Smithsonian
National Museum of American History
Kenneth E. Behring Center

Guide to the National Company (NATCO) Atomic Clocks Records

NMAH.AC.0547

Laura Zelasnic.

1998

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Table of Contents

Collection Overview

Repository: Archives Center, National Museum of American History

Title: National Company (NATCO) Atomic Clocks Records

Identifier: NMAH.AC.0547

Date: 1955 - 1968

Extent: 5.5 Cubic feet (16 boxes, 3 oversize folders)

Creator: Bagnall, James
Orensberg, Arthur
NATCO, Inc. (National Company, Inc.)
Mainberger, Walter
Lerner, Louis C.
Holloway, Joseph
Grant, Eugene
George, James
Daly, Richard Timothy, Jr.
Bovarnick, Michael

Language: English

Summary: The records document the development of the first commercial atomic clocks by the National Company, Inc., (NATCO) of Malden, Massachusetts, a company known for producing specialized electronic equipment. The records include blueprints, technical drawings and schematics, technical and research reports, instruction manuals, photographs, and marketing materials.

Administrative Information

Acquisition Information

Materials in this collection were donated to the Division of Electricity and Modern Physics by Louis C. Lerner in December 1984. The bulk of the blueprints were purchased from Robert Reeves in August, 1991.

Provenance

The collection was transferred from the Division of Electricity and Modern Physics (now the Division of Work and Industry) to the Archives Center in February, 1996.

Related Materials

Materials at the National Museum of American History

Artifacts related to this collection are located in the Division of Work and Industry.

Materials at Other Organizations

Materials related to MIT staff and departments who were involved in NATCO's Atomic Clock projects also can be found in the Historical Collections at the MIT Museum (http://web.mit.edu/museum/) and in the Institute Archives and Special Collections (http://libraries.mit.edu/archives/) of the MIT Libraries in Cambridge, Mass.

Processing Information

Processed by Laura Zelasnic, August 1998; supervised by Alison Oswald, archivist.

Preferred Citation

National Company (NATCO) Atomic Clocks Records, 1955-1968, Archives Center, National Museum of American History, Smithsonian Institution.

Restrictions

The collection is open for research use.

Conditions Governing Use

Collection items available for reproduction, but the Archives Center makes no guarantees concerning copyright restrictions. Other intellectual property rights may apply. Archives Center cost-recovery and use fees may apply when requesting reproductions.

Accruals

Additional materials were added to this collection in January 2012. The materials were collected by National Museum of American History Curator, Paul Forman, and were transferred to the Archives Center in 2012.

Biographical / Historical

An atomic clock is a cesium-based frequency standard. It operates by exposing cesium atoms to microwaves at one end of their resonant frequencies and then counting their corresponding cycles as a measure of time. In 1955, Louis Essen of Britain's National Physical Laboratory and William Markowitz of the U.S. Naval Observatory collaborated to produce the first measurement of what is now called the atomic second. In 1967, the 13th general Conference of Weights and Measures formally redefined the atomic second as 9,192,631,770. The atomic second became the internationally accepted unit of time. Atomic clocks are the most accurate of all clocks. The first clock in 1949 was based on the microwave resonances of the ammonia molecule. It was patented by Harold Lyons and Benjamin F. Husten. The first commercial atomic clocks were developed at the Massachusetts Institute of Technology (MIT) Research Laboratory of Electronics under J.R. Zacharias, a protégé of I.I. Rabi's, circa 1955-1956 and were manufactured by the National Company, Inc. (NATCO) of Malden, Massachussets. NATCO, founded in 1914, was a well-respected company known for producing specialized electronic equipment in short runs. Prototype clocks bore the working name National Atomic Frequency Standard (NAFS). When the first commercial product was unveiled on October 3, 1956, it bore the trade name "Atomichron" and the model number NC-1001. Between 1956 and 1960, fifty Atomichrons were made and sold to military agencies, government agencies, and universities. Nine other models followed with refinements in size, portability and accuracy. The most radical design departure began with the NC3001 when the beam tube was placed in the horizontal position. Prices ranged from $10,000 to $50,000.

Patents covering NATCO's frequency standards include: 2,960,663, 2,972,115, 2,991,389, 3,258,713, 3,305,290. In 1965, James J. Bagnall was assigned patent 3,167,772 for a Collision Avoidance System to NATCO. It never reached production.

Although supported by research contracts by all three military branches, especially the Army Signal Corps, NATCO failed to achieve a lasting profitability. It was liquidated, and its patents were acquired by Frequency Electronics in 1969.

Sources

1. PEM Drawing C43767, 1967, PEM Drawings (C38037-C43767), 1964-1967, Series 3, Components, 1955-1967, Atomic Clock Collection, Archives Center, Smithsonian Institution National Museum of American History.

2. Forman, Paul. "Atomichron: The Atomic Clock from Concept to Commercial Product," in Proceedings of the IEEE, vol. 73, p. 1181-1204, 1985.

Scope and Contents

The National Company (NATCO) Atomic Clocks Records, 1955-1968, documents the development of the first commercial atomic clocks. Materials were generated by the National Company, Inc. (NATCO) of Malden, Massachusetts which produced the clocks under contract for military branches of the U.S. government and also marketed them on a retail basis. The collection consists of blueprints, technical drawings and schematics, technical and research reports, instruction manuals, photographs, marketing materials, and a stock offering prospectus for NATCO. If one blueprint, drawing or parts list had two or more models listed, it is included under the first model cited.

Series 1, National Company, Inc., (NATCO), 1957-1959, consists of a stock offering prospectus, 1959, which describes the organization of NATCO, its executives and Board of Directors, financial condition, and products. Located in this series is a bound volume of photographs which accompanied NATCO's contract bids. This volume contains photographs of a state-of-the-art machine shop and electronics laboratory of the late 1950s and early 1960s. A blueprint for a radio receiver— the product on which NATCO had built its reputation—is here.

Series 2, Atomichrons, 1955-1968, contains blueprints, original technical drawings and schematics, instruction manuals for setup and operation, technical and research reports, photographs and marketing materials arranged by Atomichron model from the National Atomic Frequency System (NAFS) prototype through the NC3701 and NC3702. The NC1001, the first commercial atomic clock, is fully documented. Technical Memoranda and proposals (TM-) related to particular models have been included with them. Other Technical Memoranda and proposals are in Series 3, Components, 1955-1957, and Series 5, Technical Memoranda and Reports, 1956-1957.

Series 3, Components, 1955-1967, contains materials related to the development of NATCo's Cesium Beam Tube and other parts of the Atomichrons. It includes Technical Memoranda (TM-), blueprints and original drawings, original notes and computations, parts lists, and photographs. Also included in this series is material related to the Production Engineering Measure (PEM), 1962-1967. This was a piece of equipment designed and built by NATCO to measure the accuracy of each Cesium Beam Tube as it was produced.

Series 4, Collision Avoidance System, 1962-1967, consists of material related to James J. Bagnall's patented Collision Avoidance System, using the Cesium Beam Frequency Standard. It includes his research report, the patent assigned to NATCO, and proposals and reports from NATCO representatives to Air Transportation Association conferences and meetings for 1967.

Series 5, Technical Memoranda and Reports, 1956-1967, consists of bound and numbered (TM-) technical memoranda. These are research reports and proposals for future research or products. Other technical memoranda are in Series 2, Atomichrons and Series 3, Components, 1955-1967.

Series 6, Reprints from Massachusetts Institute of Technology (MIT), 1953-1955, contains a bound volume of reprinted or photocopied papers which document research developments in Cesium Beam Frequency Standards at the time NATCO was establishing itself as a commercial producer.

Arrangement

The collection is arranged into six series.

Series 1: National Company, Inc., (NATCO), 1957-1959

Series 2: Atomichrons, 1955-1968

Subseries 2.1, National Atomic Frequency System (NAF), 1956

Subseries 2.2, NC1001, 1955-circa 1959

Subseries 2.3, NC1001, Polaris, 1956-1958

Subseries 2.4, NC2001, Militarized, 1956-1961

Subseries 2.5, NC3001, Airborne, 1956-1961

Subseries 2.6, NC1200, 1959

Subseries 2.7, Missileborne Atomichron, 1959-1960

Subseries 2,8, NC1501, 1958-1964

Subseries 2.9, NC1601, Economy, 1958-1964

Subseries 2.10, Tactical Frequency Standard Drawings, 1959

Subseries 2.11, Tri-Service CBFS, circa 1965

Subseries 2.12, NC3501, circa 1965, 1967

Subseries 2.13, NC3601, Aerospace, circa 1965

Subseries 2.14, NC3701, Commercial, 1964-1968

Series 3: Components, 1955-1967

Series 4: Collision Avoidance System, 1962-1967

Series 5: Technical Memoranda and Reports, 1956-1967

Series 6: Reprints from MIT, 1953-1955

Physical Characteristics and Technical Requirements

Gloves must be worn when handling unprotected photographs and negatives.

Names and Subject Terms

This collection is indexed in the online catalog of the Smithsonian Institution under the following terms:

Subjects:

Airplanes -- Collision avoidance -- 1950-1970
Atomic clocks
Clocks and watches -- 1950-1970
Cold War -- 1950-1970
Frequency standards -- 1950-1970
Inventions -- 1950-2000
Military-industrial complex -- Massachusetts -- Cambridge
Patents -- 1950-1970
United States -- Air defenses -- Military -- 1950-1970

Types of Materials:

Blueprints -- 20th century
Manuals -- 1950-1970
Photographs -- 1940-1970
Reports -- 1940-1970
Technical drawings

Container Listing

Series 1: National Company, Inc. (NATCO), 1957 - 1959

Box 1, Folder 1	Prospectus, 1959
Box 1, Folder 2	National Company [work] experience, 1959
Box 1, Folder 3	AN/WRR-2 receiver blueprint, 1957

Return to Table of Contents

Series 2: Atomichrons, 1955 - 1968

Subseries 2.1: National Atomic Frequency System (NAFS), 1956 - 1956

Box 1, Folder 4	Blueprints (A17120-B17709), 1956
Box 1, Folder 5	Blueprints (C16001-D16488), 1956

Subseries 2.2: NC1001, 1955-circa 1959

Box 1, Folder 6	Blueprints (A15696-A17802), 1955 - 1957
Box 2, Folder 1	Blueprints (A15942-A27531), 1955 - 1957
Box 2, Folder 2	Blueprints (B15942-B17148), 1955 - 1957
Box 2, Folder 3	Blueprints, (B17155-B17265), 1955 - 1957
Box 2, Folder 4	Blueprints (B17266-B25265), 1956 - 1957
Map-folder 3, Drawer 19, Folder 1	Blueprints (B20285-B22545), 1957 - 1959
Box 2, Folder 5	Blueprints, (C16224-C20014), 1955 - 1957
Box 2, Folder 6	Blueprints, (D17063-D17950), 1955 - 1957
Box 3, Folder 1	Blueprints, (E1708-E17919), 1955 - 1957
Box 15, Folder 1	Drawings (20285 and 22545), 1959
Map-case 3, Drawer 19, Folder 1	Drawing D17117, 1955 - 1956
Box 3, Folder 2	*Beam Tube Assembly Manual*, 1957 Image(s)
Box 3, Folder 3	Instruction manuals, 1957
Box 3, Folder 4	Photographs, 1957
Box 3, Folder 5	Short-Term Stability Study, final report, circa 1959

Subseries 2.3: **NC1001, Polaris**, 1956 - 1958

Box 3, Folder 6	Proposal, TM-144, 1956
Box 3, Folder 7	Interim report, 1957
Box 3, Folder 8	Interim development report, 1958

Map-case 3, Drawer 19, Folder 3	NC1106 blueprint (C29888), 1960

Subseries 2.4: **NC2001, Militarized**, 1956 - 1961

Box 3, Folder 9	TM-110, proposal, 1956
Box 4, Folder 1	Blueprints (A18014-A29846), 1959
Box 4, Folder 2	Blueprints (B25141-B32015), 1959
Map-folder 3, Drawer 19, Folder 2	Drawings (B26508-B34828), 1958 - 1961
Box 4, Folder 3	Blueprints (C25313-C27783), 1959
Box 4, Folder 4	Blueprints (C28464-C32728), 1959
Box 4, Folder 5	Blueprints (D25300-D31961), 1959
Box 5, Folder 1	Blueprints (E26452-E31052), 1959
Box 5, Folder 2	Blueprints (J32008-J32727), 1959
Box 15, Folder 2	Drawings (B26508-B34828), 1959
Box 5, Folder 3	Beam tube assembly, evaluation and test procedures
Box 5, Folder 4	Atomic beam frequency standard, final report, 1955 - 1957
Box 5, Folder 5	Semi-final report, 1958
Box 5, Folder 6	Instruction manual, circa 1959
Box 6, Folder 1-2	NC2001-2011, instruction manuals, circa 1959
Box 6, Folder 3	Final report, 1961
Box 6, Folder 4	Range measurement with two atomic beam oscillators, 1957
Box 6, Folder 5	TM-432, Proposal to measure directly the phase error in an atomic beam resonance tube, circa 1960
Box 6, Folder 6	TM-520, Proposal to investigate and eliminate distortions in the Cs 133 resonance of the NC2001 cesium beam tube, 1963

Subseries 2.5: **NC3001, Airborne**, 1956 - 1961

Box 6, Folder 7	Blueprints (A24357-A28476), 1959
Box 6, Folder 8	Blueprints (A28502-A32730), 1959

Box 7, Folder 1	Blueprints (B18009-B32717), 1959
Box 15, Folder 3	Drawings (B26520-B34858), 1958 - 1961
Box 7, Folder 2	Blueprints (C22347-C27749), 1959
Box 7, Folder 3	Blueprints (C27773-C33597), 1959
Box 7, Folder 4	Blueprints (D25434-D28438), 1959
Box 7, Folder 5	Blueprints (D28926-D32724), 1959
Box 8, Folder 1	Blueprints (E27564-E53595), 1959
Box 8, Folder 2	Blueprints (J28434-J29995), 1959
Box 8, Folder 3	Completion Report, DR 1277, 1956
Box 8, Folder 4	Instruction manual, 1959
Box 8, Folder 5	*Oscillator Handbook*, circa 1959
Box 8, Folder 6	TM-474, final report, 1961
Box 15, Folder 3	NC3011, Drawings (B34389-B34441), 1961

Subseries 2.6: **NC1200**, 1959 - 1959

Box 9, Folder 1	Blueprints (A25466-D37180), 1959
Box 9, Folder 2	Instruction manual, circa 1959
Box 9, Folder 3	*NC1201 Oscillator-Comparator Manual*, circa 1959
Box 9, Folder 4	NC1200 and 1201, *Transistorized Frequency Standard Manual*, 1959
Box 9, Folder 5	NC1251A, *Auxiliary Frequency Standard Manual*, 1959

Subseries 2.7: **Missileborne Atomichron**, 1959 - 1960

Box 9, Folder 6	Detail drawings, 1959
Map-case 3, Drawer 19, Folder 2	Harmonic generator drawings, 1959
Map-case 3, Drawer 19, Folder 2	Cross-section drawings, circa 1959
Box 15, Folder 4	Drawings (notes J31998), circa 1959

Box 15, Folder 4	Sketches, circa 1959
Box 15, Folder 4	Blueprint, layout No. 3-X-288 multiplier module B-2-3-4, circa 1959
Box 15, Folder 4	Drawings (notes J31998), 1959
Box 15, Folder 4	Beam tube cross-sections, 1959
Map-case 3, Drawer 19, Folder 2	Oscillator drawings, 1959
Map-case 3, Drawer 19, Folder 2	Harmonic generator drawings, 1959
Box 9, Folder 7	Technical proposal, Lockheed missiles, circa 1959
Box 9, Folder 8	Technical proposal for missileborne Atomichron volume 2, circa 1959
Box 9, Folder 9	TM-438, Missleborne atomichron frequency standard, 1960
Box 9, Folder 10	TM-453, Beam optics for MBA tube, 1960

Subseries 2.8: NC1501, 1958 - 1964

Box 9, Folder 11	Blueprints (B25432-C33985), 1958 - 1960
Box 15, Folder 5	Drawings (B29931-B38097), 1959 - 1964
Map-case 3, Drawer 19, Folder 1	Blueprints (C38104-C38107), 1964
Map-case 3, Drawer 19, Folder 1	Blueprints (D34816-D38132), 1961 - 1962
Map-case 3, Drawer 19, Folder 1	Unnumbered cross-section, circa 1964
Box 9, Folder 12	TM-504, Short Ttrm stability measurement, 1961
Box 9, Folder 13	*NC1501 and NC1511, Instruction Manual*, 1961

Subseries 2.9: **NC1601, Economy**, 1958 - 1964

Box 9, Folder 14	Blueprints (A2448-C29179), 1959
Map-case 3, Drawer 19, Folder 1	Blueprints (C36380-C36499), 1962 - 1963
Map-case 3, Drawer 19, Folder 1	Blueprints (D36447-D36501), 1962 - 1963
Box 15, Folder 6	Drawings, (B25448-B36509), 1958 - 1963

Box 9, Folder 15	*NC1601 (M) Instruction Manual*, circa 1960
Box 9, Folder 16	Cesium beam tube studies, 1962 - 1964
Box 10, Folder 1	Contract, 1963

Subseries 2.10: Tactical frequency standard drawings, 1959 - 1959

Box 15, Folder 8

Subseries 2.11: **Tri-Service CBFS**, circa 1965

Box 10, Folder 2	TM-634, Proposal, volume 1, circa 1965
Box 10, Folder 3	TM-634, Proposal, volume 2, circa 1965
Box 10, Folder 4	Photographs, circa 1965

Subseries 2.12: **NC3501**, circa 1965, 1967

Map-case 3, Drawer 19, Folder 3	Blueprint (C43694), 1967
Box 10, Folder 5	Photographs, circa 1965

Subseries 2.13: NC3601, Aerospace, circa 1965

Box 10, Folder 6	Photographs, circa 1965
Box 10, Folder 7	Specifications, circa 1965

Subseries 2.14: **NC3701, Commercial**, 1964 - 1968

Box 10, Folder 8	Blueprints (A44252-D44251), 1967
Map-case 3, Drawer 19, Folder 3	Blueprints (C43656-C43663), 1967
Box 10, Folder 9	Assembly beam tube, 1967
Box 10, Folder 10	*Preliminary Technical Manual*, circa 1968
Box 10, Folder 11	*Preliminary Technical Manual*, (incomplete), circa 1968
Box 10, Folder 12	Specifications, 1968
Box 10, Folder 13	Photographs, circa 1968
Map-case 3, Drawer 19, Folder 3	NC3702, drawing 38059, 1964

Map-case 3, Drawer 19, Folder 3 Blueprint (C43666), 1967

Return to Table of Contents

Series 3: Components, 1955 - 1957

Box 11, Folder 1	RPD blueprints (B15971-B15979), 1955
Box 11, Folder 2	TM-219, Cesium beam tube design information, 1957
Box 11, Folder 3	Beam tube optics for offset and conventional designs, 1957
Box 11, Folder 4	[Beam tube] magnetic measurement data, J. Mackowiack, 1957 - 1958
Box 11, Folder 5	TM-307, Method of matching and compensating the RF structure of the beam tube, 1958, Constance W. Franklin, 1958
Box 11, Folder 6	[Summary and notes on thirteen topics], Constance W. Franklin, circa 1958
Box 11, Folder 7	TM-435, Notes on the design and testing of the temperature compensator for the 24" and 72" cesium beam tubes, 1960
Box 11, Folder 8	Detail drawing, airborne and missleborne beam tubes, circa 1960
Box 11, Folder 9	Cesium beam resonator (6201CBR) photographs, 1967
Box 11, Folder 10	PEM quarterly reports, 1963 - 1964
Box 11, Folder 11	PEM quarterly reports, 1965 - 1967
Box 12, Folder 1	PEM parts list, 1965
Map-case 3, Drawer 19, Folder 3	PEM blueprints (C38037-43767), 1964 - 1967
Map-case 3, Drawer 19, Folder 3	17" PEM model drawings, unnumbered, 1964
Map-case 3, Drawer 19, Folder 3	PEM blueprints (E39972), 1965
Map-case 3, Drawer 19, Folder 2	PEM blueprints (D36505-D41155), 1965
Box 12, Folder 2	PEM assembly blueprint (J39092), 1965
Box 15, Folder 7	PEM drawings (B36449-B40086), 1962 - 1965
Box 12, Folder 3	PEM acceptance test procedure, 1965
Box 12, Folder 4	PEM acceptance test procedure, NC6201CBR, cesium beam resonator, 1967
Box 12, Folder 5	PEM final report, 1967
Box 12, Folder 6	General purposes blueprints, 1959

Box 12, Folder 7	TM-621, Operational considerations for driving crystal oscillator for APFS, circa 1962
Box 12, Folder 8	Stability computation notebook for tri-service crystal oscillator, 1965
Box 12, Folder 9	Assembly blueprints (D111-158-D44458), 1966
Box 12, Folder 10	Specifications, 1966
Box 12, Folder 11	Calibrator blueprint and parts list [electron multiplier], 1962
Box 12, Folder 12	General description of 60 degree electron multiplier, undated
Box 12, Folder 13	Effect of noise on an oscillator controlled by a primary Rrference, Bagnall, undated
Box 12, Folder 14	Specifications for processes and materials, 1960
Box 12, Folder 15	Temperature compensator for airborne and Signal Corps, 1960
Box 12, Folder 16	Parts lists, NC2001, 2021, 1200, 1501, 1601, 3001, 3011, 1960 - 1963
Box 12, Folder 17	Parts list [unidentified], circa 1965
Box 13, Folder 1	Unassigned blueprints, 1959 - 1967
Map-case 3, Drawer 19, Folder 1	ASD blueprints (C40321 and C41135), (D38984), 1965

Return to Table of Contents

Series 4: Collision Avoidance System, 1962 - 1967

Box 13, Folder 2	James J. Bagnall paper, 1962
Box 13, Folder 3	James J. Bagnall patent, 1965
Box 13, Folder 4	Air Transport Association, memoranda and reports, 1967
Box 13, Folder 5	National Company (NATCO) Atomic Clocks proposals and reports, 1967
Box 13, Folder 6	National Company (NATCO) Atomic Clocks trip reports, 1967

Return to Table of Contents

Series 5: Technical Memoranda and Reports, 1956 - 1967

Box 13, Folder 7	TM-124, Molecular beam oscillator for frequency control, 1956
Box 13, Folder 8	TM-311, Carbon monoxide frequency standard, 1959
Box 13, Folder 9	TM-419, Magnetohydrodynamic effects, 1960
Box 13, Folder 10	TM-425, Magnetic resonance and possible applications in biophysics and medicine, circa 1960
Box 13, Folder 11	TM-429, Ultrasensitive mass spectrometer, undated
Box 13, Folder 12	TM-439, Processing of cesium, 1960
Box 13, Folder 13-14	TM-446, Isochron Study, final report, two volumes, 1960
Box 13, Folder 15	TM-458, Advanced techniques for frequency standards, circa 1960
Box 14, Folder 1	TM-460, Precision frequency and time measurement techniques, circa 1960
Box 14, Folder 2	TM-461, Investigation of a nuclear magnetic resonance oscillator, circa 1960
Box 14, Folder 3	TM-462, Time and frequency requirements for ARDC division systems programs offices, circa 1960
Box 14, Folder 4	TM-465, Application of universal frequency control systems to aerospace vehicles, circa 1960
Box 14, Folder 5	TM-500, Investigation of coupled electron and nuclear spin systems, circa 1961
Box 14, Folder 6	TM-525, Tactical atomic clock and frequency standard, circa 1961
Box 14, Folder 7	TM-697, Atomic clock for satellite operation, circa 1962
Box 14, Folder 8	Study and investigation of an improved proton maser antenna, 1966
Box 14, Folder 9	TM-964, Portable, tactical CBFS, circa 1967
Box 16, Folder 1	Technical proposal to develop a carbon monoxide frequency standard, circa 1950s
Box 16, Folder 2	TM-689, Propagation of Microwaves Across a Plasma Filled Section of Waveguide, 1963 March 21
Box 16, Folder 3	[TM-670?], Optics of an atomic beam, undated
Box 16, Folder 4	TM-721, Final report, Rho-Rho navigation system study, phase 1, 1963 July 18
Box 16, Folder 5	TM-875, The synthesis problem in the CBFS, 1965 March 1
Box 16, Folder 6	TM-900, Universal Synthesizer for the CBFS, 1965 October

Box 16, Folder 7	TM-925, Investigation of large order division and multiplication inphase-locked frequency synthesis, 1966 January 31
Box 16, Folder 8	TM-980, Master timing of CAS ground station, undated

Return to Table of Contents

Series 6: Reprints from the Massachusetts Institute of Technology (MIT), 1953 - 1956

Box 14, Folder 10 Reprints and photocopies of articles about Atomic Clocks, 1953 - 1955

Return to Table of Contents