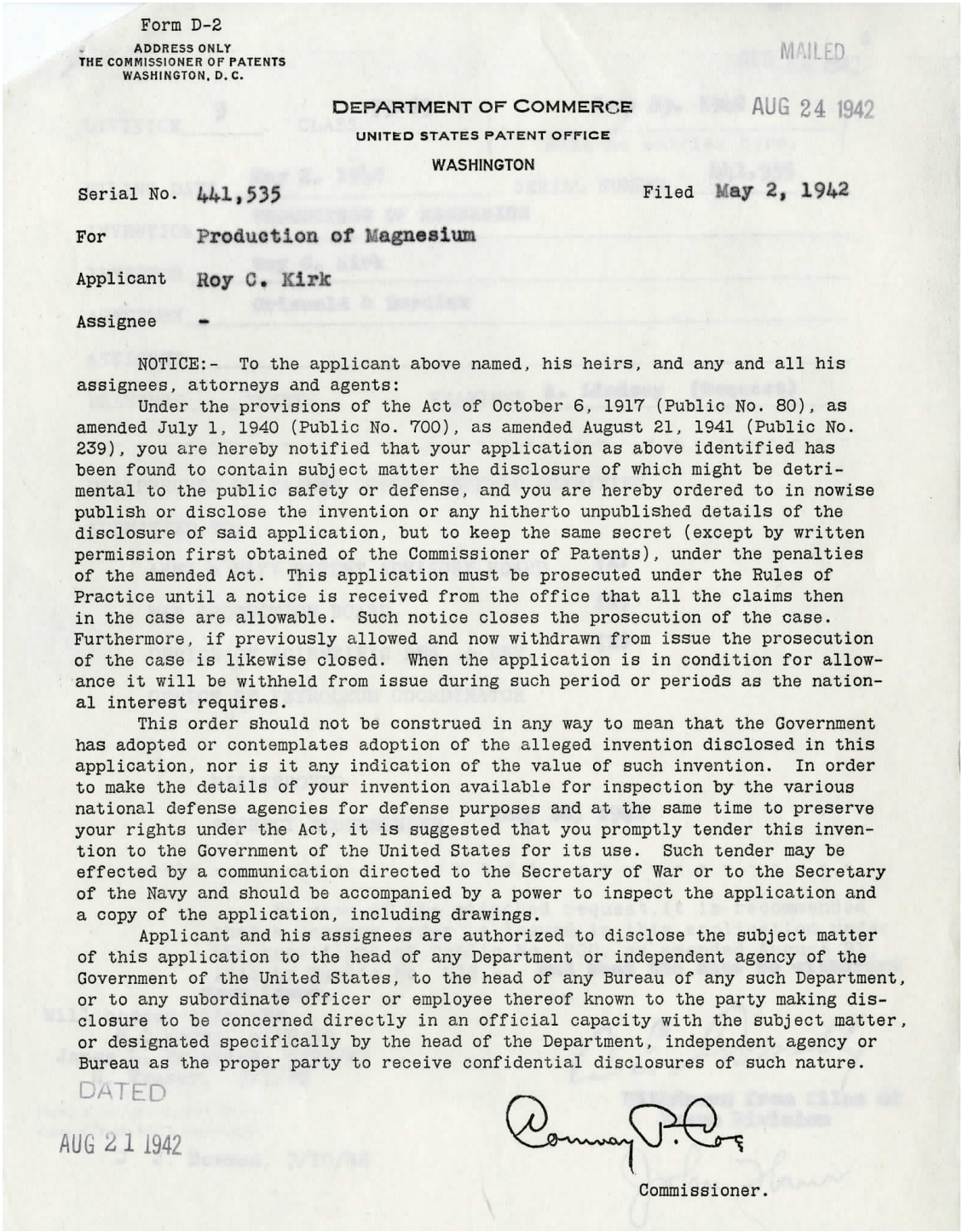
DATED

AUG 21 1942

Conway P. Coe

Commissioner.

Figure B.4: Example Secrecy Order: Individual



Form D-2

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C.

MAILED

AUG 24 1942

DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE
WASHINGTON

Serial No. 441,535 Filed May 2, 1942

For Production of Magnesium

Applicant Roy C. Kirk

Assignee -

NOTICE:- To the applicant above named, his heirs, and any and all his assignees, attorneys and agents:

Under the provisions of the Act of October 6, 1917 (Public No. 80), as amended July 1, 1940 (Public No. 700), as amended August 21, 1941 (Public No. 239), you are hereby notified that your application as above identified has been found to contain subject matter the disclosure of which might be detrimental to the public safety or defense, and you are hereby ordered to in nowise publish or disclose the invention or any hitherto unpublished details of the disclosure of said application, but to keep the same secret (except by written permission first obtained of the Commissioner of Patents), under the penalties of the amended Act. This application must be prosecuted under the Rules of Practice until a notice is received from the office that all the claims then in the case are allowable. Such notice closes the prosecution of the case. Furthermore, if previously allowed and now withdrawn from issue the prosecution of the case is likewise closed. When the application is in condition for allowance it will be withheld from issue during such period or periods as the national interest requires.

This order should not be construed in any way to mean that the Government has adopted or contemplates adoption of the alleged invention disclosed in this application, nor is it any indication of the value of such invention. In order to make the details of your invention available for inspection by the various national defense agencies for defense purposes and at the same time to preserve your rights under the Act, it is suggested that you promptly tender this invention to the Government of the United States for its use. Such tender may be effected by a communication directed to the Secretary of War or to the Secretary of the Navy and should be accompanied by a power to inspect the application and a copy of the application, including drawings.

Applicant and his assignees are authorized to disclose the subject matter of this application to the head of any Department or independent agency of the Government of the United States, to the head of any Bureau of any such Department, or to any subordinate officer or employee thereof known to the party making disclosure to be concerned directly in an official capacity with the subject matter, or designated specifically by the head of the Department, independent agency or Bureau as the proper party to receive confidential disclosures of such nature.

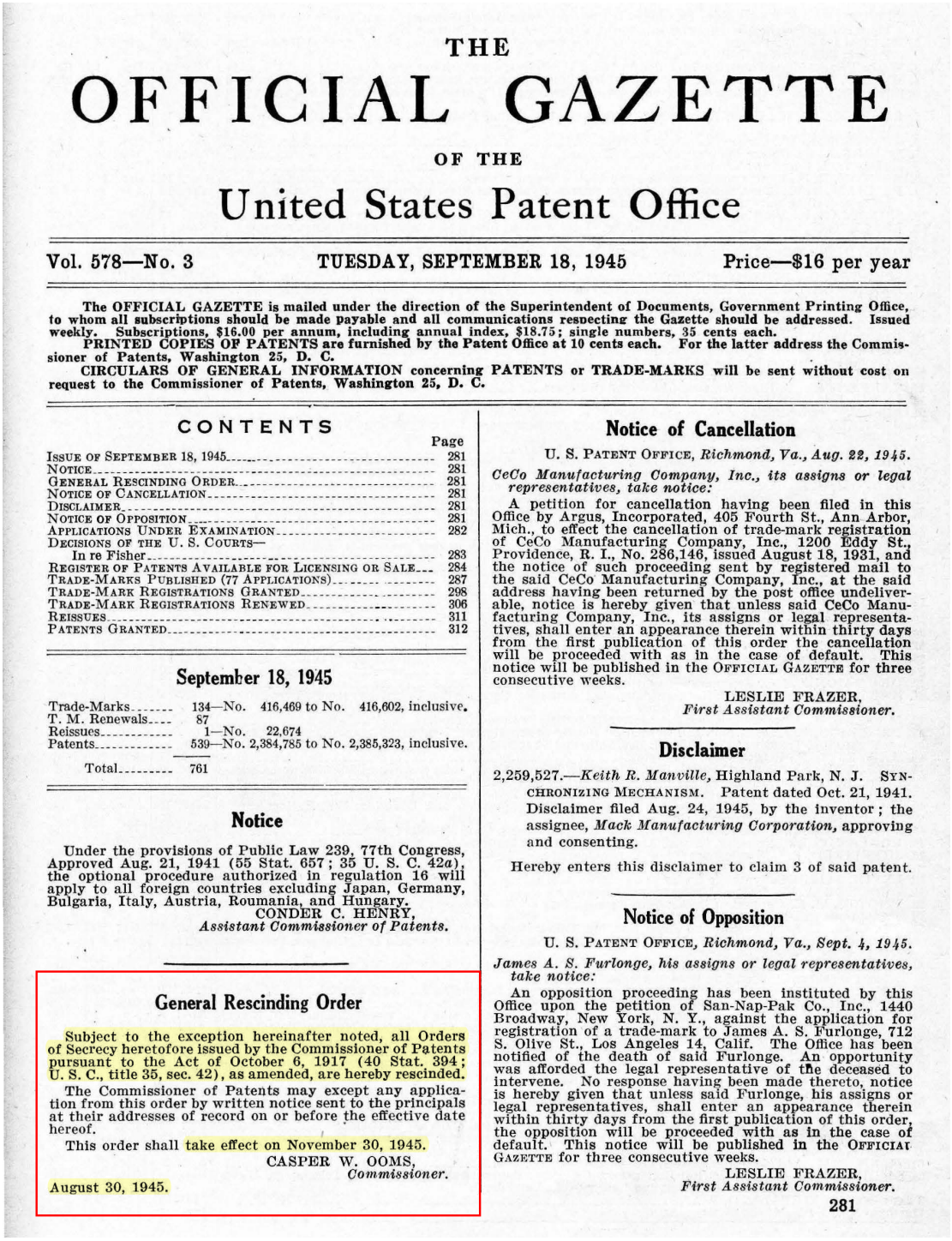
DATED

AUG 21 1942

Conway P. Coe

Commissioner.

Figure B.5: Notice of General Rescinding Order in USPTO Official Gazette



THE

OFFICIAL GAZETTE

OF THE

United States Patent Office

Vol. 578—No. 3 TUESDAY, SEPTEMBER 18, 1945 Price—$16 per year

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CIRCULARS OF GENERAL INFORMATION concerning PATENTS or TRADE-MARKS will be sent without cost on request to the Commissioner of Patents, Washington 25, D. C.

CONTENTS

September 18, 1945

Trade-Marks	134	No. 416,469 to No. 416,602, inclusive.
T. M. Renewals	87	
Reissues	1	No. 22,674
Patents	539	No. 2,384,785 to No. 2,385,323, inclusive.
Total	761	

Notice

Under the provisions of Public Law 239, 77th Congress, Approved Aug. 21, 1941 (55 Stat. 657; 35 U. S. C. 42*a*), the optional procedure authorized in regulation 16 will apply to all foreign countries excluding Japan, Germany, Bulgaria, Italy, Austria, Roumania, and Hungary.

CONDER C. HENRY,
Assistant Commissioner of Patents.

General Rescinding Order

Subject to the exception hereinafter noted, all Orders of Secrecy heretofore issued by the Commissioner of Patents pursuant to the Act of October 6, 1917 (40 Stat. 394; U. S. C., title 35, sec. 42), as amended, are hereby rescinded.

The Commissioner of Patents may except any application from this order by written notice sent to the principals at their addresses of record on or before the effective date hereof.

This order shall take effect on November 30, 1945.

CASPER W. OOMS,
Commissioner.

August 30, 1945.

Notice of Cancellation

U. S. PATENT OFFICE, *Richmond, Va., Aug. 22, 1945.*

CeCo Manufacturing Company, Inc., its assigns or legal representatives, take notice:

A petition for cancellation having been filed in this Office by Argus, Incorporated, 405 Fourth St., Ann Arbor, Mich., to effect the cancellation of trade-mark registration of CeCo Manufacturing Company, Inc., 1200 Eddy St., Providence, R. I., No. 286,146, issued August 18, 1931, and the notice of such proceeding sent by registered mail to the said CeCo Manufacturing Company, Inc., at the said address having been returned by the post office undeliverable, notice is hereby given that unless said CeCo Manufacturing Company, Inc., its assigns or legal representatives, shall enter an appearance therein within thirty days from the first publication of this order the cancellation will be proceeded with as in the case of default. This notice will be published in the OFFICIAL GAZETTE for three consecutive weeks.

LESLIE FRAZER,
First Assistant Commissioner.

Disclaimer

2,259,527.—*Keith R. Manville,* Highland Park, N. J. SYNCHRONIZING MECHANISM. Patent dated Oct. 21, 1941. Disclaimer filed Aug. 24, 1945, by the inventor; the assignee, *Mack Manufacturing Corporation,* approving and consenting.

Hereby enters this disclaimer to claim 3 of said patent.

Notice of Opposition

U. S. PATENT OFFICE, *Richmond, Va., Sept. 4, 1945.*

James A. S. Furlonge, his assigns or legal representatives, take notice:

An opposition proceeding has been instituted by this Office upon the petition of San-Nap-Pak Co., Inc., 1440 Broadway, New York, N. Y., against the application for registration of a trade-mark to James A. S. Furlonge, 712 S. Olive St., Los Angeles 14, Calif. The Office has been notified of the death of said Furlonge. An opportunity was afforded the legal representative of the deceased to intervene. No response having been made thereto, notice is hereby given that unless said Furlonge, his assigns or legal representatives, shall enter an appearance therein within thirty days from the first publication of this order, the opposition will be proceeded with as in the case of default. This notice will be published in the OFFICIAL GAZETTE for three consecutive weeks.

LESLIE FRAZER,
First Assistant Commissioner.

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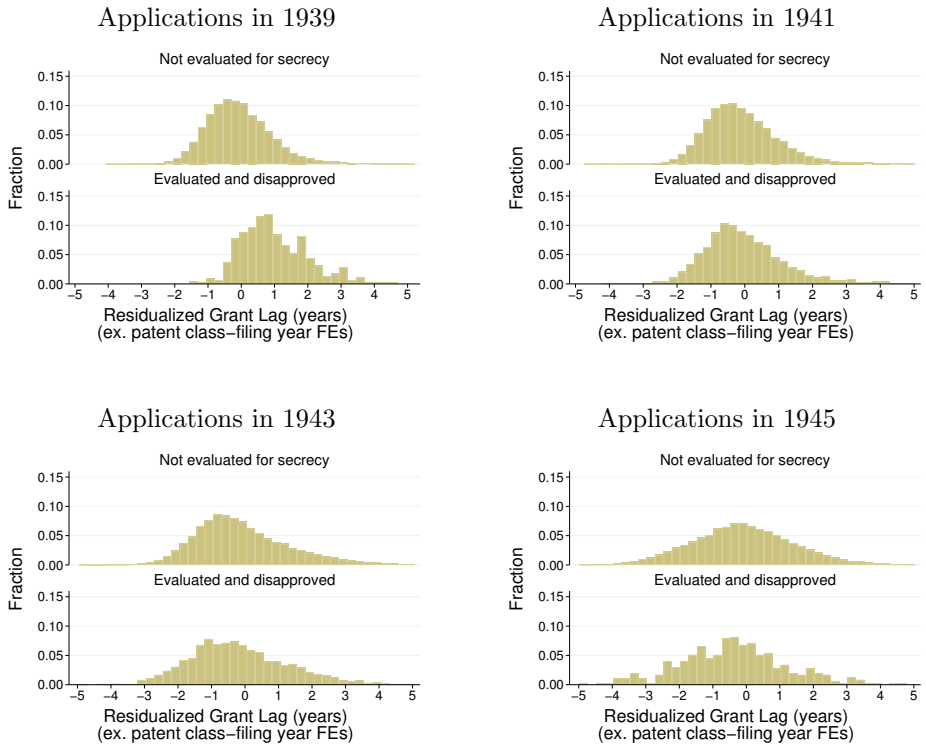
C Additional Descriptives

This appendix section provides descriptive results which supplement those in the paper.

Figure C.1 provides a counterpart to Figure 3 in the paper, comparing the grant lags of (i) patents formally evaluated for secrecy but not ordered secret, versus (ii) those not evaluated for secrecy. The figure shows little difference in grant lags as a result of simply being *evaluated* for secrecy (note that 1939 filings are included in this figure for completeness, because many were evaluated for secrecy, but a necessary condition was that they were still pending as of July 1940 – such that this set is selected on longer pendency). Recall, on the other hand, that Figure 3 compared the grant lags of secret versus non-secret patents, and showed that secret patents on average took longer to issue than their non-secret counterparts in the same class and filing year, with the difference diminishing over time. The results suggest that it was secrecy orders – rather than secrecy evaluations – which were the cause of the time-varying delays in patent grant and publication.

Figure C.1: Grant lags of non-secret applications evaluated for secrecy, vs. others, 1939-1945



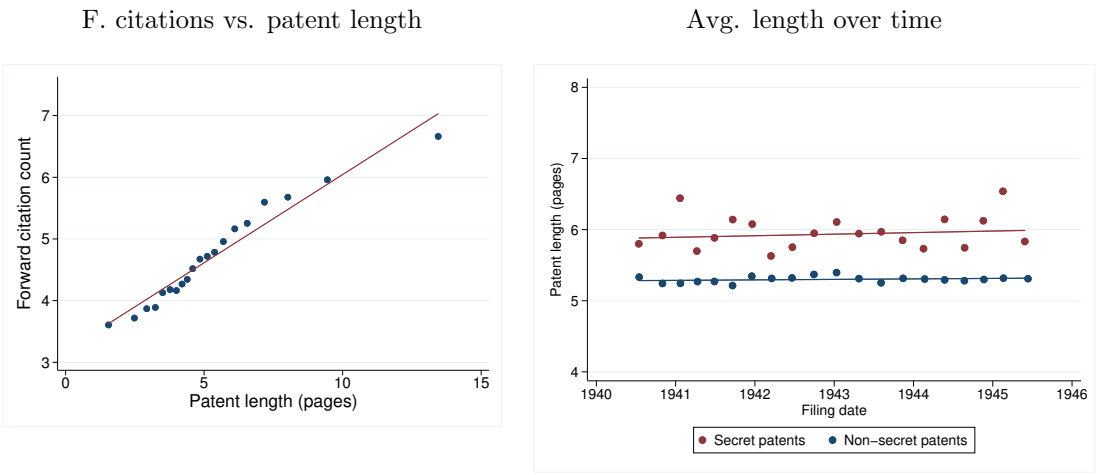
Notes: Figure shows the distribution residual grant lags of patent applications evaluated for secrecy but not issued a secrecy order versus those not evaluated for secrecy, after controlling for patent class-year FEs. Note that patent applications prior to July 1940 were only evaluated for secrecy if still under examination (such that pre-1940 differences in total pendency are in part selected).

Figure C.2 then illustrates that the differential grant delays for earlier versus later secret patents were not a function of changes in the underlying quality of these patents over time. For the empirical strategy invoked in Section 4 comparing the effects of secrecy for patents filed earlier versus later in the war – i.e., for inventions held secret for longer versus shorter terms – a principal concern is that there may be time-varying selection into secrecy, with the standards applied by evaluators possibly changing over time. This selection would confound the estimated effects if, for example, secrecy orders were applied more conservatively near the end of the war, with only the most important applications being ordered secret: in this case, what appears to be an "effect" of a shorter secrecy term would in fact be attributable to differential selection into secrecy.

To test for time-varying selection, I look for patent characteristics which are largely or fully determined at the time of filing and which correlate with ex-post measures of patent quality, namely forward citations, and I examine variation in these characteristics in secret and non-secret patents over the course of the war. Examples of observable patent characteristics which are fixed or approximately fixed at filing include the inventor(s), assignee(s), the patent class (determined by the subject matter), and the patent length (determined by the content of the invention and claims). In the data, a patent's length, measured as the number of pages in the patent document itself, is highly predictive of future citations, with longer patents being more heavily-cited: the left panel of Figure C.2 presents a binned scatterplot which illustrates this pattern for patents filed between July 1940 and June 1945, the focal sample for the patent-level analysis in the paper. This relationship could, for example, be driven by the complexity of the invention, or the number and breadth of the patent's claims.[9] Given this correlation, if later secret patents are on average longer than earlier secret patents, it would raise concerns about selection. Figure C.2 shows that this is not the case: the right panel shows a binned scatterplot of patent length over time, with secret patents in red and non-secret patents in blue. Although secret patents are on average longer than non-secret patents – reflecting the previously-documented selection into secrecy – the difference does not vary over time in a way that would suggest the results of Section 4 are confounded.

[9] Although modern evidence has shown that patents' claims are often revised (typically narrowed) in the course of patent examination (e.g., Kuhn and Thompson 2017), such that the content of the issued patent is partly endogenously determined, claims are only one section of the patent document (which also includes a specification of the invention and diagrams). Moreover, for endogenously-determined claims to confound the results in Section 4, it would have to be the case that claims were revised in response to a secrecy order, which is unlikely given that secrecy orders in this period could not be appealed, and in particular that claims were differentially revised in earlier versus later applications such that the later applications ended up with more or broader claims – a hypothesis which, if claims correlate with patent length, is not consistent with the evidence in Figure C.2.

Figure C.2: Little evidence of time-varying selection into secrecy on patent quality



Notes: Figure demonstrates that patent length (measured as number of pages in the patent publication) strongly predicts forward citations, and that average patent length was stable over the sample period for both secret and non-secret patents, as an illustration that underlying characteristics of patents with secrecy orders (vs. without) do not differentially vary over time – with the implication being that time-varying selection into secrecy is unlikely to explain results in the paper which are estimated off of the duration of secrecy. Specifically, the left panel shows a binned scatterplot of forward citations against patent length for patents filed between July 1940 and June 1945. The right panel shows a binned scatterplot of patent length against filing date for patents in this sample, separating those with a secrecy order (in red) from those without (in blue), which shows a level difference between the groups but no trends over time.

Table C.1 provides a more detailed look at who the OSRD contractors are, providing context for the analysis in Section 4 which splits patents into subsamples of OSRD and non-OSRD firms – i.e., firms which were performing R&D under contract for the war effort, versus those which were not – to draw out differences in the effects. The table examines the set of all assignees who filed a patent in the 1940s, and the patents filed in this period with a known assignee. Out of nearly 135,000 unique assignees, roughly 21,000 were firms. Of these, the majority (66%) filed no patents in the 1930s, and nearly 90% filed fewer than 10 patents. Many of the OSRD assignees, on the other hand, were among the most active filers in this era. Nearly 85% were firms, and the distribution skews towards large, R&D-intensive outfits like Bell Labs, General Electric, Westinghouse, Du Pont, and so on. Although OSRD assignees comprise only 0.2% of assignees in the 1940s, they account for 19.1% of patents, and nearly 35% of patents filed by firms.

Table C.1: Characteristics of OSRD and non-OSRD patent filing in the 1940s

	All assignees		Non-OSRD assignees		OSRD assignees	
	Number	**Percent of firms**	**Number**	**Percent of firms**	**Number**	**Percent of firms**
Patents	375,681		303,769		71,912	
Assignees	134,794		134,488		306	
Firms	21,117	100.0%	20,862	100.0%	255	100.0%
with 0 patents in 1930s	13,851	65.6%	13,808	66.2%	43	16.9%
with 1-5 patents	3,984	18.9%	3,949	18.9%	35	13.7%
with 6-10 patents	1,043	4.9%	1,028	4.9%	15	5.9%
with 11-20 patents	905	4.3%	891	4.3%	14	5.5%
with 21-50 patents	783	3.7%	740	3.5%	43	16.9%
with 51-100 patents	292	1.4%	256	1.2%	36	14.1%
with 101-200 patents	143	0.7%	119	0.6%	24	9.4%
with 501+ patents	85	0.4%	57	0.3%	28	11.0%
with 201-500 patents	85	0.4%	57	0.3%	28	11.0%
with 501+ patents	31	0.1%	14	0.1%	17	6.7%

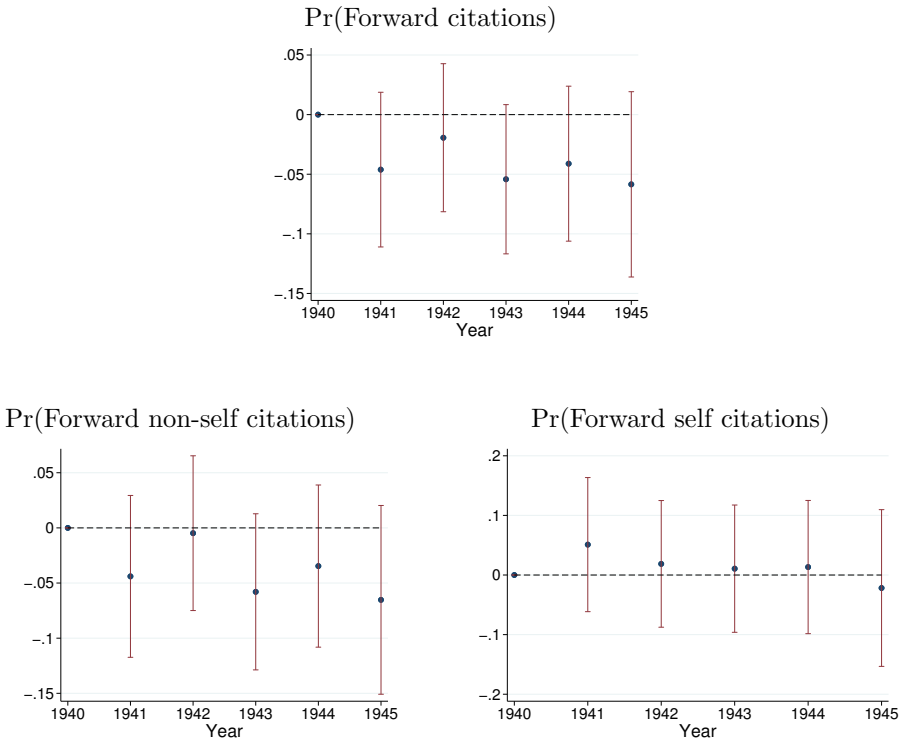
OSRD percent of...	
Assignees	0.2%
Patents	19.1%
Patents by firms	34.7%

Notes: Table shows characteristics of assignees who filing in the 1940s, focusing on the number of all / non-OSRD / OSRD assignees, the number which were firms, and the fraction of those with zero, few, or many patents in the prior decade. The table illustrates that the OSRD contractors are disproportionately large, R&D-intensive firms.

D Robustness Checks

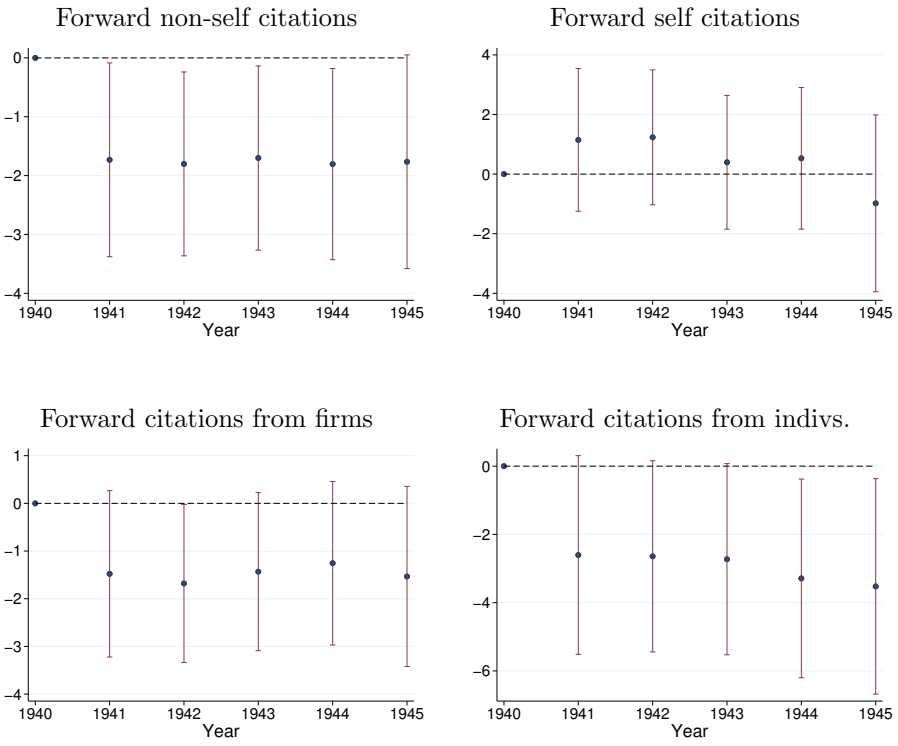
This appendix section provides additional results which supplement those in the paper.

Figure D.1: Effects of secrecy on forward citations (OSRD firms only)



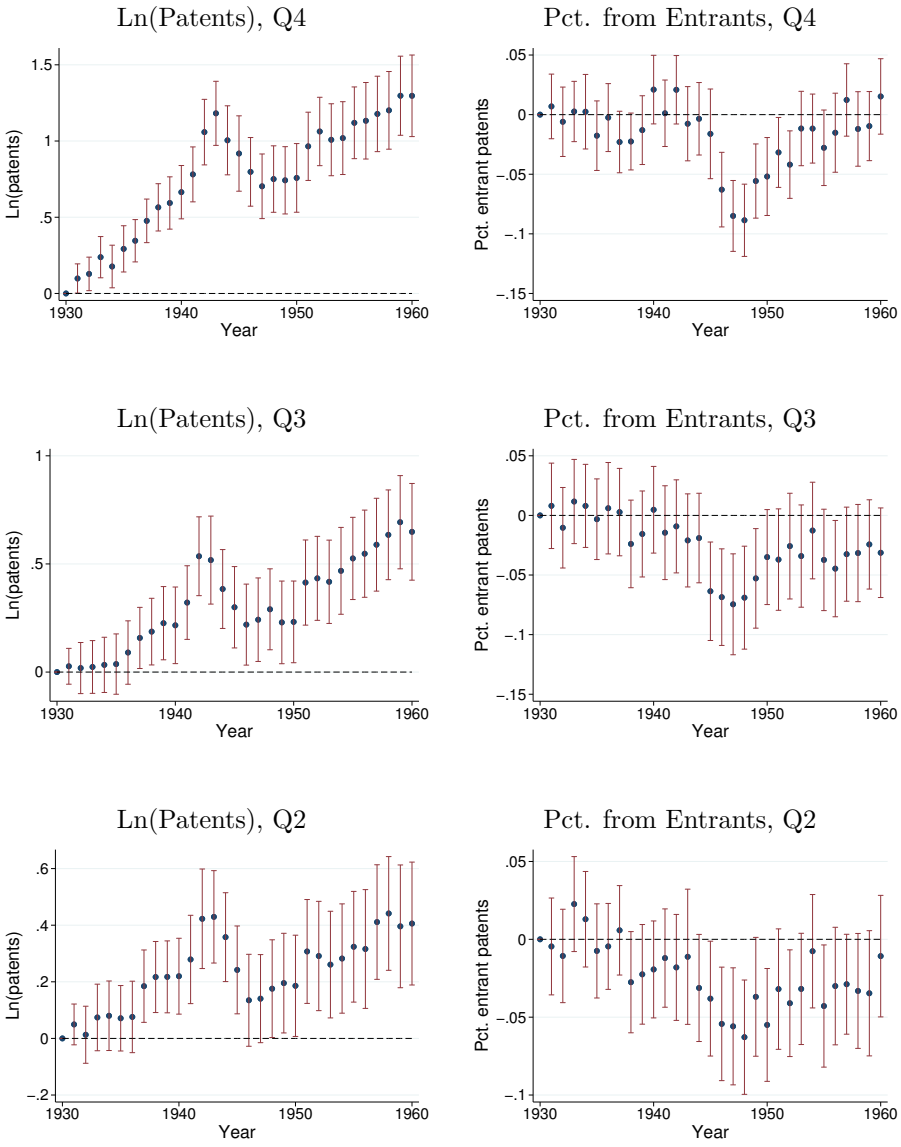
Notes: Figure shows estimates from a comparison of the probability of forward citations for patents filed by OSRD firms between July 1940 and June 1945 and issued a secrecy order, relative to those which were not, with estimates by filing year, and with 1940 being the omitted (reference) year. Underlying regressions control for whether each patent was evaluated for secrecy, as well as class-year FEs. Error bars represent 95% confidence intervals, computed from heteroskedasticity-robust SEs. Noisy estimates relative to 1940 may reflect higher variance in the issuance of secrecy orders at the beginning of the program (see text).

Figure D.2: Effects of secrecy on time to median forward citation (OSRD firms only)



Notes: Figure shows estimates from a comparison of median forward citation timing (measured as years since the cited patent's filing) for patents filed by OSRD firms between July 1940 and June 1945 and issued a secrecy order, relative to those which were not, with estimates by filing year, and with 1940 being the omitted (reference) year. Underlying regressions control for whether each patent was evaluated for secrecy, as well as class-year FEs. Error bars represent 95% confidence intervals, computed from heteroskedasticity-robust SEs. Noisy estimates relative to 1940 may reflect higher variance in the issuance of secrecy orders at the beginning of the program (see text).

Figure D.3: Changes over time in level and composition of patenting in patent classes in each quartile of secrecy order issuance rate from 1940-1945, relative to classes without secrecy orders



Notes: Left panel shows the estimated mean difference in log patents for classes in the given quartile of class-level wartime secrecy rates (defined as the fraction of patents filed in a given class between 1940 and 1945 which were issued a secrecy order), relative to classes without any secrecy orders, by year. Right panel shows the estimated mean difference in the fraction of filings from new entrants, by year. Sample aggregates patents with a single, known assignee ($> 95\%$ of patents in the sampling window) up to the patent class-year level, and is restricted to class-years with at least 10 patents (to allow for meaningful variation in composition measures). Error bars represent 95% confidence intervals, computed from SEs clustered at the patent class level.

Appendix references

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Younge, Kenneth A. and Jeffrey M. Kuhn. 2016. *Patent-to-Patent Similarity: A Vector Space Model*. SSRN working paper, available at https://ssrn.com/abstract=2709238.