FILE DESCRIPTION

NEW YORK FILE

Bulky Exhibit:

ABRAHAM

SUBJECT BROTHMAN

FILE NO. 100-95068

VOLUME NO. 1B

SERIALS 101

thru

160

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JULIUS ROSENBERG, et al.

NEW YORK BULKY EXHIBIT FILES

ABRAHAM BROTHMAN 100-95068 1B

Exhibit Number	Description	Released	Denied	Withheld
101	NOTES ON ARTICLES appearing in MOSCOW MAGAZINE (1940)	✓		
102	Trial Brief	✓		
103	employment application & related papers of 3rd party			destroyed 2/13/52
104	affidavit			destroyed 2/12/52
105	Charge to jury			destroyed 2/12/52
106	court documents			destroyed 2/12/52
107	A. Brodman's Supplementary Court Proceedings			destroyed 2/12/52
108	Copy of letter to Saypol			destroyed 2/13/52
109	Brodman appeal			destroyed 9/25/57
110	letter	✓		
111	letter from Brodman	✓		
112	Return to Writ of Habeas Corpus, + affidavit	✓		
113	letter from Brodman	✓		
114	letter from Brodtman	✓		
115	letter from Brodman	✓		
116	copy of essay	✓		
117	letter from Brodman	✓		
118	letter	✓		
119	treatise	✓		
120	letter from Brodman	✓		
121	letter (2 copies) + misc. pages	✓		
122	Copies of technical writings	✓		

JULIUS ROSENBERG, et al.

NEW YORK BULKY EXHIBIT FILES

Abraham Brothman 100-95068 1B

Exhibit Number	Description	Released	Denied	Withheld
123	copies of technical writings	✓		
124	2 copies of memorandum	✓		
125	2 letters from Brothman	✓		
126	2 copies of thesis and 2 copies of drawing	✓		
127	Circuit Court of Appeals	✓		
128	copy of "Drawing 1"			TOO LARGE
129	Copy of "Drawing 2"			TOO LARGE
130	copy of drawing of T.V. tube			TOO LARGE
131	Copy of "Drawing 3"	✓		
132	Copy of "Drawing 4	✓		
133	Copy of "Drawing 5	✓		
134	copy of paper on CR Tube			TOO LARGE
135	copy of envelope	✓		
136	Copy of "Drawing 6"	✓		
137	copy of "Drawing 7"	✓		
138	CR Tube Drawing 6			TOO LARGE
139	CR Tube Drawing 7			TOO LARGE
140	2 copies of CR Tube drawing, drawings 4 & 5			TOO LARGE
141	2 copies of letter	✓		
142	Errata, Addenda, & comments	✓		
143	Miscellaneous notes	✓		
144	Drawing 8	✓		TOO LARGE

A. B. Migdal. Ionization of atoms at pair creation in the course of nuclear reactions

A. I. Leipunsky - Fission of the nuclei

V. Perfilov - Observation of tracks of recoiling nuclei arising in the course of uranium fission under the neutron bombardment in the Wilson chamber work

3

Under Covered pressure

K. Petrzhak. Range and energy of fragments of various fissions caused by fast neutrons

V. G. Khlopin - Chemical Nature of various fission products

S. N. Flerov & L. I. Rusinov Experiments on fission of Uranium

K. O. Sinitsyn - A. K. Walter
& A. V. Ivanov. Calorimetric
measurements of the radiative
energy losses for fast
electrons in the lead.

L. A. Arcimovich & M. Bredov -
The "Bremsstahlung" of
fast electrons

M. O. Borisov, V. Bradovsky
Y. D. Leipunsky - The
scattering of fast electrons
by nitrogen nucleus

... Frankev. The pair
... tion in nitrogen by
... mma ...

I. Veksler & D. Timo-
shchuk - Absorption
of fast neutrons

I. P. Bobrovskoy &
D. I. Leipunsky -
Scattering of photo-
neutrons of differ-
ent energies by
atomic nuclei

I. V. Kurchatov -
On the Operation of
the Rad. Inst. of the Ac. of Sc.
of USSR Cyclotron

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 11-13-50

ABRAHAM E. ORTMAN

100-95068-1B
(Title of case)

Submitted by Special Agent JOHN M. COLLINS

Source from which obtained IRVING H. SAYPOL

Address USA, SDNY

Purpose for which acquired INVESTIGATION

Location of bulky exhibit IN CABINET WITH FILE

Estimated date of disposition TO BE DECIDED AT CONCLUSION OF CASE

Ultimate disposition to be made of exhibit RETAIN

List of contents:

102. Trial Brief used by USA Saypol in Subject's trial.

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N. Y. C.

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Title 18, Sec. 241, United States Code (1946

[illegible] corruptly, or by threats or force, or by any threatening letter or communication, shall endeavor to influence, intimidate, or impede any party or witness, in any court of the United States or before any United States Commissioner or officer acting as such commissioner, or any grand or petit juror, or officer in or of any court of the United States, or officer who may be serving at any examination or other proceeding before any United States commissioner or officer acting as such commissioner, or shall injure any party or witness in his person or property on account of his attending or having attended such court or examination before such commissioner or officer, or on account of his testifying or having testified to any matter pending therein, or who shall injure any such party or grand or petit juror in his person or property on account of any verdict, presentment, or indictment assented to by him, or on account of his being or having been such juror, or who shall injure any such commissioner or officer in his person or property on account of the performance of his official duties, or who corruptly or by threats or force, or by any threatening letter or communication, shall influence, obstruct or impede, or endeavor to influence, obstruct or impede, the due administration of justice therein, shall be fined not more than $5,000 or imprisoned not more than ten years, or both. (Mar. 4, 1909, ch. 321, 35 Stat. 1109; Oct. 31, 1951, ch. 655, 65 Stat. 717.)

[illegible]

The [illegible] (Oct. [illegible], 1951) charges that from on or about the 28th day of [illegible] and continuing up to and including the 12th day of [illegible], in the Southern

[illegible] Gold, and Henry Gold, a [illegible] and divers [illegible] unlawful [illegible] conspire, [illegible] and with each other, [illegible] the execution [illegible] and enforcement [illegible] United States of America, [illegible] Title 18, [illegible] (Third ed.).

[illegible] said defendants [illegible], during the [illegible] of the United States, duly [illegible] for the [illegible] District Court [illegible] investigation [illegible] the espionage [illegible] United States.

[illegible] and knowingly that the [illegible] Gold, a co-conspirator [illegible] explanations of [illegible] other persons [illegible] said conspiracy [illegible] appeared before

[illegible] would give false, fictitious [illegible] and manufactured information concerning the [illegible].

It was further a part of said conspiracy that the defendant, Abraham Brothman, would inform Harry Gold, a co-conspirator, of the substance of his testimony before said Grand Jury, for the purpose of enabling the said Harry Gold to conform his testimony thereto.

It was further a part of said conspiracy that when Harry Gold appeared before the aforesaid Grand Jury, he would give false, fictitious, fraudulent and manufactured information concerning the aforementioned relationship, which would conform with the information theretofore given to said Grand Jury by the defendant, Abraham Brothman.

Overt Acts

In pursuance of said conspiracy and to effect the objects thereof, at the Southern District of New York, the defendant, Abraham Brothman, testified before the aforesaid Grand Jury, on or about the 22nd day of July, 1947.

And further in pursuance of said conspiracy, and to effect the objects thereof, at the Southern District of New York, Harry Gold testified before the aforesaid Grand Jury on or about the 31st day of July, 1947.

- 5 -

- 6 -

Identify
Moskowitz
in office

I then took the telephone and spoke to a man, who did the following conversation:

I inquired to find he was Mr. Frothman.

I told him that I was a representative of the United States Government. I was on official business that he wished to speak to him about.

I said that he could be down in 15 or 20 minutes, and he replied that he would wait in his office until he arrived there.

Approximately one half hour later, or about 10:45 A.M., Frothman entered his office and at once said that he had a matter of confidential nature that he wished to discuss with him privately.

I first introduced myself by handing to him my official credentials, stating that I was a Special Agent of the FBI.

I then requested that Frothman be step out of the room and that no telephone calls be taken while the door was closed.

I exhibited a photograph of Coles Dale to Mr. Frothman, and asked him to identify the same. He did so, and Frothman then was photographed with a [illegible] he held his hand [illegible] the picture to [illegible] he did so.

Identi
photo
Coles
playe
Froth

I looked at the picture for a period minutes and then I [illegible] in his hand in front of his face and asked him.

I then showed him a picture of Elizabeth Hendley. [illegible] Hendley the photograph as that of Elizabeth Hendley but again merely showed him the [illegible] and asked if he could identify it.

[illegible] that three [illegible] Harry Gold was [illegible] Harry Gold [illegible] Harry Gold.

Identify picture of [illegible] Gold.

[illegible] of the F.B.I., [illegible] and told him that [illegible] confidential matter. [illegible] office, or any other [illegible]

[illegible] and there was no [illegible] interview. It was [illegible] our automobile, [illegible] the laboratory. [illegible] proceeded to the [illegible] the laboratory. [illegible]

[illegible] to identify this photo- [illegible] or if he [illegible]

[illegible] individual and the [illegible] He then stated [illegible] this man, or [illegible] Doctor [illegible] American [illegible] of Philadelphia, [illegible] concluded, [illegible] restaurant in uptown [illegible] Bill [illegible]

[illegible] made a [illegible] an engineer in [illegible] appointment to [illegible] to discuss [illegible] also to obtain [illegible] to evaluate the [illegible]

[illegible] later, after we entered the laboratory, Harry Gold received a telephone call. He did not tell us who called him, and we were unable to ascertain the substance of this telephone conversation.

After writing out the signed statement it was shown to Harry Gold. He was asked to read it, to see if it substantially reflected what he had told us in the course of the interview. He said the statement was correct, was a true statement of the facts. He was asked if he had any objection to signing the statement. He stated he had no objection. He then signed each page and the last page of the statement in the presence of myself and Agent O'Brien.

At about 9 PM the interview was concluded, and Agent O'Brien and I proceeded to the FBI headquarters in New York City.

The records [illegible] the judicial [illegible] of criminal court records which indicate that a grand jury was duly empanelled in this court on June 16, 19[illegible] by an order duly signed by the Honorable John C. [illegible] on June [illegible], and that this grand jury was discharged on December [illegible], 19[illegible].

I [illegible] Washington Avenue. My occupation is that of a [illegible] Grand Jury Reporter. I have been so employed since [illegible], and was so employed on July [illegible], 1964. On July 22, 1964, I recorded the testimony of Wayne Brotherton before the Federal Grand Jury, [illegible] Mr. Brotherton was testifying. I did not take all the testimony. I was relieved by Mr. [illegible], a Grand Jury Reporter. I [illegible] typed Mr. Brotherton's testimony in final form immediately after recording it. I have my original notes. Exhibit [illegible] for identification is the original transcript of Mr. Brotherton's testimony of July 22, 1964 original notes. I have the original notes that I took on July 22, 1964 or they have not been changed in any way. Exhibit 1 is a portion of Mr. Brotherton's testimony of July 22, 1964 which I recorded and typed. I have the original notes correctly. I have compared them with my transcript. It is an accurate and true transcript of Mr. Brotherton's testimony.

I will you please read the transcript to the ladies and gentlemen of the jury (pages 7-3 through 7-7 for the jury).

I reside at [illegible] Bath Street, Brooklyn, [illegible]. I am employed by the Grand Jury Reporters. I have been so employed for the past twenty years. I was so employed in July, 1947. On July 22, 1947, I took a portion of the testimony of Abraham Brotman. I can identify Mr. Brotman. Exhibit A contains my original notes taken on July 22, 1947. After I recorded Mr. Brotman's testimony, I made a transcript on the same day that I recorded his testimony in shorthand. Exhibit A is a true and accurate transcript of Mr. Brotman's testimony in portions that I have taken.

Will you please read it to the ladies and gentlemen of the jury.

I recorded the testimony of Harry Gold on July [illegible] 1947. I can identify Mr. Gold from pictures. Mr. Gold's testimony is contained in Exhibit A. It had never been [illegible] I made a transcript directly after recording Mr. Gold's testimony. It is a true and accurate transcript of Mr. Gold's testimony.

Will you please read it to the ladies and gentlemen of the jury.

ex

[illegible]

I, [illegible], certify:

My residence is 23 West 86th Street, New York City.

I was graduated from East High School, Rochester, N. Y.; from Wells College, Aurora-on-the-Lake, N. Y., with an A.B. Degree in 1934; and from Columbia University, New York City, with a Master's Degree, in January, 1935.

From 1935 to 1937 I taught at the Foxcroft School, Middleburg, Va. I taught French, English and Italian.

I studied on an exchange fellowship at the University of Florence, Italy, academic year 1937 - 1938.

After I obtained my Master's Degree from Columbia in 1935, I was an investigator for the [illegible] of the City of New York for about five or six months.

ehr

Elizabeth T. Bentley

In March 1935 I joined the Communist Party.

From 1935 to 1938 I was a member of the Communist Party, attended Communist Party unit meeting, and carried on the task which the Communist Party gave me.

In July of 1938 I obtained through the Columbia University Placement Bureau a position as secretary and research worker in the Italian Library of Information, which was the American branch of the Italian government's Propaganda Ministry. As a result of taking that position I was told to go underground.

As a result of instructions from the Communist Party's National Headquarters, I was removed from my unit and put in contact with one man. This man was Jacob Golos.

Identify pl
of Golos.

I obtained copies of all documents, letters, pamphlets that were being put out by the Italian Library of Information.

Identify I

[illegible] instructions to receive blueprints [illegible] to Mr. Golos

as representative of the Communist Party.

To the best of my recollection, I met Brothman for the first time in a Chinese Restaurant located on West 32rd Street between 6th Avenue and 7th Avenue.

I was taken there by Mr. Golos in the early part of 1940. It was around the late dinner hour.

Golos had been dealing with Brothman before but I do not think he ever told me how long.

Mr. Golos introduced me to Mr. Brothman by the name of Helen - no second name.

Mr. Brothman was introduced to me by his real name, Abraham Brothman.

Brothman referred to Golos as John.

I was Helen. Brothman was Abraham Brothman. Golos was John.

Mr. Golos told Mr. Brothman that from then on I would sometimes take his place to collect the material which Mr. Brothman was bringing Mr. Golos.

[illegible] told him that Mr. Brotman would be [illegible] an acceptable [illegible] was to accept and pass on to him, in Brotman's presence.

This time I was Brotman we were to make arrangements for the next meeting.

Mr. Brotman also was to pay his Communist Party dues to me. Mr. Jules told Mr. Brotman to pay his Communist Party dues to me.

Mr. Jules told me Mr. Brotman was a member.

At a prior occasion Mr. Brotman also told me that one of Mr. Brotman commenced paying [illegible] Communist Party dues to me.

[illegible] will be approximately from early 1950 until [illegible] 1951.

[illegible] difficulty experienced to get him to pay his [illegible] I received this from him but the receipt of same from [illegible] during this interview.

On the night of my first meeting in the Brotman apartment on each [illegible] Mr. Brotman and I arranged for a future appointment. In each succeeding meeting we were to meet where I took up the books [illegible] at the same time on Wednesday in the [illegible] evening.

(At these meetings) Usually we first had dinner and talked about inconsequential things.

We would discuss the weather. Then very often Mr. Brothman would ask questions on Communist Party tactics and problems which I would answer. Then he would hand me an envelope containing material he had sometimes. He would explain problems which he had in connection with the material.

Sometimes Mr. Brothman had brought a duplicate of blueprints which we could keep. Sometimes Mr. Brothman had the original blueprint and it was necessary for me to take it to the blueprint shop and have a copy made and return the original to him at the next meeting.

The blueprint that I looked at were what he described to me as kettle or kettle drums.

Mr. Brothman tried to explain in technical terms what he was doing.

I am not a chemist or engineer.

Mr. Brothman asked me twice. He was going to be in

[illegible] -4-

[illegible] ior, [illegible]

[illegible]

[illegible] matter [illegible]

[illegible] concerning [illegible]

[illegible] suggested

[illegible] blueprints were being [illegible]

[illegible]

[illegible] would have in [illegible]

[illegible] information to [illegible]

[illegible]

[illegible]

[illegible] interested in [illegible]

[illegible] activities
[illegible] in the early fall of 194[illegible].

[illegible]
[illegible]

[illegible]

[illegible] before I [illegible] in connection [illegible]. Probably Dr. [illegible] and I had several conversations in which he stated that he was primarily interested in the [illegible] because [illegible] Dr. Selye but I was sufficiently technically [illegible] to understand what his work was about. He kept insisting that we be in contact with someone [illegible] could supply the details.

Elizabeth L. Gentles

I explained John about Brotherton's dissatisfaction with my lack of technical qualifications.

I reported that to John.

I received such instructions.

I did discuss that with Brotherman.

I told Mr. Brotherton he was to be put in contact with a technical engineer who could understand and discuss the problems with him.

Mr. Brotherton told he did not want to be put in contact with anybody else. He liked the arrangements as it was. He actually reversed his stand. I asked him why. He avoided the question and said that he had gotten to know both John and myself and, by nature, he would prefer to be with people he knew rather than with strangers.

I had another conversation with Mr. Coles. As a result of the conversation with Mr. Coles, I went back and told Mr. Brotherton that he must be carried over as another contact. I told him that he, himself, had complained that he wasn't dealing with a technical [illegible] and that [illegible] contact, and that

Mr. Coles now felt that he should be in direct contact with an engineer. When Mr. Prothman continued to protest, I informed him that he was a good Communist, that good Communists followed orders without complaining, and that the party would regard him as a bad party member if he continued to behave that way. He halfway acquiesced and said he would think it over.

It is my recollection that even after three meetings Mr. Prothman still refused to be turned over to another contact.

[illegible] meeting, when I had failed to get a commitment from Mr. Prothman that he would [illegible], I had another conversation with [illegible] details of that conversation, a conversation between all three of us - Mr. Coles, [illegible].

[illegible] could withhold either of that [illegible] engineer. Mr. Coles [illegible] that [illegible] enough nonsense and [illegible] that Mr. Prothman be turned over [illegible] the technical knowledge to deal

with him. When Mr. Brothman again demurred, Mr. Golos said to immediately tell him that good Communists did not behave that way, that as a good Communist he should take orders and not ask questions." As a result of that, Mr. Brothman agreed to the re-assignment.

Mr. Golos told Mr. Brothman that I would at the next meeting explain the arrangements through which he would be turned over to the new contact.

The next meeting took place a week or two later. Before this meeting, I had another conversation with Mr. Golos.

At this next meeting, I asked Mr. Brothman for the license number of his automobile, explaining that he would be contacted by an unknown man, explaining that I could give him no details of the man, as to the appearance of the man who was to contact him, but that the man in question would have a complete description of Mr. Brothman, but as would have the license number of his automobile, and that it was to be arranged for Mr. Brothman to bring his automobile, take it to York. He refused at first to give me the license

number of his car, demanding why I wanted it. I explained to him he would make contact with his new man by his automobile and, therefore, it was urgent for him to bring his car into New York. First he wanted to know why he had to meet the new contact in his automobile, why it was that I or John could not personally bring the new contact to introduce him. I explained to him that that was the way things were done, and he finally gave me the license number. I would not remember the license number for two minutes. I wrote the number down on a piece of paper. I gave the piece of paper to Mr. Golos. I had a conversation with Mr. Golos before my next meeting with Brothman.

At my next meeting with Brothman, I told him to bring his car into New York, to park on a cross-town street, either 27th or 28th Street, between Seventh or Eighth Ave., in the evening, that he would be approached by a man whom he did not know, whose description I could not give to him, which man would get into the righthand side of the front seat, and would identify himself to Brothman by saying that he brought records from Helen. Helen was the only name by which I was known to Brothman.

Brothman again told me not to mention this
[illegible] contact could not be worked, and I said, no.
It seemed to be turned over. I gave him the same old
[illegible] line that it was too much of his duty as a Communist
to follow orders and that, moreover, I was quite sure
[illegible] would be very happy with his new contact since
they both had/[illegible] background. That was not
the true reason I had with Brothman.

I would make [illegible] with Brothman by telephone.

[illegible] for Brothman to be turned over to
[illegible] some time in the early fall of 1941.
It was set up.

[illegible] I knew Brothman and
[illegible] I have went up to Brothman's
[illegible] Brothman's office. I do not
[illegible] office, and I never knew
[illegible] I was going on the
[illegible] on her person.

[illegible] John Abt's security. John
[illegible] that I was John's

HARRY GOLD

will testify as follows:

My name is Harry Gold. I reside at 6823 Kindred Street, Philadelphia, Pennsylvania.

I have been charged with conspiracy to commit espionage for the Soviet Union.

I entered a plea of guilty on July 21, 1950, and am at present awaiting sentence. The date for sentence has been fixed for December 7, 1950, before Judge James P. McGranery in Philadelphia.

I have been charged with conspiracy to commit espionage with one David Greenglass.

The status of my case, as far as I am concerned, I believe I am supposed to plead to that case on December 4th.

There are no other charges pending against me.

No promise or offer of any kind, directly or indirectly has been made to me in connection with these crimes and no consideration for my testimonies here as a witness has been made to me by anyone.

I was born on December 12, 1910, in Berne, Switzerland.

My family name was Golodnitsky, but my father changed to Gold.

My family came to the United States in July, 1914. We arrived at Ellis Island and there were a series of misspellings of the Golodnitsky name on several of the immigration papers and, in the resultant confusion, we were almost not admitted to the United States. The name was officially changed to Gold by one of the Immigration Officers at Ellis Island, who made the suggestion to my father.

[illegible]

From New York City we went to Little Rock, Ark., and, after a very brief stay there, we settled in Chicago for a period of nine to ten months.

From Chicago we moved to Philadelphia, Pa., in the Spring of 1915.

I am a citizen. I became naturalized on my father's papers in 1922. My father is a carpenter and a cabinet maker. He lives in Philadelphia with my brother at the address I have given.

I attended the Shaerwood School in Philadelphia until 1925. Then I went to the South Philadelphia High School, graduating from there in the Summer of 1930. In September, 1930, I entered the University of Pennsylvania. I left the University in March, 1932. Until June, 1936, I was a student in the Drexel Institute, taking a course in engineering. I received my diploma in June of 1936.

From September, 1938, to June of 1940, I attended Xavier University in Cincinnati, Ohio. I received my degree - cum laude.

[illegible] from June, 1936 up until the end of 1940, I took various technical courses in the field of chemistry and also additional courses in psychology. I hold the degree of Bachelor of Science in chemistry.

[illegible] of my employment for after my graduation [illegible] in the summer of 1928, I worked for a short [illegible] in Philadelphia from September, 1928, to December of that year - a wood-working concern.

From January, 1929, until September, 1930, I was employed by the Pennsylvania Sugar Company, working in their laboratories as a routine chemist.

From April of 1932 until December of that year I was employed again by the Pennsylvania Sugar Company in the distillery division.

From February 1933 to September 1933, I worked in Jersey City, New Jersey, for the Hallbrook Manufacturing Company - a soap concern.

In September, 1933, I returned again to the Pennsylvania Sugar Company, but, this time, in the refinery division. I remained there until August, 1935.

In July of 1940, after my leave of absence to attend Xavier University, I again returned to the Pennsylvania Sugar Company and remained there until February of 1946. I not only worked for the refinery, but for various subsidiaries of the firm.

From May, 1946, to June of 1948, I worked for the firm of A. Brotman & Associates in New York.

From September, 1948 up until May of 1950, the date of my arrest, I was employed at the Philadelphia General Hospital in the Heart Station doing research on cardiac disease.

This completes the record of my employment.

ABEL, Rudolf (continued)

In or about 1933 while employed by the Holbrook Mfg. Co., a friend of mine in Jersey City, and the man who had obtained the job for me, invited me to attend about three meetings of the Communist Party in Jersey City. In addition, he urged me to attend the Communist School in New York City, in the area of Union Square, and I did make inquiries there.

I have never been a member of the Communist Party.

The first time I began to engage in espionage for the Soviet Union was in the Spring of 1935. As a result of a series of conversations with the man who obtained for me the job at the Holbrook Mfg. Co., we began to establish the methods of manufacture of various industrial solvents from the Pennsylvania Sugar Co. It was at this time that I was employed in the Spring of 1935. These solvents are used in thinners for lacquers and varnishes.

From the Spring of 1935 until February of 1946, I was actively engaged in the translation to the Soviet Union of information on various industrial processes and plant data on various military matters.

I conveyed the information in the form of written reports, blueprints, samples of various materials which were given by me to various men who identified themselves to me as Soviet agents working under cover in this country.

There was definite procedure for effecting the identification of a Soviet agent. This procedure usually consisted of a pre-arranged recognition sign in addition to mutual identification on the part of both the Soviet agent and myself.

For the first five years of my work for the Soviet Union, my function was that of supplying information which I, myself obtained. Thereafter, I functioned as a courier in which I transmitted information from various people working in the United States to agents of the Soviet Union.

I began to function as a courier in September of 1940.

[illegible] (continued)

There were several contacts. In 1940 I began to [illegible] with a Soviet agent whom I knew only as Sam.

IDENTIFY picture.

[illegible] man whom I knew as Sam and whom I [illegible] in 1940, who identified himself to [illegible] Soviet agent doing espionage work in [illegible] States.

I can identify Abraham Brotman.

Identify Brotman

The circumstances when and under which I met Abraham Brotman were:

As a result of a conversation with Sam, during the middle of August, 1941, I came to New York early in September to meet Sam. We arranged to meet on September 22, 1941. Again the proposed meeting with the chemical engineer did not take place.

As a result of the conversation with Sam on September 22, 1941, a series of details concerning a proposed third meeting were arrived at. These details I noted on a small white card.

I distinctly recall the following points: A meeting was to be between Sixth and Seventh Avenues, somewhere in the high twenties. The man whom I was to meet was in a car parked on the south side of the street. The car was to have a license number which contained among the figures a capital "J".

I was to open the door of the car and tell the man I bring regards from Helen. Also, I was to ask the man in the car about how his wife was. I do not remember his wife's name.

There were other details on the card, but these I cannot recall. I do remember that I noted the details on a white card which I had in my [illegible] at the time I received these instructions.

On the night of September 29, 1941, I came from Philadelphia to New York and went to the appointed street between Sixth and Seventh Avenue and in the [illegible]. Some fifteen minutes after the time [illegible] had been set, a car came along. I referred

[illegible]

to my card and checked the license number. It was exactly as I had written it a week previous. I then opened the door of the car. The driver seemed startled, but became reassured when I gave him the rest of the previously rehearsed recognition signals concerning regards from Jean and the remarks about his wife.

In addition, while I do not recall the exact words, and the exact nature of the remainder of the recognition signals, I followed subsequent instructions which I had written on the card.

[illegible] (continued)

When I got into the car I introduced myself as Frank Baehler and the man in the car said that he was Abe Brothman.

After we had listened to the [illegible] fight on the radio for about 20 minutes, Brothman drove the car a short distance to Bickford's Restaurant, which is either on 6th or 7th Avenues, somewhere between 39rd and 42nd Streets. We went into Bickford's Restaurant.

There was no conversation while we were driving to the restaurant because the ride was extremely brief. I think that everything took place in the Bickford Restaurant; I recall a very short ride.

In the Bickford Restaurant, Brothman asked me about a woman called Helen, whom he identified as a person to whom he had previously given technical data, data intended for transmission to the Soviet Union. He also spoke about Helen's predecessor, a man called John.

Brothman stated that he had gotten along much better with John than he had with Helen.

He also said that he was very pleased to have met me when I first identified myself as a chemist, and he felt that because of the fact that we were both technical men, as opposed to the point that Helen was not, that he could again begin funnelling information to the Soviet Union.

I never met either Helen or John at that time or afterwards.

Brothman told me that he was employed by the Hendrick Mfg. Co. of Carbondale, Pa. and New York City. He said that he worked in an office downtown on Church Street. He gave me the address of the firm and also the telephone number. All that I recall about the telephone number is that the exchange was Barclay 7.

Brothman went into great detail concerning his personal education and industrial background. As a matter of fact, this narration consumed the greater part of the 3 hours during which we spoke.

[illegible] (continued)

I told Brothman that I was a chemist and that I did not live in New York. I told him that I was married and had a wife and two children, twins. I did not identify the city where I lived nor the firm for which I worked. I made this statement on direct orders. He did not ask me where I lived.

The final event of the evening was that an arrangement was made between Brothman and myself for a second meeting to take place, some 10 days hence.

This meeting was to take place inside of a Child's restaurant on the west side of Columbus Circle, and was to be at about 8 o'clock in the evening.

I went to the appointed place, at the designated time.

As a result of the first meeting with Brothman I had a meeting with Sam in New York City a few days after meeting Brothman. At this meeting I reported to him in complete detail all that had taken place between Brothman and myself. I gave him a written report.

Sam and I had a set and rigid procedure, one which went into complete detail regarding all meetings between us. At any one particular meeting, the details, that is the time and the exact place, were arranged. I always made a note as to the details of my meetings which we projected.

I was at the Child's restaurant at the appointed time, about 8 o'clock, some 10 days after our first meeting. I waited in the restaurant for almost two hours. At several points during this waiting period I telephoned Brothman at the Barclay 7 number, or where the Amtorg offices were, and on each occasion Brothman told me that he was just on the point of leaving. Eventually he did come, some two hours after the time which had been set.

We had dinner, and during the course of this I gave Brothman a verbal list of the types of information which the Soviet Union desired.

This list had been given to me by Sam at our last meeting. The subjects on which Russia desired specific information were the following:

[illegible]

[illegible] (continued)

I [illegible] brothers on instructions from Sam that the first matter to be considered in giving information to the Soviet Union was to clean up any unfinished business, that is, data on processes which he might have been engaged in with the woman Helen, who had preceded me.

The following were processes which were on this verbal list and in which Russia was interested:

Any process relating to the manufacture of aviation gasoline.

Any data relating to the manufacture of rubber, that is both the processes regarding the fabrication of natural rubber and any process relating to the manufacture of synthetic rubber.

Third, any information regarding the production of petroleum lubricants.

Fourth, information relating to the production of colloidal graphite. Colloidal graphite is a material used in high temperature lubrication such as in steel manufacturing processes.

Data or information relating to the production of chemicals, particularly organic chemicals such as acetone, used in the manufacture of smokeless powder, and butanol alcohol, used in many chemical processes as a basic raw material.

Finally, there was a hard gun item which referred to any data whatsoever on information which might possibly be of military value. There was nothing specific as to machinery in that list.

[illegible] told me after I had enumerated these items that he could furnish lots on a goodly number of the items which I had detailed to him.

He arranged a third meeting. At this third meeting [illegible] told me that he would have information for me [illegible], blueprints and process data.

[illegible] (continued)

The third meeting took place some 10 days or two weeks after the second meeting; it was at the corner of Ivy and Church Streets, at approximately 9 o'clock in the evening.

As far as I can quote the significance or character of 9 in the evening or 9 in the evening is that I had originally employed it this time at the Pennsylvania Depot.

The street was completely deserted, not a single, solitary person was visible.

Brotherman did not come down to the meeting until some 2 hours after the scheduled time of 9 P.M. In the meantime I made several calls to the office and just walked on the corner.

After I called the office Brotherman answered and said that he would be down immediately.

I were Brotherman when he arrived May he was so late for this meeting and he stated that there were a good many people there on that particular night, working late, and that is why for this reason that he felt that it would be not safe to entrust any blueprints nor bring them down to me.

The total time of our conversation was some 5 minutes, during which we arranged for the fourth meeting.

The third meeting was to be in the vicinity of [illegible] Church Street, Manhattan in that area, but [illegible] public places. The time given was some [illegible] after the third meeting.

The fourth meeting took place; I came to New York and went to the appointed place. I was met by Brotherman, who gave me a blueprint.

I placed the blueprint in an envelope which I had with me, a plain manila envelope of the size used to contain 8-1/2" x 11" sheets. The blueprint was folded, and I gave this blueprint to him later that evening.

We had previously arranged to meet the very night that I met Brotherman.

[illegible] (continued)

I cannot recall any details of the conversation with Brothman except the fact that he arranged for another meeting.

The [illegible] pattern was followed on some 5 or 6 successive meetings, up until the middle of December of that year, 1944.

I gave the envelope containing the blueprint which had been given me by Brothman to Sam.

Before the next meeting - the subsequent meeting with Sam which took place in New York - about a week after the meeting with Brothman - the envelope containing the blueprint was returned to me by Sam.

I took the blueprint home with me.

As a result of the conversation with Sam regarding the blueprint, I told Brothman on the occasion of our subsequent meeting, that more complete data was desired than merely a single unrelated blueprint.

Exhibit
blueprint

PAGE ONE

Up until the middle of December, 1941, I met Brothman on possibly six different occasions in New York City. The arrangements were generally of the same nature - I was to meet him at a street corner.

A resin kettle is used for the manufacture of plastic materials. This was a resin kettle intended for the use of Synrez Corporation of Pittsburgh, Delaware. Exhibit

There was no additional information; it was just a bare blueprint. This arrangement continued until December of 1941.

Sometime in December, 1941, I had a meeting with Brothman. At this time, pursuant to a conversation, I had had with Sam, I told Brothman to expedite matters. I could arrange to have blueprints, or any typed material photo-copied in a short time. The reason for telling this to Brothman was that Sam complained to me that we had received nothing of any utilitarian value to us. We had only received fragments.

In addition, I told Brothman that to date the material he had given us had been entirely too fragmentary in nature and that its utility was impaired by the fact that it was incomplete.

I also told him that his method of keeping appointments was completely out of the question. In this I referred to the fact that he was rarely, if ever, on time. Brothman became extremely irritated. He stated that the Soviet Union failed to realize the value of the material he was submitting. He added that he had given much material of value in the past and he stated as such data on the Houdry Process for the manufacture of high-test gasoline, data on a high-speed turbine-type engine for use in aircraft, and also material on one of the first jeep models.

APPENDIX II

He told me that he had given the information on the aircraft turbine-type engine to Helen's predecessor. The data on the design of the jet models had been given to Helen. Brothman continued to say that if it was of vital information, the Soviet Union desired it; that he could furnish it on the occasion of our next meeting. He said that at this very moment in the Kendrick Offices there existed a mass of blueprints relating to the design of a military explosives plant in Tennessee.

Brothman and I made arrangements whereby on the night of the 22nd of December he was to turn over those blueprints on the military explosives plant to me. I was to get them photo-copied and return them to him that very night.

The meeting was scheduled for the Northwest corner of 51st Street and Lexington Avenue. The meeting was set for 10 p.m. After seeing Brothman I met with Sam. We made split-second arrangements to work on the night of the 22nd of December, after I had picked up the blueprints from Brothman.

I came to New York on the 22nd, exactly at 10 p.m. and walked to the northwestern corner of 51st and Lexington Avenue. Brothman never came there. I waited until the last possible moment - about twenty-five minutes. Then I took a cab to West Fourth Street - Washington Square Station of the Independent Subway. The meeting with Sam was scheduled for exactly 10:30 on the uptown express platform.

When I got to the designated platform, I thought I saw Sam on a train just pulling out in the uptown direction. I took the next express train and got off at 14th Street. Sam was there waiting for me.

I told him that I had had no success and Sam excused himself saying that he would be back in a few minutes. He went upstairs and after about ten minutes returned. Sam and I then ascended to the street level at 14th Street and Sixth Avenue, and from there took a cab to 57th Street and Ninth Avenue and went into the Terrace Theater of the Henry Hudson Hotel. We had several drinks and a long talk.

(The conversation concerned my work in Rochester, N.Y., with Al Black.)

I next saw Brotman in the week between Christmas and New Year of 1941, in Akron. He said he had been away in Akron, Ohio, on December 22nd, and therefore could not keep our meeting. He told me that pursuant to our second conversation at the Childs Restaurant on Columbus Circle, during which conversation I had given him a list of material desired by the Soviet Union, he now had in his possession a complete report on the Buna-S process for the manufacture of synthetic rubber, and that he could turn over the complete report to me on the first of January, 1942.

(In the week that Brotman told me of the material on Buna-S, I saw Sam and he was highly excited.)

I made arrangements to meet Brotman on that day, the first of January, 1942. I came to New York on that day of 1942 in the morning about 11 o'clock, and after waiting for an hour or two, Brotman came along, but he did not have any material with him. He explained that he had been working on the report; but that it was not quite complete and he said he would have it for me within a week or two.

[redacted]

there then followed a series of meetings. Brotheman drove me in his car up the West Side Highway and dropped me off at a point where I could walk over to the West Station.

I saw him that same day and told him of the fact that no material had been forthcoming. There then followed a series of meetings - possibly some 12 or 15 in number, about quarter of which Brotheman never showed up at all. I specifically recall three occasions when Brotheman definitely promised to have the Sons-C report completed for turning over to the Soviet Union.

There were the incidents: The first was a meeting at the Prince George Hotel in Manhattan. I engaged a room and on a Saturday we were supposed to work all that night to complete the report. Brotheman never showed up. The second was a meeting with Brotheman at LaGuardia Field on his return from Washington after having been in consultation with the Military Reserve Commission in Washington.

I met Brotheman and David Brotheman on that occasion. They had some material - - all blueprints, but [illegible] had the complete report.

The third [illegible] occurred in March. Brotheman [illegible] arrangements that on a Saturday night [illegible] to work, driving in Brotheman's [illegible] Brotheman's house, where we could [illegible] the entire weekend - working on [illegible].

Brotheman showed up for this meeting scheduled for the northwest corner of 42nd Street and Eighth Avenue. He explained he could not go on the trip with me as his wife had some friends for guests that evening.

EARLY 1942

In very late March or very early April of 1942, I was notified by my draft board in Philadelphia that I would be inducted into the Army on the 20th of April, 1942. I told Sam of this circumstance, and he told me that I should do the following:

I told Brothman that I was being transferred by my company to California in a matter of a few weeks and told him that we should therefore try to finish up the Bunn-3 report before I left the East. Brothman agreed and we made arrangements to meet on a Wednesday night early in April at the Hotel New Yorker, at eight or nine p.m.

Brothman kept this meeting. I had engaged a suite of two rooms and we worked all that night from nine o'clock up until six the following morning - Thursday morning.

Brothman had brought with him a small suitcase full of blueprints, typewritten data and calculations. In addition, he had brought along a portable typewriter. Brothman did the typing.

We worked until six a.m., annotating and pasting in the reports, and assembling the material for the finished report. At six a.m. the report was complete, except for some of the few details of reproducing the material.

I went to bed and at ten a.m. Brothman said that he'd like to go downtown to our offices to work [illegible]. This he did. After Brothman left, I went out and had something to eat along 34th Street. I recall the day very well since there was a heavy downpour.

CHAPTER III

Except for the time when I went out to eat, I stayed in the hotel room. I had made arrangements in Philadelphia whereby I could have the day off. I made those arrangements several days before I came to New York.

Brothman returned that evening about six p.m. We completed the brief job of assembling the material and Brothman left.

The material for the Duna-3 report consisted as follows:

There were at least 200 typewritten, single spaced sheets on onion skin paper. These were a copy, not an original. The only original typing was that had been performed by Brothman that night. These were merely notes. In addition, there were a large number of blueprints, some 25 or 50 in number covering not only the details of the process but the design of specific items.

All of this I assembled into a single package, wrapped it in plain brown paper and took it with me when I checked out of the Hotel New Yorker. The material in the typewritten pages concerned a complete description of the process - the materials used in the manufacture of synthetic rubber, temperature, time of contact, and so forth and a great deal of theoretical and practical data relating to the various phases of Duna-3.

The whole report was a complete exposé of the method by which Duna-3 is made.

I checked out of the Hotel New Yorker shortly before seven p.m. and went to the area of 23rd Street and Sixth and Seventh Avenues. I waited in the doorway of Horn & Hardart Restaurant for a few minutes. Then Sam came along and I turned over the material on Duna-3 to him - the complete report.

Attached

(Affidavit (continued)

I met with at various intervals in the course of [illegible] 15 minutes with Brothman, from the time of meeting, until early in April, no turned over to me various [illegible] relating to the [illegible] process. These I kept in my home in Philadelphia and never turned them over to Sam.

There was also a considerable amount of written material, including a description of the process, and a good deal of theoretical data. The material was in Brothman's handwriting.

Offer i
evidenc

There notes were made on the night that Brothman and I were together and evidently it was more convenient at that time for me to do the writing. He read them off; I can write very rapidly, and later on they were typed up. They referred to specific pieces of equipment.

Exhibit
witness
of Fir
in Apri

Pending my selective service classification, I went to the Army and was turned down by the Selective Service Board because of my appendectomy and was classed in Class 4F.

I first communicated with Sam and advised him of the fact that I was again available for espionage work.

I received no instructions from Sam, I reestablished my [illegible] with Brothman and again on orders from Sam, advised him that I could not be transferred to California but would remain in the East.

The next meeting with Brothman took place in New York but did not occur until some time in late [illegible], 1942.

There were several consultations in between which however did not take [illegible]. I had met Brothman at Jamaica Field in January or February.

HARRY GOLD (continued)

I got in touch with Naomi Brothman at Brothman's home on one occasion and she advised me that Abe was at his other office.

She gave me the phone number and I got in touch with Abe there.

There was one meeting which occurred with Brothman in the area of the Hendricks offices on Church Street.

At this time Brothman advised me that he was having difficulties with the management of the Hendricks concern. This conversation took place in late May of 1942. He told me about difficulties at Hendricks.

There followed another period in which I was unable to get in touch with Brothman for several weeks. Finally I did call him at the office number which had been furnished me by Naomi Brothman.

I was in New York and I met Brothman in the Grand Central Station, near the Graybar Building. We went to a small drug store off one of the side passages of the Grand Central Station and there Brothman told me that he was no longer employed by the Hendricks Company. He stated that he and his co-worker, Artie Weber, whom he called Henry Golwynne, had formed a company known as the Chemurgy Design Corporation. He stated from that time on I could get in touch with him at the other offices in the Graybar Building. This was in June when he advised me

Further conversation at or about this meeting concerned the Duna S report. I told Brothman my Soviet superior had received from the Soviet Union, in which a highly favorable opinion was given on the Duna S material.

[illegible] there was one particular piece of equipment vitally involved in the Duna S [illegible] Union desired further information on. This was designated by its blueprints as the [illegible] equipment, and was made only by the Hendricks Company and he could not

obtain this information. He did say that in place of the data on this one particular piece of mixing equipment he could furnish an entire report on the whole chemical engineering unit operation of mixing and that he could have this ready in a very short time.

I also told Brothman that my Soviet superior desired very much that he return to the Hendricks Company as an employee but Brothman stated that this was impossible since he had already left the Hendricks firm.

HARRY GOLD

In the latter part of June, 1942, I came to New York and met Brothman somewhere in the Grand Central area.

We took a long walk up and down Sixth Ave., in the course of which I detailed to him the fact that my Soviet superior desired very much that he continue to work with the Hendrick Co.

Brothman told me that it would be impossible for him to leave Chemurgy entirely and go back to Hendrick, but that he believed he could work out some sort of consulting arrangement with the Hendrick firm, whereby he would still have access to their office and to their files.

The instructions from my Soviet superior, Sam, which I gave in detail to Abe, were to the effect that the Soviet Union was still very much interested in any information whatever on the synthetic rubber Buna-S, and they were very anxious to know of any developments that might come along in that field.

The over-all idea, however, behind the instructions of Sam was that by working for a firm so vitally involved in the chemical engineering process field as the Hendrick Co., Brothman would be in a strategic position where he could lay hands upon data the Soviet Union desired.

Sometime in the summer of 1942 I had a conversation with Abe Brothman, in which he told me that he was very actively engaged in designing a nickel catalyst plant for the Rufert Chemical Co. of Seymour, Indiana. Brothman stressed to me the fact that not only was this catalyst be put to the conventional use in hydrogenating shortening materials from vegetable oils, such as Spry and Crisco, but also that it would be a unique catalyst, and could be used for the production of aviation gasoline, and also as a general catalytic synthesis for the production of [illegible].

HARRY GOLD (continued)

Brothman stated that the catalyst plant being prepared for the Rufert Co. was of an entirely new type, since the nickel catalyst was carried already prepared in the material which it was to hydrogenate.

During the course of the conversation, Brothman told me that he was having great difficulty in designing the plant for the Rufert Co. since the chief chemist at Rufert, a man by the name of Freed, had refused to carry out much of the vital laboratory work, that is, the laboratory work by means of which the basic data for the design could be made available.

In the very late fall of 1942 Brothman turned over to me the complete report on mixing. This was on a week-day evening in the general area of the Grand Central Station. The material which I received from Brothman was entirely in a black leather ring-type notebook, but the rings were large, some two or three inches in diameter, and the material consisted of the following items:

First, some 300 typewritten pages, onion-skin paper - these were a copy, not an original; secondly, some 50 to 100 nomographs; thirdly, a vast amount of printed technical literature, all, as far as I could see, bearing the imprint of the Hendrick Co.

The printed technical literature gave data relating to the design and the choice of particular types of mixing equipment for doing certain chemical jobs.

I took this material and went into a small stationery store on the south side of 42nd St. just off Lexington Ave., going in the direction of Third Ave. There I purchased some heavy brown wrapping paper and some twine and wrapped the entire report securely. The package was roughly 5 inches high by 15 by 20. It was a very bulky package.

HARRY GOLD (continued)

Later that evening I went to the Ferris Wheel Bar on 57th St. and 9th Ave. and there, by pre-arrangement, met my Soviet superior, Sam. I turned the material over to Sam.

I had a conversation with Sam that evening. As a result of this conversation with Sam I told Brothman that a very important Soviet dignitary was coming to this country in a very short while, before the end of 1942. This man was coming here for the express purpose of meeting with and speaking to Brothman, though there were other ostensible and legitimate reasons for his visit. The primary purpose, however, was to meet Brothman.

Subsequent to that a meeting occurred between Brothman, Sam and myself at the Hotel Lincoln, 42nd St. and 8th Ave., New York. The arrangements for meeting with Abe had been agreed upon, that is, the day and the place had been set at a previous meeting. Once this had been arranged with Brothman I notified Sam of the day, the time and the place.

Brothman met me in the lobby of the Hotel Lincoln and we went upstairs to a two-room suite which I had engaged. The time was roughly 8:00 P.M. About twenty minutes later there came a knock on the door, and I opened it to admit Sam. According to previous arrangement I had made with Sam, I introduced Sam to Brothman as George.

The meeting lasted until about 2:00 A.M. The following items were discussed during our meeting: Sam gave a good deal of praise to Brothman for the Buna-S report. He said that this work alone was equivalent to the value of two or three brigades of first class Russians. Then followed a discussion on [illegible] between Sam and Brothman.

Brothman showed Sam certain of the items [illegible] of equipment, that is, of the Buna-S [illegible]. In particular I recall one which was a [illegible] drums of the spent nickel catalyst, [illegible] wise.

At this time Sam managed to insert the thin edge of the wedge as regarding the suggesion that the Soviet Union would appreciate it very much were he able to obtain work with a large industrial firm, preferably in the synthetic rubber or the petroleum field, say one such as Goodyear, U.S.Rubber, or Sun Oil.

The final item that was taken up was the matter that Sam told Brothman that in the future, to expedite the completion of his reports to the Soviet Union, that he would furnish stenographic help. In that way Brothman, a stenographer, and I could work together and more rapidly finish material for the Soviet Union.

At the conclusion of the meeting Sam left. As a matter of fact, three of us went downstairs. Sam left after a very brief goodbye, and while Brothman was standing there, Brothman told me that I had made him the happiest of men, and that I had provided one of the most satisfying experiences of his life by causing him to meet "George". Brothman left me saying that he felt so elated he was returning to the Chemurgy offices to work.

FRANK GOLD (cont'd)

I slept in the hotel that night and I checked out about six in the morning and went to Philadelphia to work.

Beginning about February of 1945 there began a series of meetings between Brothman and a girl called Jennie Zawrucka and myself. The purpose of these meetings was to complete a report on the so-called aerosol bomb. The aerosol bomb is, among other things, a means of dispensing insecticides in a very fine dispersion or fog.

Beginning in January, Brothman started to press me for stenographic help, and I in turn questioned him about living up to his promise. I can, however, avoid he could not be bothered and simply refused to do anything about keeping his word. In order not to offend Brothman I got in touch with the man who had originally introduced me to espionage work in 1935 and through him was introduced to a young girl called Jennie Zawrucka.

I continued from February, 1945, with Jean, up until about June of that year. I would say some ten meetings occurred between Brothman and Zawrucka. They all took place in the Amtorg offices in the Empire Building, and the usual procedure was for Brothman to dictate to Zawrucka. She would take shorthand notes, take them home, do the typing and she would sometimes send it to me by mail; most of the time, however, I picked the material up when I met her next. There was no typing done there. Some arrangement was effected for getting her a typewriter, she did not have one I know, but I am not clear as to what the arrangement was.

Jennie Zawrucka knew me as Harry Gold. She addressed me usually as Mr. Gold.

Brothman knew me as Frank Kessler but just before Jennie Zawrucka came to work with us, I told Brothman that the girl knew me as Harry Gold, and that this was the name, that he should express no surprise. I also told him that he could use this name in the future as a telegram drop.

WITNESS (cont'd)

I stopped using Jean in June or July of 1943.

The meetings during which Brothman, Jean and I worked on the aerosol bomb report were always held on week-day evenings at the Chemurgy offices. I would meet Jean at first in the Pennsylvania Station, Newark, and would escort her to New York and then to the Chemurgy offices. Later I came directly to New York and met her in one of the Pennsylvania waiting rooms there.

After her services were terminated, I would usually come to New York, call Brothman and see him either somewhere in the Grand Central area, or if no one else were in the Chemurgy offices I would go up there and speak with him.

Jean was compensated by being paid in cash by me. It was either $10 or $15 per week. I was never repaid those funds because Sam had no idea that I was taking such actions; in fact one of the reasons for discontinuing the work is that I ran out of money.

As a general practice, with the termination of the services of Jennie Zawacka, was for me to come to New York on Sunday mornings and work in the Chemurgy offices with Brothman. The subject on which we were working and which Brothman had told me to offer to the Soviet Union concerned the production of magnesium powder for use in tracer bullets and flares. The methods on which Brothman was conducting the design work was a novel one in that it involved spraying molten magnesium through a nozzle into a chamber containing inert gas, helium. The fine mist of magnesium particles would form, solidify and fall to the floor of the spray chamber and could then be removed. This method is opposed to the conventional one whereby an ingot of magnesium is taken and subjected to a succession of grinding or attrition processes until the desired particle size was produced.

One of the principal advantages of the process on which Brothman was working, and of which he told me the original idea had been Henry Colwyne's, was the virtue that any danger of producing a fire by grinding the magnesium was completely avoided. Also a more uniform particle size could be obtained.

[illegible] (cont'd)

As a result of beginning this work with Brothman, I spoke to Sam about this process, but I did not report to Brothman the true gist of what Sam had said, namely, that the Soviets already had processes for producing magnesium powder.

In the summer of 1943 Brothman obtained for me a job with a firm in Paterson, New Jersey, called S & G Interstate Corporation. The purpose of the survey I conducted at this plant was to determine whether the material could be used in a commercial distillery. I worked there under the name of Harry Gold and was paid some $300. The man with whom I worked at the Pennsylvania Sugar Company, in the Distillery Division, helped me to prepare the report. The reason for using the name Gold was because he helped me prepare the report and knew me only as Harry Gold.

Beginning in 1944 I maintained only sporadic contacts with Brothman, through 1944 and 1945.

Early in 1944 I came to New York, met Brothman, and he told me that he was doing work in the further development of aerosol insecticide bomb for a firm called the Regal Chemical Company of Brooklyn. He told me the firm was under a Government contract. He told me that on returning from a trip to Washington, Mr. Heilig had promised him a fee, or royalty of a fraction of a cent for each bomb produced, and since it was contemplated to produce several million of these, the total sum would have been very large. Then at that time Brothman took me to what he indicated was his laboratory which was at 114 East [illegible] Street, New York City. There I met a Negro chemist by the name of Gibbs, who was working in a very rudimentary sort of laboratory.

In September 1944 I met Brothman in a bar on 32nd Street, the south east corner --a combination restaurant and bar -- and we had a long conversation during the course of which Brothman told me that he had had a quarrel with Harry Golwyne, with his former co-worker, Weber, and with Mr. Heilig of the Regal Company. The upshot of all this had been that Brothman had been thrown out of his Chemurgy partnership with Golwyne and Weber, and had been dismissed from doing any further work or obtaining any further fees from Heilig. Brothman told me

...and breakup with the following people --
...Bowers, Eve Collan, ... and
...his ... and for ... a chemical
... ... socialites. At this time
... ... and I could see by my clear, ...
... ... with him.
... September, 1944. ... came
... ... but I ... to look for
... ... Company.

... continued to ... Protzman, but only
... ... Superior until
... 1946.

... meeting ... occurred in February,
1946.

... turned over to another Soviet superior
... known only as John.]

... of 1946 my relations with Sam
... terminated. I was turned over to a man whom
... as John. I worked steadily with John
... February of 1946.

... only the facts involving Abe and
... the first occasion, some time during
... ... would be possible to
... contact during the newly formed
... ... I only recall
... Abe's position to John and he said
... no point in discussing the
... Soviet Union ... through with

... traffic ... involving Abe,
... John may ... Ob.]

... my duties ... Embassy, 1946, ... of
... work, and not ... this
... ... In the course of the
... ... I made ... that I was having
... difficulty with my ... all
... ... brought immediately ... the
... ... I could ... her ... and the
... objections, and offer of a job from

Page 11 (cont'd.)

...ber 6, 1946 I joined the firm of ...ckerman & Associates, as Color Chemist, at a salary of $100 a week. I am still working in the laboratory in ..., 1947.

...ember May 23, 1947. I reached a point with my work in the laboratory where I could work more rapidly if I had a good technical literature. ...ed at 9:00 o'clock in the afternoon and I left the laboratory at 5:30 P.M., to the ... Public Library. On my way to the ... I left the ... subway at Queens ... and stopped off at the Brooklyn offices to ... Rather than ... another ... ... at the office for me to look up.

Mr. Gold, continued

Then I entered the Brothman offices (at about 3 PM), Abe came forward, grasped me by the arm, and broke into my narrative of how the laboratory work was progressing.

He said, Look, Harry, the F.B.I. was just here. They know everything. They know all about us. They know that you are a courier -- must have been that "Bitch, Helen". He said "They even have pictures of you and me together; you've got to cover me up. They are coming to see you this afternoon, and you've got to tell the same story I did. Listen did you know John?" I replied, No. He said, "Well, you've got to say you did to cover me up". He then launched into a description of a picture he said had been shown to him by agents of the F.B.I. He said this was a picture of a man with a small, wizened face, a wry grin, a receding hair line, and curly hair.

Brothman also told me that I had to tell the story -- my story to cover up the true facts of how Brothman and I had actually met. He made the suggestion that possibly I should tell the F.B.I. that we had been writing a technical book together. He also added that Miriam Moskowitz was at that moment on her way over to see an attorney at the Amtorg Company, one Gibby Macdonald.

Identify Moskowitz
Describe Gibby Mac

Direct Testimony (Continued)

Miss Moskowitz had originally come to the Brotman firm as a secretary and some time thereafter had been promoted to a full partnership in the organization.

I believe that the partnership arrangement was arrived at some time in 1946, Miss Moskowitz came to the firm some time in 1945.

In 1947, Miriam Moskowitz was the secretary of the firm and also served as the bookkeeper, stenographer and office manager.

The only supervision that I can recall is that of Herbert Brotman.

Miss Moskowitz was a full partner in the firm with Brotman and Oscar Lange.

Brotman then urged me to return to the Isburst Laboratories as rapidly as possible and this I did.

Brotman told me that I had promised agents of the F.B.I. that he would hold no conversation with me whatever, prior to the time that they interviewed me, but he wished me now to reveal that there had been a theft between us.

[illegible] affair:

Brothman told me that John had been identified to him by Agent Chamberlain on apprehension as one John Schlein. He pronounced it as if it had been Italian, German or Irish and asked me should I be shown the photograph, that I should identify John as such.

Brothman added that I should invent any story whatever to cover the true facts as to how we had actually met. He suggested that possibly it would be a good idea to say that we had been working on and writing a technical book together.

[I returned to the firm's laboratories in Elmhurst and on the way concocted the false story involving Carter Goodloe.]

On the way out to the laboratory, I considered several stories which I could tell to conceal the true facts as to how I originally met Abe. I rejected several and finally selected one.

About 20 minutes after I arrived at the laboratory [illegible] was about 4 P.M., shortly after I arrived at the laboratory and after 4 P.M., 2 men entered and asked for Harry Gold. I said that I was Harry Gold. They told me that they represented the United States Government and [illegible] to speak to me.

I wanted to bring in that I saw Miriam Moskowitz

[illegible] (Continued)

[illegible] was so big that he did her. At that time I noticed that Miriam Corbouits had come in just after [illegible]. I excused myself and she spoke to me for a minute. She said that Abe had gone home sick with a splitting headache and that she and Abe would be in touch later that evening. She left.

I am certain that they answer. It is just that these facts impress themselves on me, and that they would get in touch with me later, Brotman and Corbouits.

After Miriam left, the 2 men identified themselves to me as agents Brennan and O'Brien of the F.B.I. They advised that they had been to see us earlier that [illegible] and that he had mentioned my name to them. [illegible] that to sit in there and talk and this [illegible] for a while until the employees of the [illegible] all gone home.

[illegible] sitting in the car, the men [illegible] showed me several pictures and [illegible] of their people. I was shown one [illegible] Miscoff ce, wide rim glasses, receding [illegible] hair. It was Mathewson.

[illegible] did not know as John Golish, since Investigation Abe had earlier given

[illegible]

[illegible] being the result of [illegible] hours of interrogation [illegible] every [illegible] I [illegible] on the way [illegible] by [illegible] to the full level of [illegible] hoodlum. The [illegible] hoodlum that [illegible] completely false. I [illegible] hoodlum.

I signed the [illegible] by Agent Shannon which [illegible] the [illegible] story I told them.

[illegible] left about 9:30, but before they did, [illegible] call from Marlingdad I told her I was [illegible].

Shortly after the agents left, Miriam called, and I told her I was through in the laboratory.

A little while after that Miriam and Abe drove up to the laboratory as I bade her. They entered the laboratory, and Abe immediately said "Well, how did you make out with Libby?" I started to say that I thought I had gotten it off very well, but Miriam interrupted and gave me a big hug. She told me that I had been wonderful and incredibly nonchalant when the agents had entered.

We drove on to a restaurant on Sedgley Boulevard, called Tony of Children's. During the course of our dinner there, only two subjects were discussed: first, Abe and I spent a considerable time reassuring each other that probably the agents of the F.B.I. didn't know as much as we had at first feared.

Then Miriam told me that on her way over to see Libby she realized that she had been trailed for a while, but had finally succeeded in shaking off the [illegible].

When we were in the restaurant Miriam stated Libby's opinion had been, for example, Abe and I to talk to the F.B.I. Mainly just to tell them we were busy and that we had to go.

After we finished dinner at the Chinese restaurant, at about 10:30 or 11 P.M., Abe, Miriam and I returned to the [illegible] in Elkins Park. There we held a long conversation, during which the following matters were discussed: First, Abe wanted to know what story I had given to agents Sisenson and O'Brien, and I replied in detail the completely false fable involving Carter Goodrich, the Guggenheim Physical Society, the Franklin Institute in Philadelphia, and the dinner at Lou Tendler's.

Abe then approved of this. We then began to question me as to whether there was anything in my past involving Soviet espionage activities or personal life which could blow, because otherwise he might be tripped up on further questioning.

[illegible] that I could not tell him anything about [illegible] I had done for our Soviet Union, but I did [illegible] the fact of which he was not aware. These [illegible], first, the fact that I was in naturality [illegible] and did not have a wife and two children [illegible]. The second point was that my brother [illegible] killed in action in the Pacific, as I had [illegible] back in 1943; but we was still alive.

[illegible] point that came out was the discrepancy [illegible] by both Brothman and I that a discrepancy [illegible] between the dates 1940 and 1941. Brothman [illegible] he had told the agents that I had come to [illegible] in the fall of 1940. I had given the true [illegible] 1941. I was disturbed at this, but Brothman [illegible] to by saying that I could always tell [illegible] since I had made an error, that my memory [illegible]. He made the mistake, and he insisted that [illegible] point to him would substantiate the date as 1940.

[illegible] Brothman about the pictures he had sold me, [illegible] that by which Sharon and Agent O'Brien, there [illegible] and I were seated in a restaurant with our [illegible] close together. He said that he had been [illegible] pictures, and he could not identify the source [illegible] was doing them.

I was informed for the first time that I had been indicted [illegible] date in 1951, and various members of the [illegible] investigation during the following year, [illegible] to 1945, as near as I [illegible].

[illegible] and I discussed the fact that the use of the [illegible] could possibly be explained away [illegible] by the explanation that I had used this name to cover up [illegible] I had used this name to cover up [illegible] card due to the Pennsylvania Sugar Co. [illegible] that I was also outside work. She approved [illegible], which [illegible] excellent idea.

[illegible] then ended the all of this conversation. At [illegible] point, however, she left -- about 1 AM -- to go out [illegible] and cried, and while she was gone [illegible] I pondered the fact that she had diverted Sharon [illegible] in my difficulties. He felt that a fair [illegible] would have run across a couple or three hundred [illegible] and that Sharon was trying to appear to [illegible], but all [illegible] indicating he was the [illegible]

Harry Gold -1-

Before leaving the laboratory, the vital matter which was discussed was Brotman's suggestion that should I be questioned further, that I tell a story about our having worked on the preparation of a technical book.

Either that night or the following evening, Abe, Miriam and I drove from Queens to the Penn Station. I was returning home to Philadelphia for the Memorial Day week-end.

During our drive, a quarrel broke out between the two men involving Tom Black. Abe was very critical of the fact that on several occasions in 1945, 1946 and 1947 I brought Black to the Brotman Laboratories to assist with the work there and also to the engineering offices to act as a consultant. He was also critical about getting Black a job in Philadelphia.

Thomas A. Black was the man who originally introduced me to my first espionage agent, one Paul Smith.

Black had last been to the Brotman offices in April of 1947 in connection with consulting on the possibility of Brotman fabricating a plant for the production of [illegible] for the Antioch Company. At this time

I h[illegible] clear to the that Black had covered the [illegible]ajority of his data during the course of conversation upon this subject of Penicillin for the United Nation. We even discussed the inconsistency involved in obtaining data by espionage and then trying to put a mind build.

The principal point of the [illegible] seemed to be that by my having had such a dangerous run on Black around the Brotherhood Labor Union and office, I would thus focus the attention of the FBI upon Brotherhood and in turn reveal the[illegible] espionage activities. I in turn got very angry because Black had done all of this work for no fee whatsoever and in fact had never been compensated in having his train fare paid. We had just come to the point where I was ready to hit the when [illegible] broke up the quarrel and said that we were [illegible]ingly foolish to fight at such a vital time. [illegible]n that for a fight to break out between the and [illegible] exactly what the FBI desired. In that way they could manage to discredit the falseness of our stories.

[illegible] parked in the front of the car. It was the [illegible]. It was a 4-door Pontiac Sedan. The reg[illegible]

...ing, I noted a couple of him in front, and ... the second in the back.

... and at that time the two were ... the Queensborough Line. Then we ... the station if you in full swing and ... in two blocks.

... from Philadelphia on a day or two and went ... to Prothman's home in Sunnyside. I returned ... Then, Mrs. Hall and I drove over ... Prothman's apartment which is on one of the ... just off Central Park West.

... no operators house, but first warned ... with carefully the windows across the ... that we were being observed.

... We were met in courtesy with ...

... Prothman's, he told me that he ... further advice as to how we ... should there be any further

Page Eight

All of this conversation took place in the presence of Leon Brothers. Brothers was in the apartment about 30 minutes. I would judge this was about 9 P.M. When Leo came down, Jimmy Needleman was with him. I had met Needleman before. I had first met Jimmy Needleman in the early June, 1960, after I started to work for the Brothers organization.

Save for remin
description of
Needleman and
Ambers activi
open and conder

Needleman was in a suit. He was not
carrying a hat.

Needleman and Leo met me at the door. Needleman
then started with me in the back; Leon Brothers
was in front with Leo. We drove for about
five minutes.

Then Leo, Leon and I left Needleman that evening,
my ultimate destination was Leo's summer home
at Mt. Kisco, N.Y.

We started to drive, but drove for about five
minutes, eventually dropping Jimmy off at a

about sooner in Manhattan.

During the course of the ride, Jimmy told the following: If the one I should ever be interrogated by the FBI, to tell them as follows: Have had with them; tell them to go to hell; Enter them out of the office; tell them you are busy, you don't have time for such nonsense. There was possibly more, still, but I don't recall.

After that, Abe, Lenny and I drove to Abe's summer home near Peekskill. I don't recall what we spoke about on the way up.

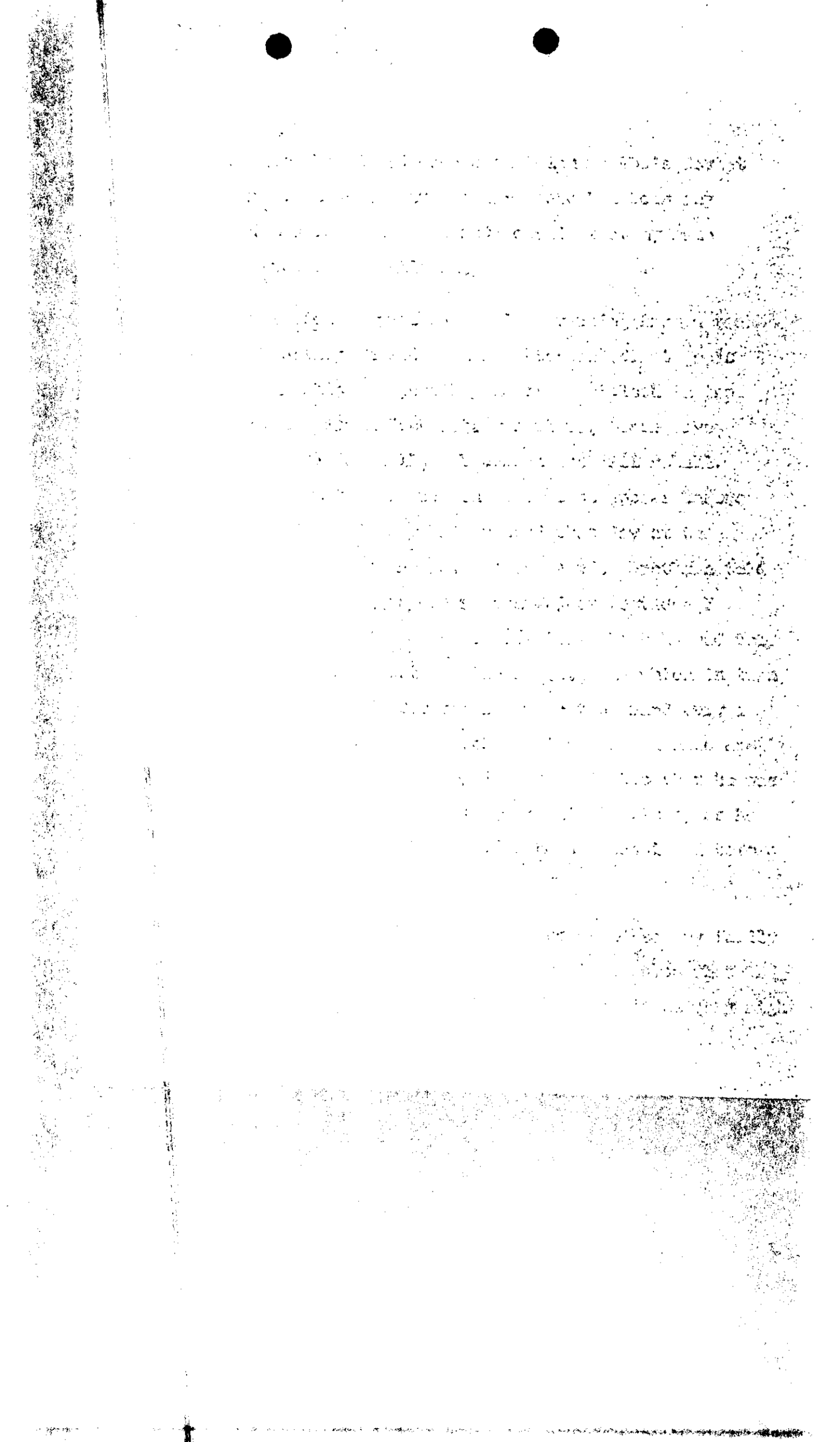
When we arrived, the two I went for a walk along the side roads near his home, and during the course of this walk, the following matters were discussed: First Abe wondered whether Nelson had given the FBI any information about the fact that I had turned over blueprints on the high speed precision grinder's secret; and also blueprints of the very first type models.

Abe explained Nelson to me during our very first meeting in September of 1941 as the Soviet [illegible].

Memorandum

It was not that the material or the aircraft engine had been given to John and that on the loop had been given to Helen. He then discussed the issue that possibly Helen had failed to appreciate the nature of the drawings she had recently given the technical background. The second matter was that I told Brotherton of a visit by two agents of the FBI to my home in Philadelphia that weekend. This had occurred shortly after I had gotten to Philadelphia. I told the that the agents spoke to me and inquired whether I had indicated to Shannon and O'Brien that there still might be some of the blueprints which she had turned over to me belonging to the Hendrick Company. She was very much upset by this and criticized me for ever having indicated to Shannon and O'Brien that such blueprints might still be in existence, but I assured him that none of such had turned up, but that the agents had just conducted an investigation, but had merely made an inquiry.

te



[illegible]

of his petitions to Mr.

He told me further that I should not answer
[illegible] that he [illegible] should show no fear,
and if necessary, I should be defiant.

He told me that very likely the Grand Jur[illegible]
[illegible] which we had first
suspected the right, and it concerned this matter of
[illegible]. I then told him that I was afraid that
[illegible] showed it incorrigible records on some of
[illegible] particularly that I had
[illegible] the northwest.

I did not [illegible] her.
(Telephone conversation)

He told me that [illegible] very far fetched
[illegible] that I should not worry at all.

[illegible] very far fetched but
[illegible] such a want
[illegible] years, and so

[illegible] that he would be entitled
[illegible] I should stay clear of the matter of giving it
[illegible].

I told Abe in response to his question, that I had succeeded in creating the impression of a small, timid, frightened man, who had become involved and had committed an overt act and was now harrangued by the ramifications of this affair.

Abe and Miriam both said that this was wonderful.

This completes the Tokarski business.

I remained with Abe Brothman and his associates until June of 1948. In the months between 1947 and June of 1948, on several occasions Brothman stressed to me that despite the fact that the firm was no longer paying regular salaries, that I could not leave the organization because two of us had to be together in close proximity, so that we could check our story, should there be a Federal investigation by the authorities.

In May of 1948, Abe and Miriam went on a trip to Atlantic City together. They were gone for a few days. They returned very early in June. Following their return, Vago, Levine and I left the Brothman organization.

On the last time that I saw Abe which was on a Saturday, very early in June, 1948, he told me the following words: "Don't pull a Louie Budenz".

Brothman told me that should I be questioned by the Rover boys. I understood he was referring to the agents of the F.B.I. He told me that I should remember to adhere to the false story we had originally given to both them and the Federal Grand Jury. The point is that he said the words in a threatening tone.

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 11-14-50

ABRAHAM ROTHMAN

100-95068-1B
(Title of case)

Submitted by Special Agent JOHN C. COLLINS

Source from which obtained P. RAUSCHENBACH, PERSONNEL DIR.

Address AMERICAN CYANAMID CO'N. 30 Rockefeller Pl.

Purpose for which acquired EVIDENCE

Location of bulky exhibit IN CABINET WITH FILE

Estimated date of disposition TO BE DECIDED AT CONCLUSION OF CASE

Ultimate disposition to be made of exhibit RETAIN

List of contents:

✓ 103. Photostatic copy of the employment application and related Papers of Alfred William Osborn

Destroyed 2/13/52 Collins

60
100-95068-1B
F. B. I.
JAN 1 1951
N. Y. C.
ROUTED TO | FILED

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 12-13-50

ABRAHAM BROTHMAN

100-95068-1B
(Title of case)

Submitted by Special Agent JOHN M. COLLINS

Source from which obtained USA JOHN M. FOLEY

Address SDNY

Purpose for which acquired INVESTIGATION

Location of bulky exhibit IN CABINET WITH FILE

Estimated date of disposition TO BE DECIDED AT CONCLUSION OF CASE

Ultimate disposition to be made of exhibit RETAIN

List of contents:

104. Photostatic copy of affidavit of USA Irving H. Seppol.
105. Photostatic copy of Judge Irving R. Kaufman's charge to jury.
106. Photostatic copy of Judge Kaufman on certain motions made by defense counsel William M. Kleinman.

* All of the above were submitted to US Circuit Court of Appeals by the government in opposition to defendants application for release on bail pending appeal.

Destroyed 2/12/52
by SA John M. Collins

(61)

100-95268-1B
F.B.I.
JAN 1 1951
N.Y.C.
RECORDED | FILED

FD-141
(7-1-48)

BULKY EXHIBIT

Date received [illegible]

[illegible]

[illegible]
(Title of case)

Submitted by Special Agent J. M. Collins

Source from which obtained AUSA Vincent P. Rao

Address

Purpose for which acquired [illegible]

Location of bulky exhibit [illegible]

Estimated date of disposition [illegible]

Ultimate disposition to be made of exhibit Retain

List of contents:

✓ 107. [illegible] ABRAHAM and NAOMI [illegible]

Destroyed 2/12/52
by SA. John M. Collins

100-95068-18 (62)
JAN 23 1951

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 5/1/51

ABRAHAM [illegible]

100-95068-1B
(Title of case)

Submitted by Special Agent John F. Collins

Source from which obtained [illegible]

Address

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Estimated date of disposition To be decided at conclusion of case

Ultimate disposition to be made of exhibit Retained

List of contents:

108. Photostatic copy of letter dated 3/11/51 from John C Vinton addressed to Irving M. Saypol.

Destroyed 2/13/52
JFC Collins

63
100-95068-1B
[illegible] NEW YORK
MAY [illegible] 1951

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 5/8/51

[illegible]

100-95068-1B

(Title of case)

Submitted by Special Agent [illegible]

Source from which obtained John L. Foley

Address [illegible], SDNY

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Estimated date of disposition To be decided at conclusion of case

Ultimate disposition to be made of exhibit Retained

List of contents:

109. Photostatic copy of appeal filed on behalf of [illegible]

Destroyed
9/25/57

64
100-95068-1B
[illegible]
[illegible] 1951

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 5/8/51

ABRAHAM BROTMAN, was

100-95068-1B

(Title of case)

Submitted by Special Agent JOHN F. COLLINS

Source from which obtained Warden E.G. Thompson

Address Federal Detention Headquarters, NYC

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Estimated date of disposition To be decided at conclusion of case

Ultimate disposition to be made of exhibit Retained

List of contents:

110. Photostatic copy of letter from Jacob Brotman to [illegible] Markowitz dated 4/20/51.

65

100-95068-1B

[illegible] NEW YORK

[illegible] 1951

Dear Nat,

This note is being sent you because of the urgent need for action in behalf of Brotman & Miriam Moskowitz. No matter how busy you are, you must immediately take care of the various matters to be discussed in this note. Couples liberty, their sole resources, & the peace of mind & happiness of their families are involved. Because of this, if you cannot come on Saturday, come during the week. Your coming to the attention of Mr. K. will hurt me very little if any. Mr. K. may already know of your having come personally. He already knows of Mr. Minton. Here are the various matters:

1. M. Moskowitz - You've been asked to prepare her appeal. You must get started on this immediately. In addition, most important, she was digested this past Wednesday to file an "election not to serve" form, otherwise they would have shipped her out of the city. Henceforth while this form is in existence her time has ceased to count. It is my belief that this was done for the following reasons (a) No visits from an appeal lawyer (Holt is a city jail & not a Federal one - & why should the Warden there take responsibility for a Federal prisoner especially when (c) She is ill, had stomach & getting dose (d) a little troublesome - complaints about food, commissary & perhaps more. Therefore it is necessary today to get the authorities (Warden & then Mr. Bennett, Director of Prisons in Wash.)

for Albert to stay until determination of her appeal, as is ordinarily the practice with the writ. If the Supreme Court, this is unsuccessful than all matters must be straightened out (Tested Chemicals, etc.) so that she can allow Israel to be shipped out + thus not lose any more time than is necessary. She is eligible for parole on July 28th (5 months hence) plus the number of days for "Election" to serve remains in Jail. Ordinarily she has excellent chance for parole etc. In view of the color in this case the chances are slightly lessened. However, more facts + color should be gathered to prove that she is innocent + not a "Commie". so as to aid her chance for parole. For this purpose I shall go to see + you should consult with Mr. Minton. I don't think you have time to argue this appeal this spring. Therefore you should get an extension of time until the fall + see what happens with her parole. The parole board will be here in June, + their decision comes 3 weeks later. Naturally if she gets parole, there would be no necessity in appealing in the fall.

2. Mrs. Brotherton has been most naturally + emotionally upset because of the ordeal for almost a year. On top of this she has financial difficulties. I'll give her encouragement when he comes to see you please be patient + patience. Encourage her to see you or call you anytime she has problems

To N.A. Yarbrough - 2

2 (cont) Miss Brothman was ~~had her~~ her regular weekly visit on Monday. When she left on Wednesday about M. Mosmond's possible means of skipping the husband, she tried to see him on Wednesday but was turned away. Likewise on Thursday & Friday. In desperation she asked Messing to come in to see Brothman - SATURDAY & convey the message.

3. You must arrange promptly to see Mr. Minton & let him know that in civil matters you represent Brothman. Also discuss M Mosmond case with him. If he isn't there speak to Mr. McNulty his partner. Tell Minton (or McNulty) that Brothman & you & that he understands that Minton may not want to argue the appeal until the fall. Anything that Minton wants to do is perfectly O.K. However appeal is going to wait, to please make strong appeal for bail. (Carrying this out, will indicate to Minton that you represent Brothman & so displace Messing. Ask Minton about printing of minutes & follow same up with Messing - Messing was given months ago $3,000 specifically for the printing. Check cost of same). — Messing when he was in S.H.T (yesterday) said that Johnston was going to argue appeal in June (which means he has to file appeal within the next four days), & also that the minutes & briefs were already printed. Follow up on all this immediately.

P 4- 7/25/51
N.A.M.

4. Tested Chemicals Inc. — This matter has been terribly neglected & therefore requires prompt attention. The plant has functioned now for several months. Get together promptly with Mrs. Brotherman & Clare Moskowitz (Their SISTER) for full details. It appears that all the other stockholders, except for Brotherman & Moskowitz, want to make an assignment for benefit of creditors & want to appoint Messers as assignee. THIS MUST NOT TAKE PLACE for many reasons — such as ① His questionable honesty & morals ② His lack of competence ③ There is no need to waste the firm's legal fees & unnecessary expenses & ④ This interests conflict with those of Brotherman & Moskowitz

(Such as — When the plant was being built Brotherman & M. worked a practically continuously for 6 weeks — all of Sept. & ½ of October 1950 rendering engineering service for which Tested Chemicals were never billed. We want you to bill Tested Chem. immediately for this at the following reasonable rates $8 per hour for straight time for A.B. & M.M. & $4 per hour for straight time for M.M. 1½ time for overtime & double time for Sat. & Sun. (Travel fare for & reasonable fees for this type of work). Compute the bill at average day of 14 Hours. During the week — 8 Hours straight bill & 6 Hours overtime. Also 6 Sat. & 6 Sun. at 14 Hours & double time. Plus interest at 6% on this bill. Also 6% interest on A.B. & M.M. investment which is 4 or 6 times as large as the others. Of course,

P.S - 4/24/51
N.A.M.

10/ N. H Markowitz

in order to do this properly, you'll have to demand & get promptly from Mark (Tested Chemicals, Inc) all agreements, resolutions, copies of minutes, financial statements (including profit & loss, showing how much has been advanced or loaned to Corp. by various individuals, & how much each individual has paid for their STOCK), copy of license agreement (10¢ a lb.) with the Buttenwieser, & copy of (ALLEGED) promissory note that Pressing owned to get Naomi Broth more to put in $5,000 from bail money into the business, agreement whereby the Buttenwieser came into the Tested PICTURE — At this point I want (PROMPTLY) to emphasize that a registered notice should be sent to Tested Chemicals Inc. cancelling the sale & (PATENTED) the process into (a licensing agreement) by which TESTED where making the product. This "provides for payment of 10¢ a lb. Point out that this agreement is being cancelled for a number of reasons 1. FAILURE to pay. (2) FAILURE to stay in operation (3) No future, etc.

LIQUIDATION of Tested Chemicals can be accomplished by two methods (1) Sale of assets by unanimous consent of stockholders in bulk to private bidders (2) Sale of assets piecemeal or in bulk (whichever bid is higher) at a public auction sale.

With reference to #1, Broth more would very much prefer that before same takes place, that the other stockholders arrange releases with Buttenwieser. Otherwise they could bring

all kinds of suits charging fraud (in connection with some type of business or firm claiming all sorts of verbal agreements with reference to any joint business activities. (THEY are a "bad" kind.) The Procedure of liquidation is the simplest to state, but will be the most difficult because of the necessary agreement between the stockholders + Bottleman. Alternative #1 fails because of inability to get very valuable releases from the seamstresses, Messing, etc. Therefore #2 will be necessary. The disadvantage of plan 2 is that it is more expensive to carry out (auditors expenses + perhaps fraud suits + litigation) + it may bring bad name + bring back to the question of assignee. Both agree that maybe the only one. After all (?) has 80% interest of the money invested. Under no circumstances should Messing ever be co-assignee.

(By the way Bottleman intends to issue Memorandum Items of money the stock of Textile Corporation.)

5. The assets of the books + records, which are down at Filey Square, should be checked into. What are the Internal Revenue regulations during the time?

6. After you have digested this letter, + have met with Mrs Bottleman, Clarice Mosimann, + "writer M.B.", You should arrange to bring A.B. + M.B. to Filey Square, so that they can discuss the things among themselves

P.J. - 4/12/71

Thanks + with you. There is at present an injunction pending there, as they were brought down a couple of weeks ago regarding their fine. I hope it should not be too difficult to bring them down again on this writ for a new writ based upon any one of the following: (1) Straightforward fine (2) Non handling of appeal of 17.14 & you need both present.

P.J. By the way months ago A.B. asked Massey for his file, including agreements etc. Massey "stalled" several times for a couple of weeks & finally indicated that he wasn't going to give him the file. He must get. Both was complete file from Massey, including (a) Agreement of A.B. with Lennox & Sugarel Chemicals LTD. (which A.B. considers now null & void) (b) Agreement of A.B. associates with Industrial Process Engineers (LEWINSON) under which A.B. intends to sue for money due. → J.P.E. should be pressed for money & accounting of funds owed A.B.A. (STORIES can be told of the Lennox practice of phony SHIPMENTS issued to BANKS + false statements of what SHIPPED + NOT shipped + of false amounts of orders on hand)

As you can readily see there is quite a bit of work to be done + to be done promptly. I'd just want to assure you at this time that you will be paid in full for your efforts & soon as we get started proper. Thanks a lot. J.F.

FD-141
(7-1-48)

BULKY EXHIBIT

Date received [illegible]

[illegible]

100-95068-1[illegible]
(Title of case)

Submitted by Special Agent [illegible]

Source from which obtained [illegible]

Address [illegible]

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Estimated date of disposition [illegible]

Ultimate disposition to be made of exhibit [illegible]

List of contents:

111. Two photostatic copies of letter written [illegible] to Norman Goldfarb.

66

100-95068-1B

SEARCHED ..... INDEXED .....
SERIALIZED ..... FILED
JUN 14 1951
FBI - NEW YORK

May 25, 1951

Dear Norman,

In the mail I passed you a long time ago I have supposed to deal with the question of perspectives, and the letter of June 4th giving on the sale of mining equipment. We touch the question in just the order.

PERSPECTIVES:-

As you know, the items we have discussed and standardized Powered Valves (Motor-Operated Valves and the Radiator Valve); Instruments (the Capacitance Ontario Control and the Liquid Level Control); Mining Equipment (the Eiby Vacuum Filter and a projected Horizontal Centrifuge).

Let's look at these, firstly, from the standpoint of "group perspectives" and then from the standpoint of individual perspectives.

From the broader "group perspective", the Power Valves and Instruments form a ground approach for partial and complete Refrigeration. [illegible] Next May the time you have read the November and December 1950 articles on Refrigeration. I. We mention that I got on the telephone to several groups of engineers at Du Pont, Monsanto, General Anilene Works, and Dow Chemical on the subject of Refrigeration economics for both partial and complete Refrigeration from a great factor in the chemical industry.

By "partial refrigeration", I mean the condensing of gaseous vapours of operations within an existing process, perhaps against the ambient vapours outside the unit and thus to cause or form a second condensate. [illegible] mean by "complete Refrigeration" is typified by the plant discussed in the second of the two Refrigeration articles.

Rotating shaft, rolling friction rollers, friction disk instruments, and adjustable friction disk ranges of pressure rollers, flat or with frustum-shaped surfaces, cylindrical surface rollers, pressure-cylinder spatial rollers, extended rollers, and spatial rollers. I discuss the shortcomings and the ordinary use of these in a previous communication, and I would expect that you would find such remarks again. But, for the brief purpose of this discussion, it is only necessary to point out that the most unsatisfactory of the usual categories of rollers with their present shape of bearing surfaces are the friction rollers and the shoulder-and-pressure rollers. The rollers have suffered from a prevailing commitment to "one-off" operation, the corresponding low pressure ranges in which they are adapted, and by their frequent bearing stresses "low reading qualities" (that is, as a group they are not referred as light-duty). The shoulder-and-pressure rollers have suffered from a poor adaptability to flexible or modulated control.

The Packless Valve on which we are working is, I believe, a valve attempt to overcome the above-mentioned shortcomings of the ordinary class of valves. Certainly, it affords higher reading forces than have previously been attempted with rollers, and by this claim has a longer range of disk-and-bar arrangement with range. The higher reading force quality and the "low reading qualities" of the bearing-on surfaces are not positive but that it rather makes for higher reading forces than have ever previously been attempted with "packless" type rollers. In the full range Mettle model of our Packless Valve, it takes out from a type of waves (that is, flexible and modulated contacts) never before attempted with rollers. And, finally, it seems to me that our Packless has a better adaptability to fabrication in a wide range of

suitable than any of the solenoids with which I am familiar. [Especially as regards, the "full range throttle" model of the Jacksons, it opens via the impedance bridge principle, [example] a wide range of instruments which we might furnish in conjunction with this model.]

Now, as to the motor operated valve on which we have been working. There is no getting away from the fact that of all the conventionally-employed powered valves, the electric motor operated class is best suited to real tight-shutting applications. ~~The~~ Even the popularly-employed diaphragm motor valve suffer from "low seating qualities". The motor operated valve on which we have been working makes an adjustment, and is completely adapted to the necessity of making this valve suited to "throttle and modulation control".

Thus, you will see that the driving purpose in the two valves which we have handled is to plug some of the gaps in the range of powered valves for Robotization duty. This does not mean, that I have been, or you should be oblivious of the application of these valves outside of Robotization.

Now, I mentioned instruments as a second main category of Robotization inventions. Instruments as used in Robotization are properly divided into two main categories: "on-off" types, and "throttle or modulation" control types. "On-off" types are almost exclusively committed to use as "pure signal" generators furnishing the pivot signals from which whole sections of interlock systems are called into operation. The "throttle or modulation" types are the real key instruments in sophisticated process control.

Thus far, we have made only the very sketchiest steps into the question of

instruments, and they have been accepted to be "on-off" type, having all the class of instrument in the market presently available. The shortcomings of the conventionally available type are that they possess a very low order of accuracy, are limited to control around a single control point (one range around a single control point), and are frequently unreliable. The cycle of the "on-off" type is "time signal generation, detection, then set-up". As such, complete dependability, high accuracy, and simple adjustment are demanded. The ability to give instrument of this type, a multi-point control would be a step advance.

The liquid level control unit which I provided you is an attempt to plug one of the most flagrant gaps in the "on-off" field with a dependable, low cost instrument. In the further material which will reach you on this instrument, you will notice that the instrument will be adapted to multi-point control (and, in some models, indicator).

The expected customer circle which we have discussed has been an attempt to achieve high accuracy, stable, and dependable control in connection with mercury column instruments such as thermometers and manometers. [The possibilities of the expected customer circle with vacuum manometers as an end instance of the application to mercury column instruments.] The further work that I shall do on the expected customer principle will be towards arranging the instrument a multi-pointed control feature as well.

Generally speaking then, the goal as regards "on-off" type instruments will be to get stable, dependable, and high accuracy control, in combination with the feature of multi-point control. Finally, the goal will be to improve the type of manometer

data. Conventional "on-off" instruments to expand to include various forms coordinate as impedance, phase, etc. ~~[illegible]~~

~~"phase angle" [illegible]~~

besides the potential of "on-off" instruments to "phase angle" meters would mean more than increasing the accuracy, the dependability, and the stability. It would involve developing a class of instrument which responds to the ratio of various phase coordinates. (In other words, it would involve the development of a class of derivative-action "on-off" instruments) We must also be a further goal of our work in the field of instruments.

[At some future time, it might be a point from the simplest to more accomplished derivative-action "phase angle" meter commercially available equipment. Just when it would be too much of a digression.]

The third principal component of Refinetics system consists of "control or modulating" control type instrument. This is called the heart of complicated process control.

Now the problem has come, and how to solve the ~~[illegible]~~ ability. First let us say that it will be the point of view, such thing as where the previous one left off.

Yours,

Jake

Mr. Herman Goldfarb
% Terminplex Corp.
Port Lewis,
New York

May 25, 1931

Dear Norman,

In the mail I passed you a long time ago I have supposed to deal with the question of proportions, and the details of how to go on the sale of mining equipment. I'll finish the question in just the order.

PERSPECTIVES:

As you know, the items we have discussed and how the Pressure Valves (Motor-Operated Valves and the Needles Valve); Instruments (the Expectance Antenna Current and the Liquid Level Control); Mining Equipment; & Rotary Vacuum Filter and a proportion Magnetic Centrifuge.

Let's look at them, firstly, from the standpoint of "group proportions" and then from the standpoint of individual proportions.

From the market possible group proportions, the Pressure Valves and Instruments form a ground approach to partial and complete Robotization. I trust that by this time you have read the November and December 1930 articles on Robotization. I. He mentions that I got on the fact that I showed the group of engineers at the Port, Mercantile, Terminal Auditorium, and Pier Elevator on the subject of Robotization convinces me that both partial and complete Robotization have a great future in the chemical industry.

By "partial robotization", I mean the automatizing of some processes within an entire process, perhaps just the critical processes while the rest are left to some other control. What I mean by complete Robotization is typified by the plant described in the second of the two Robotization articles.

Perhaps you'll agree with me, from what I've said, that the Munsell system is the only system of practical value that we have available to us today. Other systems, such as the Ostwald system, are quite impractical to use, and are therefore of little value. I discussed the shortcomings and the value of the Munsell system in a previous communication, and I would suggest that you consult that material again. But, for the brief purposes of this discussion, it is only necessary to point out that the most outstanding of the many advantages of using the Munsell system is that the colored cubes and the shades are graded values. The colored cubes suffer from a substantial commitment to "on-off" operation. The comparatively few pressure ranges in which they are adapted, and by their grouping tendency towards "two-setting operation" (that is, one group, they are referred to as "light-shading"). The shades are graded values but suffer from a poor adaptability for Manila or matched color.

The Paddles Value in which we are working is, I believe, a valid attempt to overcome the above mentioned shortcomings of the colored cubes as a whole. Certainly, it affords higher setting forces than have previously been attempted with colored, and by this does have a larger range of black-and-white component into play. The higher setting force quality and the two setting qualities should be an improvement but that it also made for higher setting forces than have ever previously been attempted with paddles type colored. In the full range Manila model of our Paddles Value, it does not have type of covers (that is, Manila and matched content) never before attempted with colored values. And finally, it seems to me that our Paddles has a better adaptability to fabrication in a wide range of

available. Here any of the relevant units selected are found. [Especially as regards, the "full range Watts" meters of the fractions, it goes over the impedance bridge principle, [a whole range of instruments which are major forms in connection with this work.]

Now, as to the meter operated valves on which we have been working. There is no getting away from the fact that of all the commercially employed power valves, the electric meter operated valves is best suited to real light-duty applications. It Even the specially designed class B valves suffer from "low reading qualities". The meter operated valves which we have been working makes an adjustment, and is especially adapted to the necessity of making these valves suited to "Watts and watt-hour meters".

Now, you will see that the driving power in the two valves which we have described is the grid current. The range of power valves for Refrigeration duty, the ones we have been, or you should be conscious of the application of these valves outside of Refrigeration.

Now, I mentioned instruments as a second main category of Refrigeration meters. Instruments as used in Refrigeration are generally divided into two main categories "on-off" types, and "Watts or watt-hour" control types. On-off types are almost exclusively connected to you expect quantity showing the point angle from which certain of certain applications are called into question. The "Watts or watt-hour" types are the real key instruments in employing control.

Now you will see much only the big problems after the question of

instruments, and thus should be confined to the "on-off" type. Looking at this class of instrument in the widest possible manner, the existence of the conventionally available types do not fully preclude the possibility of accuracy, as applied to control around a single control point (or range around a single control point), and are frequently satisfactory for this. We speak of the "on-off" type as "open-ended" control. Relatively this sub-type is rapid, simple, dependable, of high accuracy, and simple adjustment and demand. Its ability to give instruments of this type multi-point control would be a sharp advance.

The liquid level control with which I provided you is an attempt to play one of the most elegant gaps in the "on-off" field with a dependable, low cost instrument. In the further control which will result from this instrument, you will note that the instrument will be adapted to multi-point control (and, in some models, modulation). The capacitance antenna control which we have discussed further is an attempt to achieve high accuracy, stable, and dependable control in connection with mercury column instruments such as thermometers and manometers. [The possibilities of the capacitance antenna instrument in connection with vacuum manometers and the use and nature of a separate for mercury column instruments.] In further work that I shall do the capacitance antenna principle will be found capable of giving the instrument a multi-point control feature as well.

Generally speaking then, the goal as regards "on-off" type instruments will be to get stable, dependable, and high accuracy control, in combination with the feature of multi-point control. Further, the goal will be to increase the type of accurately

date. Conventional "on-off" instruments respond to absolute values of the process coordinate (e.g. temperature, pressure, etc.) that are being measured. Under the pretext of "on-off" instruments as prime signal control would involve more than increasing the accuracy, the dependability, and the reliability. It would involve developing a class of instruments which respond to the rate of variation of the process coordinate (in other words, it would involve the development of a class of derivative-action "on-off" instruments). We must then be a further goal of research in the field of instruments. [At some future time, it might be a point from the application of more accomplished derivative-action "prime signal" with conventionally-available equipment. Just what it would be [illegible] of a diagram.]

The third principal component of Robertshaw systems consists of "pneumatic" control type instruments. These [illegible] called the family of [illegible] process control.

Now the conclusion has come, and I have to close the chapter. Just let me say that I will be the first of many, such [illegible] my whole life previous and [illegible].

Yours,

J. Ziegler

FD-141
(7-1-48)

BULKY EXHIBIT

Date received 6/7/51

[illegible]

100-95068-1B
(Title of case)

Submitted by Special Agent [illegible]

Source from which obtained [illegible]

Address [illegible]

Purpose for which acquired Investigation

Location of bulky exhibit [illegible]

Estimated date of disposition To be decided at conclusion of case

Ultimate disposition to be made of exhibit [illegible]

List of contents:

112. Copy of Marshall's return to Writ of Habeas Corpus.
Copy of affidavit of [illegible] Foley.

67

100-95068-1B

SEARCHED ... INDEXED ...
... FILED ...

C 133-[illegible]

UNITED STATES, ex rel. [illegible] and [illegible],

Relators,

- v. -

[illegible] CARROLL, United States Marshal for the Southern District of New York, [illegible], Warden, Federal House of Detention, [illegible] COLLINS, Warden, Tombs House of Detention,

Respondents.

AFFIDAVIT

STATE OF NEW YORK)
COUNTY OF NEW YORK) ss.:
SOUTHERN DISTRICT OF NEW YORK)

[illegible], being duly sworn, deposes and says:

I am an Assistant United States Attorney for the Southern District of New York, and as such am familiar with the above-entitled prosecution and the facts pertinent thereto.

The relators herein are unlawfully in the custody of the United States. The defendant ABRAHAM BROTHMAN [illegible] having conspired to violate Section 241 [illegible] violated Section 241. (18 U.S.C. §§ 88, 241) The defendant BENJAMIN KOPOWITZ was convicted [illegible] Section 241 (18 U.S. §88, [illegible] ABRAHAM BROTHMAN received a [illegible] imprisonment and a committed fine. [illegible] KOPOWITZ received a [illegible] and a fine of $2,000.

The relators' petition that [illegible] to meet and confer [illegible] partnership tax returns [illegible] forth.

JLR:ak
114902

A writ of habeas corpus is intended to pro and secure to a right which has been or which is about to be taken away, which right cannot be protected through other procedure. Obviously, if no right exists, a wri habeas corpus is unavailing. Indeed it cannot seriously argued that it affords a procedure through which perso in custody may seek favors. An examination of the pet in support of the instant writ demonstrates the frivol nature of the writ and conclusively established that n right of the relators was, is or will be in jeopardy.

As herein noted, a meeting of relators is sought so that they might prepare income tax returns. petition recites that Koshowitz supervised the keeping the books and records of the partnership, A. Brothman Associates. If this is the fact, deponent fails to se why she, a partner in the enterprise, is not fully qua fied to prepare the necessary returns. A meeting of a partners has never been required in order that a tax r be prepared; business dictates do not require this. I some peculiar problem or difficulty exists or if the r tor Brothman desires to examine the returns prior to t filing, there is no reason why that cannot be arranged without a meeting. Further, it is noted that there is showing in the relators' petition that this partnersh business requires their personal attention. Deponent su that the nature of the business sought to be transacte this fourth one is customarily taken care of by an acc ant or by counsel. If such a person is not available, five has other members who are fully qualified and jus such obligated to file the tax returns as are relators Thus make the relief requested entirely unnecessary.

J.F:gk
11490

The "request" before the court is the firs
its nature recorded in the files of the United States
Attorney for this district. It is unheard of that the
exists a right which may be secured by writ of habeas
corpus for prisoners to meet and confer in a federal c
house for the purpose of conducting their businesses.

The instant writ has no basis in law or in
and should be dismissed.

Sworn to before me this
25th day of May, 1951.

J.
1
C 188-106

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

- -x

UNITED STATES, ex rel.
ABRAHAM BROTHMAN and MIRIAM MOSKOWITZ,

Relators,

-v-

WILLIAM A. CARROLL, United States Marshal for the Southern District of New York, EDWARD S. THOMPSON, Warden, Federal House of Detention, MISS RUTH COLLINS, Warden, Women's House of Detention,

Respondents.

RETURN O
HABEAS

- -x

STATE OF NEW YORK)
COUNTY OF NEW YORK) ss.:
SOUTHERN DISTRICT OF NEW YORK)

WILLIAM A. CARROLL, being duly sworn, depo
and says:

I am the United States Marshal for the So
District of New York. I make this return to the wr
habeas corpus heretofore allowed to the relators AB
BROTHMAN and MIRIAM MOSKOWITZ on relators' petition
verified the 22nd day of May, 1951.

The relator ABRAHAM BROTHMAN is presently confined at the United States Federal House of Deter 427 West Street, New York City, under a judgment of viction and sentence entered in the United States Di Court on November 28, 1950. The relator ABRAHAM BR was convicted for having conspired to and with viol the obstruction of justice statute, 18 U.S.C. §§88, (1946 Ed.). BROTHMAN received a sentence of seven imprisonment and a committed fine of $15,000.

The relator MIRIAM MOSKOWITZ was charged BROTHMAN in the same indictment, with having conspi to violate the obstruction of justice provision. Sh convicted with BROTHMAN and received a sentence of

JMF:ms/mz
11
C133-106

years imprisonment and a committed fine of $10,000.

Upon the attached affidavit of John M. Foley, Assistant United States Attorney, and upon deponent's knowledge, the detention of ABRAHAM BROTHMAN and MIRIAM MISKOWITZ is in all respects lawful.

WHEREFORE, it is prayed that the writ of habeas corpus be dismissed.

Sworn to before me this

day of , 1951.

FD-141
(1-18-48)

BULKY EXHIBIT

Date received 6/1/51

[illegible] PRIZE, INC.

100-95068-1
(Title of case)

Submitted by Special Agent JOHN R. COLLINS

Source from which obtained [illegible]

Address [illegible] Headquarters

Purpose for which acquired Evidence

Location of bulky exhibit - In cabinet with File

Ultimate disposition to be made of exhibit [illegible]

Estimated date of disposition - To be destroyed upon conclusion of case

List of contents:

1). One photostatic copy of letter written by [illegible] to Herman Goldfarb.

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100-95068-1B

MR. HERMAN GOLDFARB
d/b TECHNIFLEX CORP.
PORT JERVIS, NEW YORK

June 7, 1951

Dear Theodore,

When I last saw you, I mentioned one item in the ... originally submitted Problem Number "Celestial Navigation". I ... below without further radio.

* * * * * * * * * *

Equation (23) on Page 6, when solved for ... from

$$f = 2R(\cos\theta - \cos\theta_1)$$

is only a close approximation. It is ... neither flow an absolutely true altitude ... deflecting of the spaceship during the ... angle travel. Eq. (23) expresses the ... that the heading of the spaceship remains ... all times except in a plane which is ... to the plane of figure "A") and ...

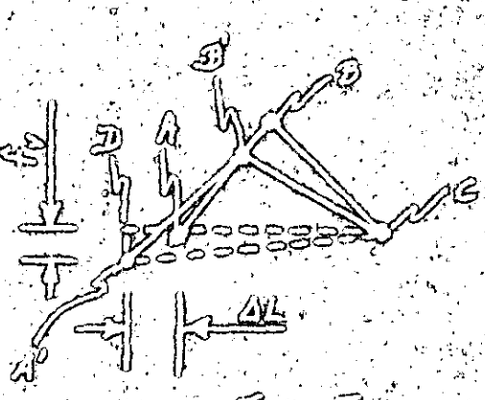


Fig. 2

Eq. (23) expresses the fact that true direction of deflection of the ... for all positions (other than two) would have to fall ... horizontal components. If four positions at which the azimuth ... would be given would be:

a. At an azimuth $\phi = 0°$

and

b. " " " " " the head (P_2), specified by point "b" ... the same area as the spaceship, has a magnitude ... of zero.

Assuming the earth, under the above flow ...

Let

a. $\overline{BC}$ be fixed "C" when $\theta = \theta_1$

b. $\overline{BC}$ " " " " $\theta =$ any other value of θ other
$\theta = 0°$

c. $\overline{BA}$ be fixed "A" when $\theta = \theta_1$

d. $\overline{BA'}$ " " " " $\theta =$ any other value of θ other
$\theta = 0°$

e. $\overline{CD}$ be the locus midway of fixed "A" and "C" when $\theta =$

f. point (A') represent the locus positions of the midpoint of
Spring-shaft when $\theta = \theta_1$ and θ_2 any other
$0°$

g. $\overline{DA'}$ be a line around to $\overline{BC}$ and originating at A'

h. $\angle DCA = \theta_1$

i. $\angle DCA' =$ any other value of θ other than $0° = \angle \theta$

j. $\angle DCA' =$ the angle formed between $\overline{CD}$ and $\overline{CA'}$

k. point (C) represent the center point of the fixed
fixed "C"

Giving the force to the midpoint of the Spring-shaft, the force
would cause the locus there the "locking angle" would
Spring-shaft from (A) to (A'). The would create a torque
of the said midpoint (A) and a vertical through of the
the locus, the longitudinal distance between (A) and (C) from
with a value of

$$\overline{AL}\,(\sin\theta_2).$$

and would therefore with the distance between (C) and (A')

$$\overline{AL}\,(\sin\theta).$$

The torque $MST\,(T_1)$ would be given by

$$f_0 = \frac{2Pl}{AE} \sin\theta \sin\theta_1$$

and also

$$\Delta L + \frac{2Pl}{AE} \sin\theta_1 = \frac{2Pl}{AE} \sin\theta \sin\theta_1$$

and

$$\frac{2Pl}{AE}(\sin\theta \sin\theta_1 - \sin^2\theta_1) = \Delta L$$

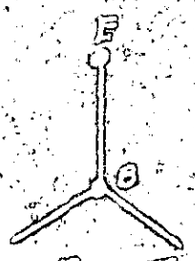


FIG. II

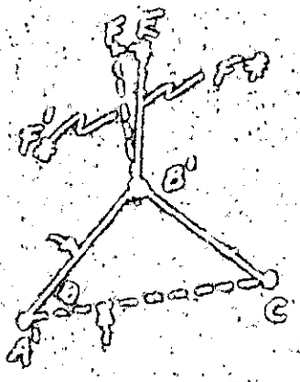


FIG. III

In Fig. II, the [illegible] Fig. II corresponds to [illegible] Fig. II corresponds to [illegible] AB and AC in Fig. [illegible] load "P" is first applied normal to AC [illegible] Fig. III corresponds to the [illegible] A B' A' C in Fig. I, then force (F) applied [illegible] B' by force "P" (represented above by EB' [illegible] F B' represents a part (F') of [illegible] F' would be taken component (F) [illegible] to AC. The force (P) applied by B'A' to [illegible] perpendicular component A' would, in turn, [illegible] by

$$\frac{F'}{\sin\theta} = P$$

which (F') would be given by

$$F' = F \sin\theta$$

and

$$\therefore EB'F \text{ would equal } \theta$$

It is clear that the vertical deflection (f_v) would be [illegible] and would be given by

$$f_v = \frac{Fl}{AEE}$$

showing Eq. (4) in its form

$$\frac{4\pi E^2 L \sin\theta}{L_1^3} = \frac{P_2}{\sin\xi_T \cos\xi_T} \qquad (4)$$

It is obvious that when $\theta = 0°$, and hence $\sin\theta = 0$, since P_2 would still have a finite value, ($\sin\xi_T$ and $\cos\xi_T$) would approach zero, thus defining a condition in which $\xi_T = 0$ — which is to be expected and desired.

The actual deflection of the spring must then be considered as

$$\left[f_v^2 + \Delta L^2\right]^{\frac{1}{2}} = f \qquad (4)$$

and, it follows, that all of the relationships which are found in Eq. (3) are given in the 'Calculation Form' must accordingly be adjusted to be in accordance.

* * * * * * *

The machine has called again, and has put another flip. It is being copied from another one, so that it's just a matter of putting according onto another slip. You would have gone on to study, as could from the drawing for the Parallel Vibe, the calculations for its model, and the failure of this will have until it. I'm not reading the drawing for the Parallel, or the calculations first, today, because I would like to correct a repetition of the condition that under were intended to correct.

Please hear with me, and keep plugging.

Yours very truly,

Alz

FD-141
(1-13-48)

BULKY EXHIBIT

Date received 6/20/51

[illegible]

100- 95068-1A

(Title of case)

Submitted by Special Agent John M. Collins

Source from which obtained [illegible]

Address Federal Detention Headquarters.

Purpose for which acquired evidence

Location of bulky exhibit In safe [illegible] file

Ultimate disposition to be made of exhibit Returned

Estimated date of disposition - [illegible]

List of contents:

114. Photostatic copy of letter addressed to [illegible] from A. Brotman, dated 6/13/51.
115. Photostatic copy of letter signed by [illegible] from A. Brotman, dated 6/19/51.
116. Photostatic copy of [illegible] Type Packless Valve.
117. Photostatic copy of letter dated /19/51 addressed to Jerome S. Barbara from A. Brotman.

69

100-95068-1B

June 10, 1951

Dear Norman,

The following is a continuation of my note of June 7th, and I hope this will complete the job.

Page 3 line 5 of my note of June 7th was written with the assistance breathing down my neck. On the present, I will take the opportunity to clarify the original statement, before I continue with the rest of what I intended to write.

At the bottom of Page 3, it is stated that "It is clear that the natural deflection (f_1) would be proportional to (F)". This is approximately true, but the condition that (f_0) is given by

$$f_0 = \frac{FL}{4EI}$$

as per Eq. (11) is in error. Consider Fig. III. Fig. III contains 5 force diagrams, (a), (b), (c), (d), and (e). Force diagram (a) contains the force (F_1)$_a$ with respect to AC as a reference axis. Force diagram (b) contains (F_2)$_b$ with respect to CC as a reference axis. Force diagram (c) contains (F_1)$_c$ with its components with respect to AC as a reference axis, which force diagram (d) contains the same force with its components with respect to CC as a reference axis. Force diagram (e) contains of link B as force (F_3) with its components with respect to AC as a reference axis.

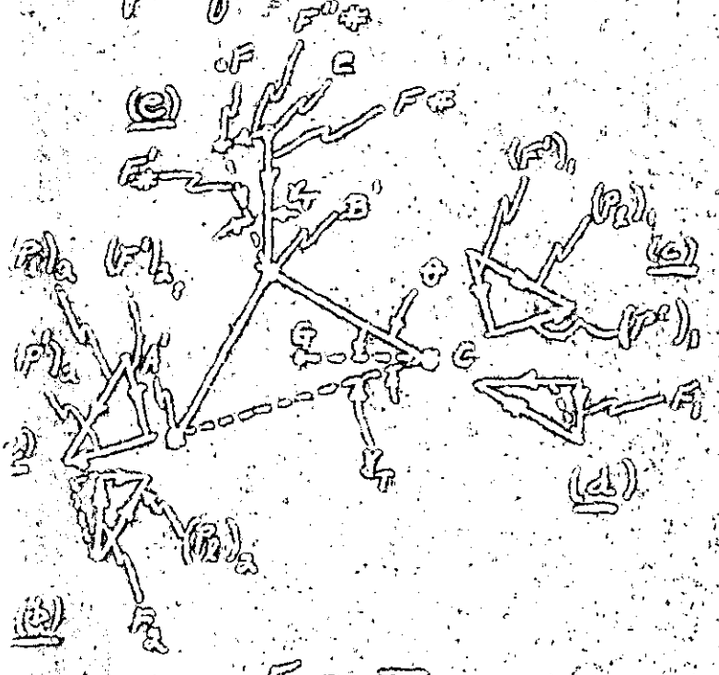


Fig. III

Observing force diagram (c), and especially that force which is designated by $(F'')_T$, it is observed that

$$(P')_2 - (P')_1 = F'' \tag{1-A}$$

or

$$(P')_2 = (P')_1 + F'' \tag{2-A}$$

By this, we may write

$$(P_2)_2 = \frac{(P')_2}{\cos\theta} \tag{3-A}$$

by reference to force diagram (a); and

$$(P_2)_1 = \frac{(P')_1}{\cos\theta} \tag{4-A}$$

by reference to force diagram (c). It is observed that

$$F'' = F \sin\gamma_T \tag{5-A}$$

Also, by reference to force diagram (b),

$$F_2 = (P_2)_2 \cos(90 - [\theta + \gamma_2]) = (P_2)_2 \sin(\theta + \gamma_2) \tag{6-A}$$

and

$$F_1 = (P_2)_1 \cos(90 - [\theta - \gamma_1]) = (P_2)_1 \sin(\theta - \gamma_1) \tag{7-A}$$

by reference to force diagram (d), and, since

$$F_1 + F_2 = F \tag{8-A}$$

it follows that

$$\frac{(P')_1 + F''}{\cos\theta} \sin(\theta + \gamma_2) + \frac{(P')_1}{\cos\theta} \sin(\theta - \gamma_1) = F \tag{9-A}$$

$$\frac{(P')_1 + F\sin\gamma_T}{\cos\theta} \sin(\theta + \gamma_2) + \frac{(P')_1}{\cos\theta} \sin(\theta - \gamma_T) = F \tag{10-A}$$

which would lead to

$$(F')_1 (\sin[\theta+\gamma_1] + \sin[\theta+\gamma_2]) = F(\cos\theta - \sin\gamma_1 \sin(\theta+\gamma_1)) \quad (11A)$$

and

$$(F)_1 = \frac{F(\cos\theta - \sin\gamma_1 \sin[\theta+\gamma_1])}{\sin[\theta+\gamma_1] + \sin[\theta-\gamma_1]} \quad (12A)$$

or, on the other hand,

$$F = \frac{(F')_1 (\sin[\theta+\gamma_1] + \sin[\theta+\gamma_2])}{\cos\theta - \sin\gamma_1 \sin[\theta+\gamma_1]} \quad (13A)$$

By the logic, it will be found that

$$F_2 = \frac{F(\cos\theta - \sin\gamma_2 \sin[\theta+\gamma_2]) + F\sin\gamma_2 \sin(\theta+\gamma_1)}{\cos\theta(\sin[\theta+\gamma_2] + \sin[\theta-\gamma_2])} \quad (14A)$$

and, since

$$(F')_2 = \cos\gamma_2 F_2, \quad (15A)$$

then

$$(F')_2 = \frac{F(\cos\theta - \sin\gamma_2 \sin[\theta+\gamma_2]) + F\sin\gamma_2 \sin(\theta+\gamma_1)\cos\gamma_2}{\cos\theta(\sin[\theta+\gamma_2] + \sin[\theta-\gamma_2])} \quad (16A)$$

Since the deflection (f_1) would be proportional to $(F')_2$, which is a force normal to the axis AC, it follows that

$$f_1 = \frac{(F)_2 L_1^3}{48EI} =$$

$$\frac{L_1^3 [F(\cos\theta - \sin\gamma_2 \sin(\theta+\gamma_2)) + F\sin\gamma_2] \sin(\theta+\gamma_1)\cos\gamma_2}{48EI \cos\theta(\sin[\theta+\gamma_2] + \sin[\theta-\gamma_2])} \quad (17A)$$

But, by Eq. (5) of my note of the 4th,

$$f_1 = \frac{2}{3} L_1 \cos\theta \sin\gamma_1 \quad (C)$$

Thus, it follows that

$$L_1^3 \{[F(\cos\theta - \sin\gamma_T \sin[\theta+\gamma_T]) + F\sin\gamma_T]\sin(\theta+\gamma_T)\cos\gamma_T\}$$

$$= EI\cos\theta(\sin[\theta+\gamma_T] + \sin[\theta-\gamma_T]) \quad (19A)$$

$$= 2L\cos\theta\sin\gamma_T$$

and also

$$\cos\gamma_T = \frac{2L EI\cos^2\theta\sin\gamma_T(\sin[\theta+\gamma_T]+\sin[\theta-\gamma_T])}{L_1^3\sin(\theta+\gamma_T)F(\cos\theta-\sin\gamma_T\sin[\theta+\gamma_T]+F\sin\gamma_T)} \quad (19A)$$

Now we provide the write Eq (E) of the orig Eq that

$$\Delta L\left[\frac{2L EI\cos^2\theta\sin\gamma_T(\sin[\theta+\gamma_T]+\sin[\theta-\gamma_T])}{L_1^3\sin(\theta+\gamma_T)F(\cos\theta-\sin\gamma_T\sin[\theta+\gamma_T]+F\sin\gamma_T)} - \cos\theta_1\right]$$

$$= \Delta L \quad (20A)$$

From Eq. (19A), it is apparent that whenever the force (F) increases to a value of zero, $(\sin\gamma_T)$ would of necessity have to take on a similar value, (γ_T) would have a value of zero, eventually at last, when $\theta = \theta_1$ and when $\theta = 0^\circ$; and hence, the extent depletion of the spring slope would occur when these two limits of the "locking angle bound" are attained.

For any angle of depression which would be attained to when the elastic limit, it is abundantly obvious that in view of the corresponding value of θ involved when the "locking angle bound" is performed, (γ_T) would involve very small values. It therefore serves as a fortuitous approximation that

$$\Delta L(\cos\theta - \cos\theta_1) = f$$

as per Eq (20) of the original "Calculation Form."

By Eqs. (3.1), (3.2), and (3.3), the second term vanishes and Eq. 3.4, namely

$$\frac{48EI}{L^3}\cdot\frac{L}{2}(\sin\theta-\sin\theta_1)=AF+\sin\theta\,\frac{L}{2} \tag{3.4}$$

Also Eq. as transformed from (3.5) and (3.6) for Eq. (3.7), which reads

$$\frac{192EIL}{L^3}(\sin\theta-\sin\theta_1\cos\theta)=F \tag{3.7}$$

and so proper. However, in the location of the value of θ at which (F) is a maximum, we must of course differentiate. We cannot multiply the given values of θ.

Differentiate (F) with respect to (θ), and we obtain

$$\frac{192EIL}{L^3}(\cos\theta-\cos\theta_1\cos^2\theta)=\frac{dF}{d\theta} \tag{3.8}$$

Setting $\left(\frac{dF}{d\theta}\right)$ equal to zero, we obtain

$$\cos\theta=\cos\theta_1\cos^2\theta \tag{3.9}$$

or

$$\frac{\cos\theta}{\cos^2\theta}=\cos\theta_1=\sec^2\theta \tag{3.10}$$

$$\cos\theta_K=\sec^{1/3}\theta_1 \tag{3.11}$$

value $(\cos\theta_K)$ denotes a point on the plot of θ vs. F at which $\left(\frac{dF}{d\theta}\right)=0$. For this value $(\cos\theta_K)$ denotes a maximum or a minimum, we may differentiate Eq. (3.8) for a second time, and we obtain

$$\frac{192EIL}{L^3}(-\sin\theta-2\cos\theta_1\sin\theta\cos^2\theta)=\frac{d^2F}{d\theta^2} \tag{3.12}$$

We already negative value of the second derivative implies a maximum. We already negative value of θ at which (F) is a maximum is called (θ_K) denotes a value of θ at which (F) is a maximum.

The corresponding value for (θ_K) should satisfy Eq. (3.6) in the original undeformed position from which Eqs. (3.6) to (3.11) were derived.

By current procedure, if

$$\cos\theta_K = \cos^{1/3}\theta_1 \tag{2.5A}$$

then

$$\cos^2\theta_K = \cos^{2/3}\theta_1 \tag{2.6A}$$

and

$$\sin\theta_K = \left[1 - \cos^{2/3}\theta_1\right]^{1/2} \tag{2.7A}$$

and, naturally,

$$\tan\theta_K = \frac{\sin\theta_K}{\cos\theta_K} = \frac{\left[1-\cos^{2/3}\theta_1\right]^{1/2}}{\cos^{1/3}\theta_1} \tag{2.8A}$$

If [illegible] it

$$\frac{192\,EIL}{L_0^3}\left(\left[1-\cos^{2/3}\theta_2\right]^{1/2}\cos\theta_2\,\frac{\left[1-\cos^{2/3}\theta_2\right]^{1/2}}{\cos^{1/3}\theta_2}\right) = F_m \tag{2.9A}$$

as the expression defining the maximum value of (F) during the "locking angle interval". Eq. (2.9A) could be written as

$$\frac{192\,EIL}{L_0^3}\left[1-\cos^{2/3}\theta_2\right]^{1/2}\left[1-\cos^{2/3}\theta_2\right] = F_m$$

$$= \frac{192\,EIL}{L_0^3}\left[1-\cos^{2/3}\theta_2\right]^{3/2} \tag{3.0A}$$

which is almost identical to Eq. (3.0A) [illegible] Eq. (1.1) of the originally-submitted "Calculation Form".

Now the case when $L' = L$ and $\theta_1 = \theta_2 = \theta_3$ is considered [illegible] of the original "Calculation Form". Thus

$$F_n = \frac{192\,EI}{L_0^3}\left(\sin\left[\cos^{-1}\theta - \cos^{-1}\theta_2\right]\right)\left[1-\left[\left\{f_1 + \frac{f_2}{2L} + f_3\right\}\frac{2}{\cos\theta} + \frac{f_2}{L} + f_3\right]\right] \tag{3.1A}$$

and also,

$$F_n = \frac{192\,EI}{L_0^3}\left(\sin\left[\cos^{-1}\theta - \cos^{-1}\theta_2\right]\right)\frac{1}{\cos\theta}\left[1-\left(\left\{f_1 + \frac{f_2}{2L} + f_3\right\}\frac{2}{\cos\theta} + \frac{\text{[illegible]}}{2L}\right.\right.$$

$$\left.\left. + \frac{\text{[illegible]}}{L}\right]\right] \tag{3.2A}$$

disregard

[Eq. (3.3) is reported on the next page]

$$F_N = \frac{\pi EI}{L_0}\left(2\left[\sin\theta + \sin\theta_1\right]\right)\frac{2}{\sin\theta}\left[1-\left[\left\{f_1+\frac{f_2\pi}{2L}+f_3\right\}\frac{2}{\sin\theta}+\frac{\pi f_2\sin\theta}{2L}+\frac{f_3\sin\theta}{2}\right]\right] \quad (5.5)$$

Above Eq. (5.5) may be reduced to

$$F_N = \frac{192EIL}{L_0^3}\left(\sin\theta-\sin\theta_1\tan\theta\right)\left[1-\left[\left\{f_1+\frac{f_2\pi}{2L}+f_3\right\}\frac{2}{\sin\theta}+\frac{\pi f_2\sin\theta}{2L}+\frac{f_3\sin\theta}{2}\right]\right] \quad (5.6)$$

And, since

$$F = \frac{192EIL}{L_0^3}\left(\sin\theta-\sin\theta_1\tan\theta\right) \quad (5.7)$$

Then

$$\frac{F_N}{F} = 1-\left\{f_1+\frac{f_2\pi}{2L}+f_3\right\}\frac{2}{\sin\theta}+\frac{\pi f_2\sin\theta}{2L}+\frac{f_3\sin\theta}{2} \quad (5.8)$$

Now, if (F_N) is not equal to F_N, it follows that since

$$\frac{192EIL}{L_0^3}\left(1-\sin^{2/3}\theta_1\right)^{3/2} = F_N \quad (5.9)$$

Then

$$\frac{192EIL\left(1-\sin^{2/3}\theta_1\right)^{3/2}}{\left[1-\left\{f_1+\frac{f_2\pi}{2L}+f_3\right\}\frac{2}{\sin\theta_1}+\frac{\pi f_2\sin\theta_1}{2L}+\frac{f_3\sin\theta_1}{2}\right]} = F =$$

$$\frac{192EIL\left(1-\sin^{2/3}\theta_1\right)^{3/2}}{\left[1-\left\{f_1+\frac{f_2\pi}{2L}+f_3\right\}\frac{2\left[1-\sin^{2/3}\theta_1\right]^{1/2}}{\sin^{1/3}\theta_1}+\frac{\pi f_2\sin^{1/3}\theta_1}{2L\left[1-\sin^{2/3}\theta_1\right]^{1/2}}+\frac{f_3\sin^{2/3}\theta_1}{2\left[1-\sin^{2/3}\theta_1\right]^{1/2}}\right]} \quad (5.10)$$

Eq. (5.10) will therefore replace Eq. (5.1) of the originally submitted Calculation Form.

Again, in connection with Eqs. (3F) from (3F) by the original condition from an extremum. The following method applies for continuous ships:-

Starting from Eq (3F) which states

$$2\left[KS\sin\theta + 2IK(\cos\theta - \cos\theta_0 \sin\theta)\right] = F \qquad (3F)$$

will arrive by the first differentiation etc

$$2\left[KS\cos^2\theta + 2IK(\cos\theta - \cos\theta_0 \cos^2\theta)\right] = \frac{dF}{d\theta} \qquad (3F/A)$$

Additionally adding $\left(\frac{dF}{d\theta}\right)$ equal to zero

$$K\cos^2\theta\left[S - 2I\cos\theta_0\right] = -2IK\cos\theta \qquad (3F/A)$$

$$\frac{2I\cos\theta_0 - S}{2I} = \frac{\cos\theta}{\cos^2\theta} = \cos^3\theta \qquad (3F/A)$$

$$\left[\frac{2I\cos\theta_0 - S}{2I}\right]^{1/3} = \cos\theta_m \qquad (3F/A)$$

Finding for a maximum or minimum, we substitute Eq.(3F/A) by the partial differentiation, getting etc

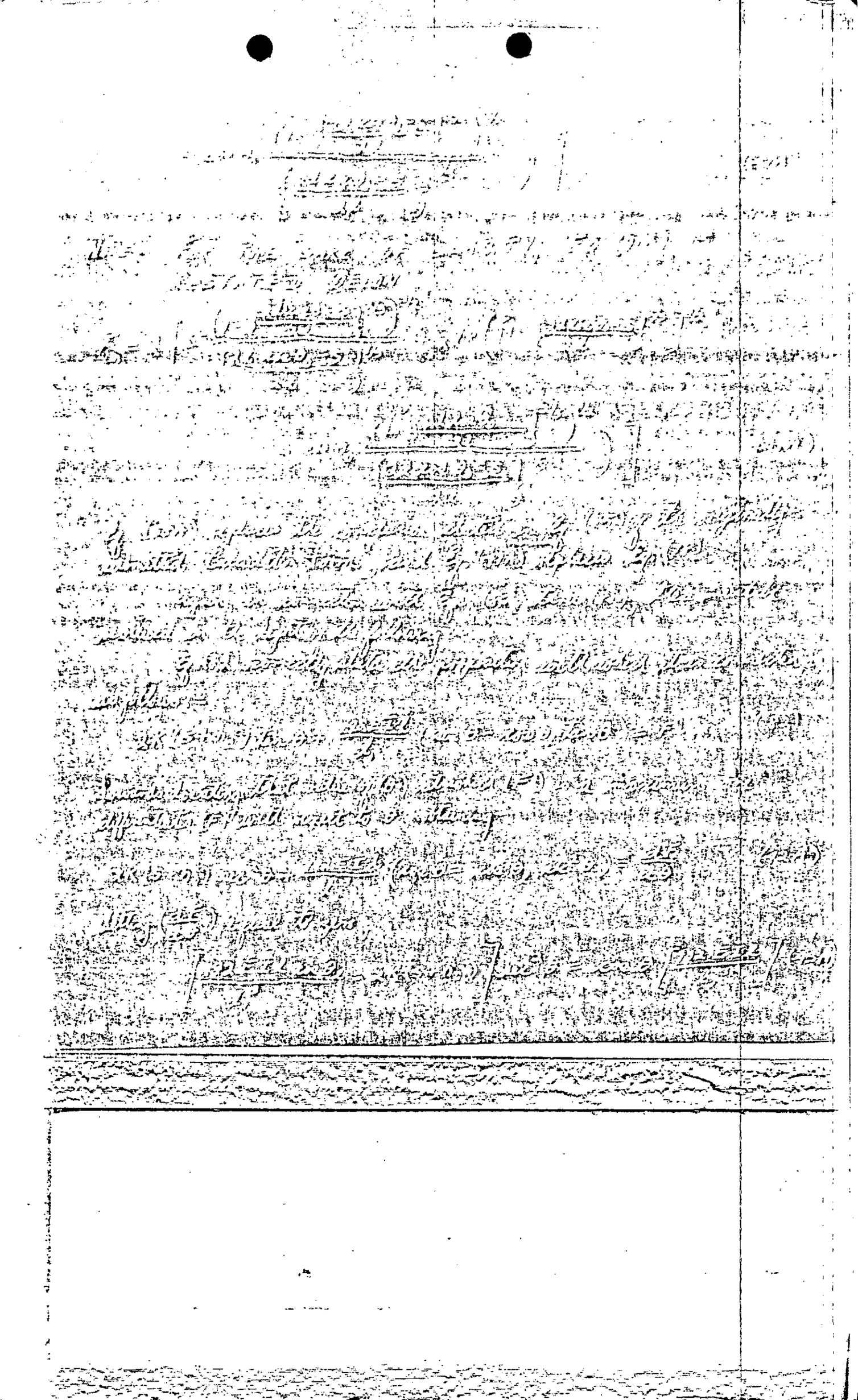
$$2\left[2KS\sin\theta\cos^2\theta + 2IK(-\cos\theta - 2\cos\theta_0 \sin\theta\cos^2\theta)\right] = \frac{d^2F}{d\theta^2} \qquad (3F/A)$$

For the maximum value of which (θ_0) is taken it is clear that

$$4I\cos\theta_0\sin\theta\cos^2\theta > 2S\sin\theta\cos^2\theta \qquad (4F/A)$$

and hence $\left(\frac{d^2F}{d\theta^2}\right)$ is always negative. And, hence, $\left[\frac{2I\cos\theta_0 - S}{2I}\right]^{1/3}$ defines a value of (θ) at which the compound (F) is a maximum, etc. Now follows that

$$F_m = 2\left[KS\frac{\left(1 - \left\{\frac{S}{2I}\right\}^{2/3}\right)^{1/2}}{\left\{\frac{2I\cos\theta_0 - S}{2I}\right\}^{1/3}} + 2IK\left(\left[1 - \left\{\frac{S}{2I}\right\}^{2/3}\right]^{1/2} - \right.\right.$$



$$\left[\tan\theta_2 - \frac{2KL_1^2(S+h_0)}{KR_2EI_2}\right]^{1/3} = \tan\theta_K \qquad (4\cdot74)$$

Differentiating (4·73) for a small change in the angle of

$$+R(S+h_0)\delta\tan^2\theta + \frac{KR_2EI_2}{L_2^3}(\tan\theta - L_2\tan^2\theta) = \frac{dF}{d\theta} \qquad (4\cdot75)$$

Considering the small change taken as $\delta(\theta_2)$ in (4·74), we have

$$\frac{3KR_2EI_2}{L_2^3}\tan\theta_2\sec^2\theta > KR(S+h_0)\tan\theta\sec^2\theta \qquad (4\cdot76)$$

and hence $\left(\frac{d^2F}{d\theta^2}\right)$ being always negative,

$$\left[\tan\theta_2 - \frac{2KL_1^2(S+h_0)}{KR_2EI_2}\right]^{1/3}$$

where the value of (θ) obtained (F) is the maximum thrust in order

$$F_{max} = R(S+h_0)\frac{\left[1-\left\{\tan\theta_2 - \frac{2KL_1^2(S+h_0)}{KR_2EI_2}\right\}^{3/3}\right]^{1/3}}{\left\{\tan\theta_2 - \frac{2KL_2^2(S+h_0)}{KR_2EI_2}\right\}^{1/3}}$$

$$+\frac{KR_2EI_2}{L_2^3}\left(\left[1-\left\{\tan\theta_2 - \frac{2KL_1^2(S+h_0)}{KR_2EI_2}\right\}^{3/3}\right]^{1/3}\right.$$

$$\left. - \tan\theta_2\frac{\left[1-\left\{\tan\theta_2 - \frac{2KL_1^2(S+h_0)}{KR_2EI_2}\right\}^{3/3}\right]^{1/3}}{\left\{\tan\theta_2 - \frac{2KL_2^2(S+h_0)}{KR_2EI_2}\right\}^{1/3}}\right) \qquad (4\cdot77)$$

In the above Eq. (4·74) replaces Eq. (4·7) of the original "Calculation Form", and Eq. (4·77) similarly replaces Eq. (4·8) of the above amendments to the original "Calculation Form" the latter is in good shape.

Very truly yours,

MLE

June 12, 1957

Dear Thomas,

Enclosed you will find a continuation and completion of [illegible] of the fourth, and last book of the computations governing [illegible] design of a 1" Dia - 6" Inc 2500 PSI Positive Valve. All the [illegible] including the complete set of Valve design in the following: The [illegible] pin design, and the strength computations for the Valve Housing. [illegible] covering aspects of the Valve Design together with a drawing for the [illegible] model will get forward in the near future. Please contact the [illegible] time for the Positive Valve in accordance with any suggestions you [illegible] and the Navy.

In the meantime, it is necessary that you give the following your immediate attention:-

It has been decided to go ahead with a complete [illegible] project immediately, of which a particular segment of 1000 [illegible] daily is desired. The key factor is the availability of scrap metal for remelting (de-galvanizing) in quantity. What you must [illegible] immediate and reliable information on is the following: (a) [illegible] scrap can we get on a second quantity assurance basis, and at what price? (b) If possible to get the scrap on the basis of a contract arrangement which assures the availability of supply and a [illegible] firm price? (c) What is the present price situation for [illegible] melting stock, in terms of the price per ton for [illegible] and, (d) What is the general market situation now?

You must get the facts that I ask for above! [illegible] can supply them with a rush on this request by the first [illegible] next week. If the situation is at all favorable, we will go ahead immediately. Especially as regards the scrap supply situation, [illegible] hand as soon as we get a favorable scrap supply. [illegible] on 75% yield of ingot from remelted scrap metal stock.

You now have the entire kit and a good job!

The next step you get will contain:

a) a drawing of the 1" Pickup "On-Off" Switch

b) the balance of the calculations for the above

c) the continuation of my work on prospectors and the program as a whole

d) a transistor on the Color TV problem proving the above I've played with here, and some thoughts and experience for the friend and Detroit visiting problem interested in the analog Dive display

and

e) the article I promised you.

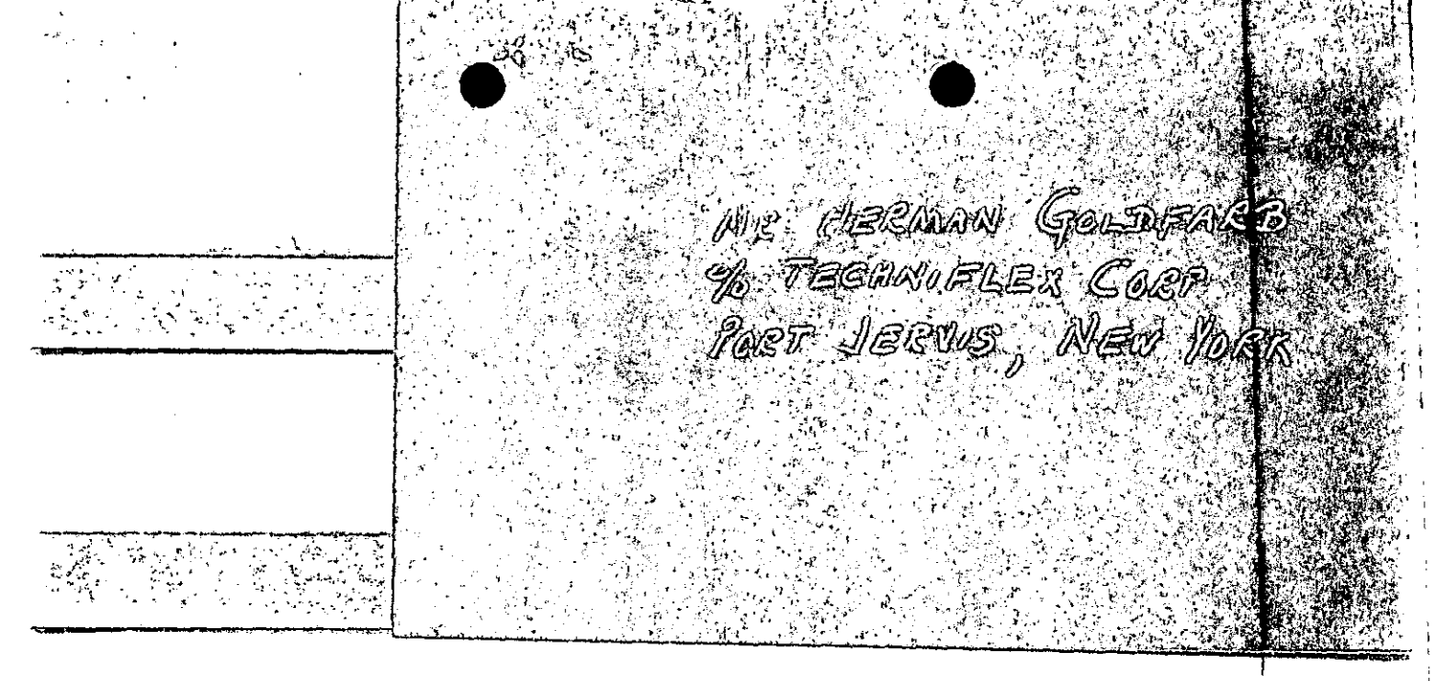
All of these are presently in existence in rough form, with the exception of the drawing as parts which requires another drawing before it can be finished under the present scheme of things. As they are, I have provided the drawing to go.

Rest assured that they will be rapidly moving on completing any unfinished work at the time.

While it is Expeditionary, the Jason Name system will give you to have it built incorporating fixes & modifications that we have worked out. Jason gave him some instructions on it for printing of the Moving Entity. What he does about this? What the Name means, let me know the drawing with her as that I can give it a final going-over before committing to print. Let Name have a print of the board with all on it. Operator what I gave you on the address of your last visit here.

I'm working as hard as I can now to clean up along and complete this breadth from there. As time (as) the above are removed for the most part. Immediately after the next writing of the Depth Book contact will follow.

Abe


ATT: HERMAN GOLDFARB
% TECHNIFLEX CORP
PORT JERVIS, NEW YORK

The Design Of A 1" On-Off Type Packless Valve

Assume a 1" high rise sprinkler system against 250 ft. head. The pressure will be fluid of the density of 1 and pint. Assume that the force F is given by the formula:-

$$F = 0.22 (\Delta p)_m (D_m)^2 \text{ lbs}$$

where

Δp_m = the maximum pressure differential across the sealing surface = 250 psi

D_m = the nominal diameter of the valve

and design the valve for "on-off" service as a function of the required force.

By the formula given above, F would have a value of

$$F = 0.22 (250)(1)^2 \text{ lbs}$$

$$= 1150 \text{ lbs}$$

If we were to arbitrarily establish a nominal velocity of 5 ft/s to be allowed in the seating area, then by Eq (1) the following must

$$\frac{1}{\pi d^2} = 5$$

or

$$\pi d^2 = 0.2$$

the seating area would have to be approximately $\pi = 20.4$ sq. in. By Eq (11), it follows that the seating force (F) under the under is fully-closed would have to

$$1150 (0.2) = 230 \text{ lbs}$$

With a Dash shaft of 1" O.D. and an assumed open area of 70%, it follows by Eq (5) for rectangular

from that of (b_0) so much that the "b_0" and (w_0) is essentially unchanged, i.e.

$$2w_0 = \pi(0.6)(1)$$

$$w_0 = \pi(0.4) = 0.256''$$

The question then is how many times would w_0 occupy

$$\frac{1.256(2)}{\pi} 360^\circ = 288^\circ$$

of the circumference. Then

$$b_0 w_0 b_0 = 1$$

and $w_0 = 1.256$, then

$$b_1 = \frac{1}{2(1.256)} = 0.4'' = b_0$$

Comparing the angle found mentioned on Page 2 of the "Solution Form", the corrected value of (b_0) would then become

$$\sin^{-1}(0.4) = 0.5'' = b_0 \text{ (corrected)}$$

Still we must set an arbitrary length of 6" on finite "A" and "B" when $\theta = 0^\circ$ (meaning that each link would be 3" long). Then then

$$2L(\cos\theta^\circ - \cos\theta_0^\circ) = b_0$$

and then

$$2(3)(1 - \cos\theta_0) = 0.5$$

$$\cos\theta_0 = 1 - \frac{0.5}{6} = 1 - 0.0833$$

$$= 0.9167$$

indicating an angle of approximately $23^\circ - 33'$ for θ_0. Therefore the distance of link of finite "B" to be

$$L\cos\theta_0 = 3(0.9167)$$

$$= 2.7497''$$

to give finite size to finite element.

Using (Δp_i) at the maximum value of 250 psi, as follows by Eq. (a) that

$$\frac{\pi}{4}(1)^2(250) = 196.5 = W_0$$

By adding one small unit (Δp_i) above the above-indicated value of 250 psi on the "full-open" gauge, like

$$\frac{196}{3} = 65.33$$

would have the indicated from which of the 3" units in the spring deflection of the valve in the full-open. But we assume that the maximum at the actual computed value of 196 lbf over the valve is the full-open position. Now the point the valve is given an opening reading from the spring characteristic, it would be assumed that the Reed spring exerts a 196 lbf reaction force. Modifying the requirements of Eq. (65) accordingly, let us express that a deflection equal to 3 times (h_0) leads to the force of 196 lbf on the part of the Reed spring. Then by Eq. 60

$$k = \frac{196}{3(0.5)} = 130.7 \text{ lb/in}$$

for the Reed spring. Since the spring is made of the same material as the seat below with the (W) expanded upon upon, it follows that only the added of spring loading supplied by the Reed of the force from the valve to the $\frac{1}{2}$" or an additional deflection of $\frac{1}{2}$" would be imposed on the spring by reason of the Reed spring. The maximum would amount to

$$130.7\,(0.5) = 65.3 \text{ lbf}$$

Adding this to the final working force of 211 lbf, we get

$$211 + 65.3 = 276.3 \text{ lbf}$$

as the force imposed on the spring. Now, let the spring have a span of 3", and let us initially plan the spring rate 3

By Eq. (23), the angular twist in going from $\theta = \theta_2$ to $\theta = 0$ is

$$\phi = \frac{T}{GJ}(L - 0.1436) = 0.0054^\circ$$

By Eq. (17),

$$\frac{4(2760.3)(3)^3}{3\pi d_1^4 (26)(10^6)} = 0.0054$$

$$d_1 = \left[\frac{4(2760.3)(3)^3}{3\pi (0.0054)(26)(10^6)}\right]^{1/4} = [1.45(10^{-2})]^{1/4}$$

$$= 0.348^\circ$$

would be the required diameter of the drive shaft. By Eq. (17), we have

$$f = \frac{Pl_0^3}{48EI} = \frac{Pl_1^3}{48} \cdot \frac{l_0^2}{8EI} = \frac{Ml_0^2}{8EI}$$

$$= \frac{S_s \frac{I}{c} l_1^2}{8EI} = \frac{S_s l_1^2}{8Ec} = \frac{2S_s l_1^2}{8Ed_1} = \frac{S_s l_1^2}{6Ed_1}$$

where S_s = stress. Using the equation, we find that

$$\frac{6Ed_1 f}{l_0^2} = \frac{6(26)(10^6)(0.0054)}{(3)^2} = S_s$$

$$= 17500 \text{ lb/in}^2$$

would be the induced stress. For a spring steel, this would be the value for the condition we have used. Thus,

$$Kh_0 f + \frac{48EIL}{l_0^3}(x_0 - x_{0_2}) = F \quad (23)$$

The equation may be transformed as follows:

$$Kh_0 \sin\theta + \frac{48EIL}{l_1^3}(x_0 - x_{0_2} \sin\theta) = F \quad (24)$$

To locate the value of θ at which F is a maximum, we differentiate

(F) with respect to (θ) and equating the same to zero

$$2Kh_0 \sec^2\theta + \frac{P_2 E I_2}{L_2}(\sec\theta - \sec\theta_1 \sec^2\theta) = \frac{d^2F}{d\theta^2} \quad (e)$$

and putting $\left(\frac{d^2F}{d\theta^2}\right)$ equal to zero, we find

$$\sec^2\theta\left[\frac{P_2 E I_2}{L_2^3}\sec\theta_2 - 2Kh_0\right] = \sec\theta\left[\frac{P_2 E I_2}{L_2^3}\right] \quad (d)$$

$$\left[\sec\theta_2 - \frac{2Kh_0 L_2^3}{P_2 E I_2}\right] = \frac{\sec\theta}{\sec^2\theta} = \sec^3\theta \quad (e)$$

$$\left[\sec\theta_2 - \frac{Kh_0 L_2^3}{P_2 E I_2}\right]^{1/3} = \sec\theta_2$$

Using the value of (θ) for which F attains a minimum or maximum, the function is again differentiated with respect to (θ), thus giving

$$4Kh_0 \tan\theta\sec^2\theta + \frac{P_1 E I_1}{L_1^3}(-\sec\theta\tan\theta\sec\theta_1 \tan\theta\sec^2\theta) = \frac{d^2F}{d\theta^2} \quad (f)$$

If the value of $\sec\theta_1$ being equal to 0.99 is used, it is clear that

$$\frac{2P_1 E I_1}{L_1^3}\sec\theta_1 > 4Kh_0 \quad (g)$$

making it clear that $\left(\frac{d^2F}{d\theta^2}\right)$ would be negative, and hence that

$$\left[\sec\theta_1 - \frac{Kh_0 L_1^3}{P_1 E I_1}\right]^{1/3} = \sec\theta_1 \quad (h)$$

designates a value of (θ) at which (F) is at a maximum. Thus

$$F_{max} = 2Kh_0\frac{\left[1 - \left\{\sec\theta_2 - \frac{Kh_0 L_2^3}{P_2 E I_2}\right\}^{2/3}\right]^{1/2}}{\left\{\sec\theta_2 - \frac{Kh_0 L_2^3}{P_2 E I_2}\right\}^{1/3}} + \frac{P_1 E I_1}{L_1^2}\left(1 - \left\{\sec\theta_1 - \frac{Kh_0 L_2^3}{P_2 E I_2}\right\}^{2/3}\right)^{1/2}$$

(This equation is continued on the next page)

$$-\cos\theta_2 \frac{\left\{1-\left[\cos\theta_2-\frac{Kb_0L_0^3}{96EIL}\right]^{2/3}\right\}^{1/2}}{\left\{\cos\theta_2-\frac{Kb_1L_1^3}{96EIL}\right\}^{1/3}}) \quad (2)$$

$Kb_0 = 130.7\,(0.5) = 65.3$ #

$$\left\{\cos\theta_2-\frac{Kb_0L_0^3}{96EIL}\right\} = \left[0.9956-\frac{130.7\,(0.5)(3)^3}{96\,(29)(10^6)(I)(3)}\right] =$$

$$\left\{0.9956-\frac{3.357\,(10^{-7})}{I}\right\}$$

$$I = \frac{\pi}{64}d^4 = \frac{\pi\,(0.344)^4}{64} = \frac{\pi\,(1.45)(10^{-2})}{64} = 7.12\,(10^{-4})$$

$$\left\{0.9956-\frac{3.357\,(10^{-7})}{I}\right\} = 0.9956-\frac{3.357\,(10^{-7})}{7.12\,(10^{-4})} = 0.9956-3.7\,(10^{-4})$$

$$= 0.995246$$

$$\left\{\cos\theta_1-\frac{Kb_0L_0^3}{96EIL}\right\}^{1/3} = 0.995246^{1/3} = 0.998252$$

$$\left\{\cos\theta_2-\frac{Kb_1L_1^3}{96EIL}\right\}^{1/3} = 0.995246^{1/3} = 0.998252$$

$$\left[1-\left\{\cos\theta_1-\frac{Kb_0L_0^3}{96EIL}\right\}^{2/3}\right]^{1/2} = \left[1.0-0.996565\right]^{1/2} = (0.003435)^{1/2} =$$

$$5.7631\,(10^{-2}) = 0.037831$$

$$F_{cr} = 2\,(6653)\frac{0.037831}{0.998252} + \frac{\pi^2 EIL}{L_0^2}\left[0.037831-0.998252\,\frac{0.037831}{0.998252}\right]$$

$$= 4.951 + \frac{\pi^2 EIL}{L_0^2}\left[0.037831-0.037854\right] =$$

$$4.951 + \frac{(0.00023)(\pi^2 EIL)}{L_0^2}$$

$$\left[\frac{\text{KB E I}}{L^2}\right] = \frac{19.626 \text{ lbs/in} \times 30 \times 10^6 \text{ psi} \times 7.62 \text{ in}^4}{3^2} = 2.95 \times 10^6 \text{ lbs}$$

$$F_{A1} = 4.951 + 0.000027(3.25)(10^6) = \frac{1.065}{\text{in}}(10^3) + 4.951 =$$

$$10.65 + 4.951 = 15.601 \text{ kips}$$

would be the most maximum force demanded of the driving electromagnetic and function arrangement for driving that the braking of the load.

The driving force, at a maximum, which is required in the early time for the interval $\theta = \theta_0$ to $\theta = \theta_2$ equals maximum. The relationship between the driving force (F) and (θ) during the forcing of the power stroke would be given by

$$2lK(\sin\theta - \sin\theta_0) = \frac{F}{2}\sin\theta \qquad (1)$$

as a close approximation. To establish that value of (θ) during the maximum interval, let us firstly transform (1) into the more convenient form embodied below:-

$$4lK(\sin\theta - \sin\theta_0\cos\theta) = F \qquad (2)$$

and then let us differentiate (F) with respect to θ, resulting at

$$4lK(\cos\theta - \sin\theta_0\sin^2\theta) = \frac{dF}{d\theta} \qquad (3)$$

Letting $\left(\frac{dF}{d\theta}\right)$ equal to zero, we obtain

$$\frac{\cos\theta}{\sin^2\theta} = \sin^3\theta = \sin\theta_0 \qquad (4)$$

or

$$\sin\theta_2 = \sin^{2/3}\theta_0 \qquad (5)$$

By inspection, we see that that (θ_A) defines a maximum condition for (F). Thus

$$F_{\max} = 4lK\left(\left[1 - \sin^{2/3}\theta_0\right]^{1/2} - \sin\theta_0\frac{\left[1 - \sin^{2/3}\theta_0\right]^{1/2}}{\sin^{1/3}\theta_0}\right) =$$

$$= 4lK\left[1 - \sin^{2/3}\theta_0\right]^{3/2} \qquad (6)$$

Substituting in the formula for (F_m) among the maximum factor of the three power blades, we obtain as

$$F_m = 4(3)(130.7)\left[1 - 0.9167^{3/2}\right]^{3/2}$$

$$= 4(3)(130.7)(0.05633)^{3/2} = 22.9\ \text{ft}$$

as the maximum net force required during $\theta = 0^\circ$ and $\theta = \theta_0$.

Similarly, solving the equations of friction (F_1), (G_1), and (F_2) and for θ_0, it will be found that

$$\left[1 - \left\{f_1 + \frac{f_2}{2}\right\}\frac{2}{\pi}\theta_K + \frac{f_1 \sin\theta_K}{2} + \frac{f_2 \sin\theta_K}{2\sin\theta_K}\right]$$

where the power efficiency of the triple linkage when (F) is at its maximum

$$\left[1 - \left\{(0.01 + \frac{0.01(0.3417)}{2(2)(3)} + 0.01\right\}\frac{0.0379(2)}{0.9793} + \frac{0.3417(0.01)(0.9793)}{2(2)(3)(0.0379)} + \frac{0.01(0.9793)}{2(0.0379)}\right] =$$

$$= 1 - \left[\underbrace{\{\quad\}[\quad]}_{\text{complement}} + 0.0076 + 0.1315\right] = 0.8619$$

where the efficiency of the triple linkage at the critical angle during the upstroke is the "lowest angle thereof," while

$$1 - \left[\left\{0.01 + \frac{0.01(0.3417)}{2(2)(3)} + 0.01\right\}\frac{0.0563}{0.9776} + \frac{0.3417(0.01)(0.9776)}{2(2)(3)(0.0563)} + \frac{0.01(0.9776)}{2(0.0563)}\right.$$

$$= 1 - \left[\underbrace{\{\quad\}[\quad]}_{\text{complement}} + 0.0052 + 0.089\right] = 0.9058$$

where the triple linkage efficiency at the critical angle between θ_0 and θ_1. Consequently

$$\frac{45.6}{0.8619} = 43.1\ \text{ft}$$

which now is the figure "B" as from the critical angle between $\theta = \theta_1$ to

would be $\theta = 0°$, while

$$\frac{30.7}{0.9855} = 23.05 \text{ lb}$$

would be the required force by finding "B" at the critical angle between $\theta = \theta_0$ and $\theta = \theta_2$.

Let us return to the guessing for Round Spring. By Eq. 56, if we take $D_m = 0.5"$, $n = 4$, and (G) as taken at $12(10^6)$, it will be found that

$$\frac{d_g^4 (12)(10^6)}{8(0.5)^3 4} = 130.7$$

or

$$d_g = \left[\frac{130.7(8)(0.125)(4)}{12(10^6)}\right]^{1/4} = \left[4.36(10^{-5})\right]^{1/4} = 0.0815"$$

would be the required wire diameter for the coils. Now, if 116 lb is the load on the spring when $\theta = \theta_0$, then

$$116 + 0.5(130.7) = 231.35 \text{ lb} = P_c$$

would be the load in the spring when $\theta = 0°$. Then

$$C = \frac{D_m}{d_g} = \frac{0.5}{0.0815} = 6.13$$

Then

$$k = \frac{4C-1}{4C-4} + \frac{0.615}{C} = \frac{4(6.13)-1}{4(6.13)-4} + \frac{0.615}{6.13} = 1.147 + 0.095 =$$

$$1.242$$

and by Eq. (55)

$$\frac{8(231.4)(0.5)(1.242)}{\pi\, 0.0815^3} = 770{,}000 \text{ lb/in} = S_g$$

would be the stress in the spring. This is for the k_f, and ends for a number of the spring.

Let us see if there is a tolerable amount, as for instance -1% from S_g, it would be necessary to increase the wire diameter to

$$\frac{970.710}{200.000} = \left[\frac{d}{0.0713}\right]^3$$

$$\left[\frac{7.7}{2}\right]^{1/3} 0.0713 = 0.1278''$$

To maintain the desired K-value for the spring, it would be necessary to increase the mean coil diameter.

$$\frac{0.1278^4 (12)(10^6)}{8(0.5)^3 n} = 130.7$$

$$n = \frac{0.1278^4 (12)(10^6)}{8(0.5)^3 130.7} = \frac{2.67(10^{-4})(12)(10^6)}{8(0.25)(10^{-1})(0.307)(10^6)} = 24.5 \text{ turns}$$

which would again make for a rubbing condition. If however, the mean coil diameter (D_m) is $0.75''$, then

$$\left[\frac{0.75}{0.5}\right]^{1/3}(0.1278) = \frac{0.1465}{0.1278}$$

which would be required to maintain the nominal stress limit, while

$$\frac{8(0.75)^3 (12)(10^6)}{8(0.75)^3 (130.7)} = n = \frac{12}{(0.75)(10^{-1})(0.307)} = 13.6 \text{ turns}$$

would be required to obtain required K-value for the spring. Thus, it will be seen that the proper direction of change of the spring dimensions are increasing of D_m, with the subsequent multiplication of (d_w) and (n) to maintain the desired K-value and (n). A $1''$ D_m would mean the wire

$$\left[\frac{1}{0.5}\right]^{1/3} 0.1278 = 0.1611''$$

wire, and

$$\left[\frac{0.1611}{0.1278}\right]^4 \left[\frac{0.5}{1.0}\right]^3 24.5 = 7.8 \text{ turns}$$

of this wire. Thus a $1''$ (D_m), 8 turn spring, $0.162''$ (#8 W&M Gage) wire spring would suffice.

Mr. S. North
Sloan House
34th St.
New York City

HOLD FOR:-

MR. J. E. TARTAKOW

PERSONAL

June 12, 1951

Mrs. James A. Jackson
Wood for J

Dear Mary,

Just a note to let you know that I am sending my book
to Henry and that I expect to have it go forward by early next week
complete form.

As to that other material I spoke to you about, the one title
that will contain the essay will also contain the names of the contributors
mentioned.

Henry is here to spend Xmas, but you'll have to believe that
the last I seen of him was the evening he left. If I see him at all, I'll
give him your message and your wishes. The work on which he is going
you is peculiar in character.

We will give love from me again, C, C, & P, and best wishes
P for yourself.

Yours,
Ike

P.S. Henry is writing you a few pages of explanation. Please return letter
when you have taken it.

A

FD-141
(1-13-48)

BULKY EXHIBIT

Date received 6/20/51

ABRAHAM BROTHMAN, was

100-95068-1B

(Title of case)

Submitted by Special Agent JOHN M. COLLINS

Source from which obtained Warden E.E. Thompson

Address Federal Detention Headquarters, NYC

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Ultimate disposition to be made of exhibit Retained

Estimated date of disposition - To be decided at conclusion of case

List of contents:

118. Photostatic copy of letter dated 6/18/51 addressed to "Dear Herman".
119. Photostatic copy of 14 page treatise entitled "SHIFTING FROM A DYNAMIC VIEWPOINT".
120. Photostatic copy of letter dated 6/18/51 from Brothman to S. Lidz os Starrett Television Corp.

70

100-95068-1B

MR. HERMAN GOLDFARB
% TECHNIFLEX CORP
PORT JERVIS, NEW YORK

June 18, 1951

Dear Harry,

What's enclosed will be quite a comedown from what was promised to you in my last letter. But when you read the enclosed letter to Sidney Fitz, you'll understand how it happened without further explanation.

Next time you're in New York, ask Sidney to give you a copy of the paper that the letter mentions. Actually, the remainder of the extract from the article which I dictated will give, [illegible] that we plan for publication in the near future. Kill it, anyhow!

I hope that you've made good progress on the things I asked of you in my last letter. I'm looking forward to word from you on these regards. Make it as soon as possible. Enclosed you will also find the last pages of the computations on a 1" On-Off Packless Valve. The drawings will follow to complete the computations on these. I've just got to check them over in the next mail.

I'm also trying to make arrangements for a special meeting with you here. I'll have word to you on this in the near future.

Please comply with all of the requests in my last letter.

Yours,
Abe

[illegible] bearing pressure, the width of the [illegible] of the "B" must be [illegible]

$$\frac{2.5}{2(1)(0.25)} = 10.416$$

In looking at this section from Table 11, we see that for the same [illegible] for the longitudinal lines of reinforcement is equal to 2 times the allowable [illegible] allowable bearing pressure. The factor shown in the table of 8.0 [illegible] a minimum width of approximately [illegible].

We cannot make use of the change of the steel reinforcement therefore [illegible] using Equation (90), and assuming the use of a 1" x [illegible] the load,

$$P_2 = 276.3 = S_c \left[0.785 (0.25)^2\right] / \left(1 + \frac{n}{2(3.14)} \left(\frac{\pi D}{4}\right)\right)$$

$$\frac{276.3 \left[1 + \frac{n(0.05)}{2(3.14)}\right]}{0.785 (0.0625)} =$$

$$\frac{276.3 \left[1 + 0.072\right]}{0.785 (0.0625)} = 6150 \text{ lb/in}^2$$

which is the compressive stress induced in fibre "A" and "C" and is [illegible] is definitely excessive value. If the same number of steel fibres [illegible] fibre "B" is first omitted, saying that the compressive stress induced would be [illegible] more economical.

If you were to [illegible] of the spirals used in previous [illegible] (which we have already found to advantage), the allowable [illegible] which support the spirals. Assuming a compressive bearing pressure [illegible] as in Fig. 3, we would obtain by Eq. (96) at a bearing length of

$$\frac{276.3}{2(l_s)(0.375)} = 1470$$

$$l_s = \frac{276.3}{2(1470)(0.375)} = 0.375''$$

say 3/8".

SHAFTING FROM A DYNAMIC VIEWPOINT

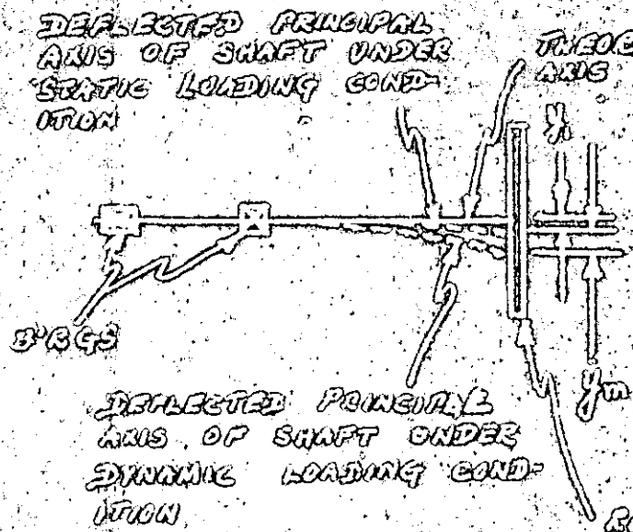


FIG. I

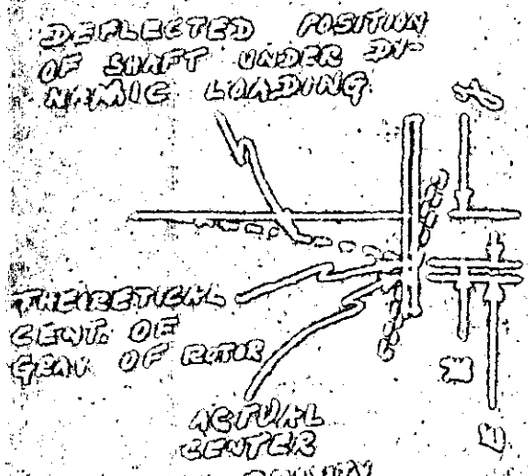


FIG. II

In Fig. I, [illegible] is shown as an [illegible] shaft is [illegible] is attached, [illegible] and, a rotor of weight (W) and [illegible] (E). By an [illegible] (E), it is meant that the [illegible] (or actual) [illegible] of [illegible] displaced from its [illegible] of [illegible] of the shaft by a distance of (E) units. The [illegible] of inertia of the rotor [illegible] coincide with the [illegible] of the shaft on which the rotor is [illegible]. It is assumed that the [illegible] of the rotor (W) would [illegible] a deflection equal to $E(g)$, as shown [illegible] dynamic conditions, it is assumed that a [illegible] between the [illegible] of the shaft and the [illegible] of the rotor, so that the shaft is [illegible] to [illegible] displacement from its [illegible] [illegible] would [illegible] to give [illegible]

$(y_{max})_2$ as shown. In Fig. III, if in actual flight the assembly is subjected to a radial acceleration of which the centrifugal displacement force (F_c), is assumed to be taken as the mean of $(F_c)_1$, any final displacement from the neutral axis of inertia, and E; and, thus (F_c) would be given by,

$$F_c = \frac{W}{g}(y + e)\omega^2 \qquad (1)$$

where ω = the angular velocity of the assembly in radians per sec; and, g = the gravitational acceleration constant in consistent units.

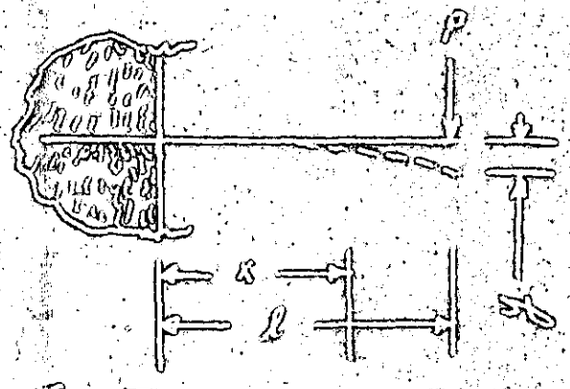


Fig. III

In the cantilever beam shown in Fig. III, it is clear that the bending moment at any section $x = 0$ would be at its maximum, and would decrease from there at the rate according to

$$M = P(l - x) \qquad (2)$$

and, accordingly

$$E_1 I \frac{d^2y}{dx^2} = -P(l - x) \qquad (3)$$

where (E_1) = young's modulus of elasticity in lbs/in² - compression

I = moment of inertia of the beam.

Integrating Eq. (3) for the successive steps of integration, we find :-

$$E_1 I \frac{dy}{dx} = -P\left(lx - \frac{x^2}{2}\right) + C_1 \qquad (4)$$

Since $\left(\frac{dy}{dx}\right)_0$ the slope of the deflection curve is clearly zero, when $x = 0$; and, hence (C_1), the constant of integration must be zero. Thus, (4) reduces to

$$E_1 I \frac{dy}{dx} = -P\left(lx - \frac{x^2}{2}\right) \qquad (5)$$

which when integrated again, yields

$$E_1 I \cdot y = -P\left(\frac{lx^2}{2} - \frac{x^3}{6}\right) + C_2 \qquad (6)$$

Again, it is clear that when $x = 0$, (y) would also equal zero; and, hence, the second constant of integration, (C_2), would also be equal zero. Leaving Eq. (6) in the form

$$-y = \frac{P}{E_1 I}\left(\frac{lx^2}{2} - \frac{x^3}{6}\right) \qquad (7)$$

Letting $x = l$, Eq. (7) takes the form

$$y = \frac{P_E}{3EI} \tag{6}$$

which may be rewritten in the form

$$\frac{3EI}{l^3} = \frac{P_E}{y} = K \tag{7}$$

We find that Eq. (6) leads to a definition of the constant of elastic restraint, or the "spring-constant" (K) of the beam in question. Considering the shaft-member of the device in Figs. (II) and (III) as the beam which it really constitutes, it follows that we may write the elastic restoring force of the shaft to be

$$F_E = Ky \tag{8}$$

when the shaft is displaced a distance (y) from its theoretical rectilinear axis. Since the setting-up of any given position of displacement involves an instantaneous equilibrium between (F_I) and (F_E), it is clear that we may write:-

$$Ky = \frac{W}{g}(y + E)\omega^2 \tag{9}$$

Digressing for a moment, let us return to Fig. I. The theoretically deflected shaft-member shown in Fig. I could be expected, in consequence of the balance of forces implied in Eq. (9) and in consequence of its elastic nature, to act as a spring — a spring undergoing a simple harmonic orbiting motion. If such were the case, (y) could be expected to vary as a function of Time. Explicitly, where t = Time, and ω_n = the number of oscillations (natural oscillations) per 2π seconds, the instantaneous value of (y) would be given by:-

$$y = y_m \cos \omega_n t \tag{12}$$

where (y_m) is the displacement position corresponding to $t = 0$. If we further premise that the velocity of the shaft-member as it was when $y = y_m$, it must follow that

$$\frac{dy}{dt} = -\omega_n y_m \sin \omega_n t \tag{13}$$

Since Eq. (13) describes the instantaneous velocity of the vibrating shaft above its oscillating frame as a function of (y), it follows that the kinetic energy (E_K) of the rotor at any point along its length would be given by:-

$$E_K = \frac{W}{2g}\left(\frac{dy}{dt}\right)^2 = \frac{W}{2g}\left(\omega_n^2 y_m^2 \sin^2 \omega_n t\right) \quad (14)$$

Referring to Eq. (10), it is clear the potential (restitutive) energy stored up in the shaft at any displacement (y) from its theoretical axis of rotation would be given by

$$E_P = \int_{y=0}^{y=y} F_E \, dy = K \int_{y=0}^{y=y} y \, dy = \frac{K}{2} y^2 \quad (15)$$

where (E_P) = the potential (or restitutive) energy stored up in the shaft.

Obviously, the total energy of the vibrating system shown in Fig. 1 would be composed of the kinetic energy of the rotor-and-shaft system and the potential (or restitutive) energy stored up in the shaft. The principle of the conservation of energy would demand, that, neglecting damping, the relation

$$E_P + E_K = \text{constant} = k \quad (16)$$

at all times. The law, as it is obtaining above the conditions which hold when $y=0$ and when $y=y_m$.

When $y=0$,

$$E_P = 0 \quad (17)$$

Now this would follow by definition from Eq. (15). However, since

$$\sin \omega_n t = 1 \quad (18)$$

the maximum value between 0 and π radians, it follows inevitably that (E_K) would have its maximum value when $y=0$; and the maximum value would be given by:-

$$[E_K]_{max} = \omega_n^2 y_m^2 \frac{W}{2g} \quad (19)$$

Summing up these for the maximum amplitude $y = 0$, it is observed that

$$E_p + E_k = A = 0 + [E_k]_{max} \quad (20)$$

or

$$[E_k]_{max} = A \quad (21)$$

When $y = y_m$, it follows by definition from Eq. (13) that (E_p) would attain its maximum value; and would be given by:-

$$[E_p]_{max} = \frac{K}{2} y_m^2 \quad (22)$$

But the same value of (y_m),

$$\sin \omega t = 0 \quad (23)$$

and, hence,

$$E_k = 0 \quad (24)$$

Summing up this, for $y = y_m$,

$$E_p + E_k = A = [E_p]_{max} + 0 \quad (25)$$

or

$$[E_p]_{max} = A$$

By Equations (19), (20), (21), (22) and (23), it follows that

$$\frac{M}{2g} \omega_N^2 y_m^2 = \frac{K}{2} y_m^2 \quad (26)$$

and, further,

$$\omega_N = \left[\frac{Kg}{W}\right]^{1/2} \quad (27)$$

Referring to Eq. (11), it is found, with the help of (27), that

summing it will be of the form

$$\frac{Kg}{W} = \frac{(1+E)\omega^2}{1} = \omega_N^2 \quad (28)$$

$$= \left(1 + \frac{E}{1}\right)\omega^2 = \omega_N^2$$

and, by further arrangement, we find that

$$\frac{\omega_N^2}{\omega^2} = 1 + \frac{E}{y} \tag{29}$$

and

$$y = \frac{E}{\frac{\omega_N^2}{\omega^2} - 1} \tag{30}$$

The significance to be attached to Eq. (30) may be seen. Firstly, it indicates that when the angular velocity of the assembly is equal to the assembly's natural frequency of vibration, (and, when, therefore, the denominator of Eq. [30] reduces to zero), the deflection (y) will become infinite (i.e. the shaft will shear) regardless of how small the eccentricity of the rotor is. Thus a resonance between the natural frequency of vibration of the system and the angular velocity of the shaft assembly must be avoided at all costs. Avoiding the undesirable resonance condition entails doing one of four things:-

a) (ω_N) may be established at a value substantially greater than (ω), which is the normal thing to do;

or

b) (ω_N) may be established at a value substantially smaller than (ω).

When

$$\omega > \omega_N \tag{31}$$

the deflection of (y) as a positive magnitude given Eq. (30) the following form:-

$$y = \frac{E}{1 - \frac{\omega_N^2}{\omega^2}} \tag{32}$$

From Eq. (32), it follows that the more that (ω) exceeds (ω_N), the smaller does (y) become. This is to say that when (ω_N) is established well beneath (ω) (or, (ω) exceeds the resonant speed"), the physical deflection is such that the shaft will exert a self-straightening action on itself. This self-straightening action is such that the

under $\left(\frac{\omega_N}{\omega}\right)^2$ approaches zero as a limit, the ratio in (y) will tend to (E) as an asymptotic limit.

In formula Eq. (30), which holds for the condition where

$$\omega < \omega_N \tag{33}$$

and a shaft diameter which is assumed to a given limit, we found as follows:-

Since (y) is also defined by:-

$$\frac{Pl^3}{EI} = y \tag{7}$$

we may write

$$\frac{Pl^3}{3E_1I} = \frac{E}{\frac{\omega_N^2}{\omega^2} - 1} \tag{34}$$

$$= \frac{(Pl)\,l^2}{3E_1I}$$

But

$$Pl = M \tag{35}$$

and hence for a shaft which is loaded at its ends, as Eq. (34) may be taken in the form

$$\frac{E}{\frac{\omega_N^2}{\omega^2} - 1} = \frac{Ml^2}{3E_1I} \tag{36}$$

But, for all beams, the moment (M) is also defined by:-

$$M = ZS \tag{37}$$

where:- S = the allowable stress in the shaft, and Z = the sectional modulus of the beam in question. Thus, Eq. (36) may be put in the form

$$\frac{E}{\frac{\omega_N^2}{\omega^2} - 1} = \frac{ZSl^2}{3E_1I} \tag{38}$$

Since it is also true that, for a round section,

$$\xi = \frac{T}{c} \tag{39}$$

where c = the distance of the beam cross section fibre from the neutral fibre, as further explained later:-

$$\frac{E}{\frac{\omega_N^2}{\omega^2} - 1} = \frac{\frac{T}{c} Sl^2}{3E_T I} = \frac{Sl^2}{3E_T c} \tag{40}$$

and, hence, since

$$c = \frac{d}{2} \tag{41}$$

for a round section of diameter (d), then

$$\frac{E}{\frac{\omega_N^2}{\omega^2} - 1} = \frac{2Sl^2}{3E_T d} \tag{42}$$

By (37), however,

$$\omega_N^2 = \frac{Kg}{W} \tag{43}$$

and by (7)

$$K = \frac{3E_T I}{l^3} \tag{9}$$

we have

$$\frac{E}{\left[\frac{3E_T I g}{l^3 W \omega^2}\right] - 1} = \frac{2Sl^2}{3E_T d} \tag{44}$$

Eq. (44) may finally be written in the form

$$E = \frac{2Sl^2}{3E_T d}\left[\frac{3E_T I g}{l^3 W \omega^2} - 1\right] \tag{45}$$

And, lastly, for a round section,

$$I = \frac{\pi d^4}{64} \tag{46}$$

$$\frac{\pi S_q d^4}{32 A W w^2} - E d - \frac{2 S L^2}{3 E_T} = 0 \qquad (47)$$

It follows that the roots of the quartic set forth by (47), for a prescribed limit for (S), a practical limit for (E), and the appropriate value of (E_T), would yield a shaft diameter (d) which satisfies the condition that

$$w \leq w_N$$

By inspection, we may also write that when it is intended that

$$w > w_N$$

the quartic to be solved would be:-

$$\frac{\pi S_q d^4}{32 A W w^2} - \frac{2 S L^2}{3 E_T} + E d = 0 \qquad (48)$$

NOTE:- To preserve the comparison to the form of (47), (48) should be written

$$\frac{\pi S_q d^4}{32 A W w^2} + E d - \frac{2 S L^2}{3 E_T} = 0 \qquad (48)$$

Whether the condition

$$(w) < (w_N),$$

or the condition

$$(w) > (w_N)$$

should be established should be resolved by

a. the required diameter of the shaft in bending

and,

b. the magnitude of the combined bending and torsional stresses induced in the shaft.

and,

c. the body limiting criterion which can be selected.

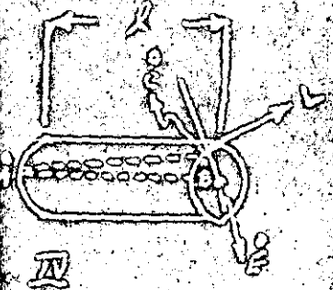


Fig. IV

Consider the twisted bar shown in Fig. IV. If the cantilever mounted at the left-hand end is such a manner that the bar is being twisted by a tangentially applied force (F). Assume that the bar has been twisted sufficiently for a point originally along the radius OA to reach the position OB, as a result of the twist, the angle (θ) subtended at the centre of the bar is equal to

$$\frac{F \cdot d}{2} = M_t = \frac{S_s I_p}{\left(\frac{d}{2}\right)} = \frac{2 S_s I_p}{d} \quad \text{(49)}$$

where :- I_p = the polar moment of inertia of the bar; (S_s) = the shear stress induced in the extreme circumferential fibre; and, M_t = the twisting moment applied to the bar by the force (F) acting tangentially at a radial distance of $\left(\frac{d}{2}\right)$.

By definition, (G), the modulus of elasticity for a shearing material, is given by

$$\frac{S_s}{\varepsilon} = G \quad \text{(50)}$$

where :- ε = the unit deformation of the material at a shear stress of (S_s). The unit deformation in the present case is given by :-

$$\varepsilon = \frac{d \cdot \theta}{2L} \quad \text{(51)}$$

By (49), (50), and (51), we arrive at :-

$$\frac{M_t \cdot d}{2 I_p} = S_s = \frac{d \cdot \theta}{2L} \cdot G \quad \text{(52)}$$

which, in a simplified form, yields :-

$$\frac{M_t}{I_p G} = \frac{\theta}{L} \quad \text{(53)}$$

Also,

$$I_p = \frac{\pi d^4}{32} \tag{57}$$

for a round bar, Eqn (53) may also be written

$$\frac{32 M_t}{\pi d^4 G} = \frac{\theta}{L} \tag{54}$$

$\left(\frac{\theta}{L}\right)$ above which may be called torsional stiffness. Conventionally, 2½° is adopted for a stiffness of 1° of twist per twenty diameters of length. And a condition would be satisfied by:-

$$\frac{32 M_t}{\pi d^4 G} = \frac{2\pi}{360} / 20 d = \frac{2\pi}{360(20)d} \tag{55}$$

Making it

$$\left[\frac{32(360)(20) M_t}{2\pi^2 G}\right]^{1/3} = d$$

$$= 28.7 \left[\frac{M_t}{G}\right]^{1/3} \tag{56}$$

Eq. (56) therefore provides a formula for computing that diameter of shafting which complies with conventional standards for torsional stiffness. Returning to Eq. 49, it will be seen that it is possible, in view of (57), to write:-

$$\frac{32 M_t d}{2\pi d^4} = \frac{K_t M_t}{\pi d^3} = S_s \tag{58}$$

thus giving us an expression for intensity (S_s).

Obviously, where S = the shear stress induced in bending, and S_s = the shear stress induced in torsion, the combined stress (S_c) also in shaft, would be given by:-

$$\left[S^2 + S_s^2\right]^{1/2} = S_c \tag{59}$$

Hereto We are now brought to the last of the matters affecting the design of the shaft in question, namely the matter of torsional stiffness.

In a simple single disc system as indicated in Fig. 1, the torsional vibration of the system would signify that the elements of a single harmonic motion about their mean, or zero, position. That is the instantaneous value of (θ), the angular displacement of the system, would be given by :-

$$\theta = \theta_m \sin[\omega_n]_T t \qquad (60)$$

where $= (\theta_m)$ = maximum angular displacement of the system, and also the displacement at $t = 0$; $(\omega_n)_T$ = the number of natural cordial flow per 2π secs ; and (t) = Time. If we further endeavour to find the velocity of the system in torsional oscillation in general when $\theta = \theta_m$, it would follow that :-

$$\frac{d\theta}{dt} = [\omega_n]_T \theta_m \cos[\omega_n]_T t \qquad (61)$$

where $\frac{d\theta}{dt}$ is the angular velocity of the system in giving flow angular all points in its oscillating path.

Now the Energy of a rotating body is given by :-

$$E_K = \tfrac{1}{2}\Sigma(mr^2)\omega^2 \qquad (62)$$

where :- $\Sigma(mr^2)$ = the inertia of the rotating body about its axis of rotation ; and (ω) = the angular velocity of the body in motion ; Hence

$$E_K = \tfrac{1}{2}\Sigma(mr^2)[\omega_n]_T^2 \theta_m^2 \cos^2(\omega_n)_T t \qquad (63)$$

The shaft in its capacity as a torsion spring exerts the angular oscillating motion of the disc and, in the course, exerts the stress-up the kinetic energy of the oscillating disc in the form of potential energy (E_P).

Combining Eqs. (59) and (53), we arrive at :-

$$\frac{\frac{Ld}{2}}{I_p G} = \frac{\theta}{L} = \frac{\frac{Ld}{2}}{\frac{1}{2} I_p G} \qquad (64)$$

which, when rearranged, are as follows :-

$$\frac{2 I_p G}{Ld} = \frac{T}{\theta} = K_T \qquad (65)$$

Where the "spring-constant" for the shaft as a torsion spring is given as it follows that restoring force (F_R) of the spring would be

$$F_R = \frac{d}{dt}\left(\frac{I_p G}{L}\theta\right) = K_T \theta \qquad (66)$$

and the potential energy stored as a result of (θ) rotation would respectively would be given by:-

$$E_p = \frac{I_p G}{L}\int_{\theta=0}^{\theta=\theta} d(d\theta) = \frac{I_p G}{2L}\theta^2 \qquad (67)$$

NOTE:- In (67), the quantity $d(d\theta)$ is to be understood as a result of the product $[d.\theta]$, in which the first term (d) stands for the diameter of the shaft and (θ) stands for the angular twist of the torsion spring. The factor ($\frac{1}{2}$) within the $\int$ sign corrects the product ($d\theta$) for a circumferential distance for a shaft of (d) diameter.

As per the logic in the case of the previously considered lateral vibration of the shaft, (E_K) has its maximum value when $\theta = 0$, and is expressed by

$$[E_K]_{MAX} = [\omega_N]_T^2\, \theta_M^2 \left\{\frac{1}{2}\Sigma(m_n r_n^2)\right\} \qquad (68)$$

and $[E_P]$ expresses its maximum value when $\theta = \theta_M$, and is expressed by:-

$$[E_P]_{MAX} = \frac{I_p G}{2L}\theta_M^2 \qquad (69)$$

Again, by analogy to the case of the previously considered lateral vibrations,

$$[E_P]_{MAX} = [E_K]_{MAX} = \frac{I_p G}{2L}\theta_M^2 = \frac{1}{2}\Sigma(m_n r_n^2)[\nu_N]_T^2\,\theta_M^2 \qquad (70)$$

from which it would follow that:-

$$\left[\frac{I_p G}{L^2\,\Sigma(m_n r_n^2)}\right]^{1/2} = [\omega_N]_T \qquad (71)$$

For a simple shaft, where

$$\Sigma(mr^2) = \frac{WD^2}{8g} \qquad (72)$$

$(\omega_N)_T$ would be given by:-

$$\left[\frac{8 I_p G g}{WD^2 L}\right]^{1/2} = [\omega_N]_T \qquad (73)$$

Additionally, since

$$I_p = \frac{\pi d^4}{32}, \qquad (74)$$

Eqn. (73) may be written

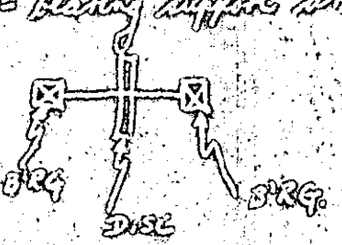
$$\left[\frac{\pi d^4 G g}{4 W D^2 L}\right]^{1/2} = [\omega_N]_T \qquad (75)$$

Note:- In Eqns. (72) thru (75), D = the diameter of the rotor disc.

Eq. (75) provides the basis by which the shafting should be considered.

June 16, 1951

Enclosed you will please find a "Sundstrand Hydraulic Unit for Use in a Dynamic Viewpoint", a unit duly filled with for a very pressing friend. Actually, the document was filled up with the design of certain shafts, and the unit, I suppose, would be of interest to you (from an application point of view) in your projected design of a CBS-type valve which you mentioned, when I met you in Paris, that you would like to avoid a four-bearing support arrangement as per below.



in favor of the type of arrangement shown on Page 1 of the enclosed. Anyway, I figured you that I would provide you with the enclosed, since I expected to make a relatively-simple enclosed arrangement.

From a practical point of view, the most elementary formulas we can be discovered about Eqs. (47), (47'), (57), (57'), (59), and (75) are because of the stiffness of your very general enclosed valve, and represent what you've got to do when you're designed of shafts.

Now, for the above enclosed Equations:-

Eq. (47) applies to a enclosed shaft which is provided at less angular velocity which is less than the frequency of the first or natural enclosed (lateral vibration) of the shaft. Eq. (47') applies to a enclosed shaft which is operated at an angular velocity which is greater than the frequency of the first lateral oscillation of the shaft. In either case, the given data should consist of:- (S), the shaft stress in bending; (g), the gravity acceleration constant; (W), the weight of the rotor; (ω), the angular velocity of the shaft; (E), the modulus of the rotor; (L), the unsupported or enclosed length of the shaft; and, (E_T) the Young's modulus (or the modulus of elasticity in tension-compression) of the shaft material. Lastly, in either case, (d), the required diameter of shaft, would be the unknown

for wheel and rotor.

(S) shows the finite stiffness peak in Eq.(47) and is true for 10,000 rpm in Eq.(48), if ordinary centrifugal stiffening is used. (g) shows the letter g instead of index for wheel speed; (W), the letter (w), for rotor speed; (R), the index R and (E_r), for rotor stiffness would run about 30(10^6) psi. (E), which is the diameter of the first rotor to gravity from the Newtonian mass of inertia (an index), is an unstiffened, depending on the same which the rotor is balanced. It is finitely in a transverse thing, for a rotor of weight 30#, its [illegible] at 75%.

Briefly, the condition on which Eq.(47) is based is one in which the shaft that the angular velocity of the shaft approaches the frequency of free natural lateral vibration, the greater would the dynamic deflection of the shaft be. Rayleigh under specific conditions for the precise [illegible] question proposed by Eq.(47) would demand an increasing order of shaft diameter as must the demand of decreasing order of "dynamic deflection". On the contrary, the condition on which Eq. 48 is based is one in which the more that the angular velocity of the shaft exceeds the frequency of free natural lateral vibration, the less would the "dynamic deflection" of the shaft be. In other words, Eq.(47) is based on the "self-straightening" action which is characteristic of shafting operating beyond the "resonance or critical" speed.

Since many reasons, Eq.(48) proves a preferred condition; and, as we shall see later, the reasons for "beyond getting away" with a smaller diameter of shafting. But, as the comments at the bottom of page 4 indicate, whether or not a (d) value obtained via Eq.(48) would depend upon other factors.

Using the maximum stress to which the shaft is subjected (and this might be the start-up stress), the value for (d) obtained via Eq.(48) or Eq.(47), whichever value for (S) will govern in reducing value for (d), the diameter of shafting required. (S) may run the latter as low as two per cent.

should be checked in Eq. (5.6) for any trial value of ω_n. Since the value for ω_n in Eq. (5.6) is positive, the smaller of the two values for ω_n is selected. This is a first trial, and not the most important one.

Next, the value yielded by Eq. (5.6) should be substituted in Eq. (5.5) to obtain the shear stress which it implies under the maximum force value for (S_c), the shear stress arising out of the frictional load, should then be inserted in Eq. (5.7), along with the design-permitted stress (S) in (5.8), — all as per Eq. (5.7) — to obtain the combined stress arising out of bending and force. If the combined stress (S_c) has a value 80% - 85% of the elastic limit for the shafting material, the value can be accepted.

In Eq. (5.6), (C) may be taken for value still at $\pi/(11^6)$ psi. In Eqs. (5.6) and (5.5), (d) is of same in inches. (S_s) in (5.5) is in units of psi. In Equation (5.7), the units for all stress members are psi.

The final test for the value yielded by Eq. (5.6) is that set by Eq. (5.5), which calculates the frequency [the number of free transverse vibrations per sec.] of the free (unloaded) vibrations. This frequency as symbol by $[\omega_n]_T$ should not exceed the frequency of the natural vibration of the shaft as symbol by (ω_n) in Eq. (5.3) as per (5.2). [NOTE:- In Eq. (5.6), the value (K) is defined by Eq. (5.1) as given on page 8, and the value (L) is as per Eq. (5.6).]. The value of $[\omega_n]_T$ should, in point of fact, be substantially less than (ω_n) of the value of (d) as per Eq. (5.6) is to be accepted.

In Eq. (5.5), (d) is the value yielded by (5.6); (C) is approximately taken at $\pi/(11^6)$ psi for similar steel; (E) is the Young's modulus constant in inches per second squared; (W) is the weight of the rotor in lbs.; (D) = the diameter of the rotor in inches; and (L) =

the unsupported, or cantilever, length of shaft in bearings.

Briefly, if the value of (d_s) as predicted by Eq. (6.6) survives the first, or criteria, established by Eqs. (6.7) and (6.7') combined, and then the last according to (6.8), with the condition imposed above as regards the comparative magnitudes of (ω_n) and $[\omega_n]_T$, it may be said that the three criteria under (d) can be accepted. Yes to any, that if the above is true and even if the value for (d_s) as per (6.8) fails to survive the test as per Eq. (6.6), it may still be accepted. On the other hand, if the value for (d_s) survives (6.6), and (6.7) and (6.7') combined, then (6.8) can be neglected.

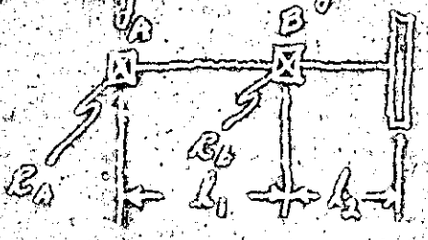
Finally as regards computational methods, it should be noted that if the value as per (6.6) fails to survive the conditions as commented on above, then a value for (d_s) as per Eq. (6.7) should be sought and similarly tested.

Before closing this section of this letter, I would like to point out the following regarding the larger significance of the above given and its rendered methods. Eq. (6.6), as previously noted, implies recourse to the available ways of shafting that can be tabulated, from the ranges of shafting diameter which we have at right to contemplate, properly spaced bearings of the same bore as the required diameter of shafting from which the loads to which the shafting is subjected in bending. (NOTE: I will give immediately below, after I finish this comment, the means for computing the bearing loads.) If, for the moment, we can assume that the bore of the bearings used for supporting the shafts will be equal to the diameter of the shafting. From this, it follows that the smaller the shafting, the smaller will the bearings be. Smaller bearings mean lower cutting and/or lower rolling speeds, and, consequently, the lower cause loads which lower working and rolling speeds favor. In general, the background of FM reveals, it is obvious that all factors tending to encourage failure must be neglected, for the FM record proves that

sufficient background for the selection of sweep.

The only shortcoming, so far as Eq. (xii) is concerned, is that the equation fails to contribute towards an understanding of the manner in which the shaft must accompany itself to the bearings and the general vibrating of the shaft. But more than anything else, the attention of the above-described computational methods for the evaluation of the shaft stability contributes towards a clarification of the virtual picture of the whole carrying element rather than obtaining instantaneous functional values in combinations of both, say, by the variation in the vertical component of the drive's motion which may easily lead to a stroboscopic effect which would mar the stability of the picture and appear as flicker to the eye.

I would like I would give the computational methods for determining the bearing loads.



If (M_b) as determined by (xii) or (xiii), whichever is found to be greater, and the value of (xv) and the distance (a) are substituted in the following expression:-

$$\frac{\pi d^3}{32}(xv) = M_b$$

The bending moment factoring the shaft is obtained. Then the reaction at Bearing B would be given by:-

$$\frac{M_b(l_2+l_1)}{l_2 l_1} = R_b$$

and the reaction (R_a) at Bearing A would be given by:-

$$\frac{M_b}{l_1} = R_a$$

Just one more remark concerning the ground type diamond drill, before I launch into the main topic. This concerns the matter

of running up and down at constant speed (as a function of speed) with the mechanical system, in the same way as adopted according to Eqs. (5.6) in which Eqs. (5.6) and (5.7) which define the relationship of the lateral displacement of the shafts to the ratio $\left(\frac{\omega_n}{\omega}\right)$ for the cases respectively when $\omega < \omega_n$ and $\omega > \omega_n$ are the first two portions of study-state. By the next chapter the condition prevailing during the unsteady state, standing start-up, of running, the attaining of the steady state for which (5.6) and (5.7) hold is a matter of interest. An increase in the centrifugal force (F_c) on the shafts manifests as shaft-up; an increase in the lateral displacement of the shafts as (F_c) increases; and a shaft-up of (F_c) as the lateral displacement of the shafts increases, etc. etc.

However more pertinent in which the running of unsteady speed-trains of the shaft would be noted the attaining of full-speed by the shafts the condition where start-up the attainment of more or less the unsteadily according shafts and the lagging (approximately of natural lateral vibration of the shafts as compared and less of running of the system than its "normal" speed without damage unsteadily predictable.

The steps are to the first Equation noted it would be found as in the letter.

By the time I imagine that you must have received the next which I expected last Thursday. We note no news on Indian last during which I felt would give acceptable efforts to those over accomplished by the CBS color drive. It may be best to use the current as applicable to the larger size (5½ up to 21") would be found a good ability against lateral displacement, and up-to-date and would comply to the more standards of freedom from vibration noise as made for the color drive.

It later is to consist of a hundred of five shots of the gage speed grade selection and to handle to be one hundred pairs of selected color filters by a transparent plastic adhesive. The selection

[illegible] in the hand with each of the cellophane outer pieces to the inward-facing surface of the cellulose acetate sheets, and in the hand the inward-facing surface of the sandwiching sheet which they are to another directly. The cellophane sheets are to be held [illegible] cellulose acetate sheets. The edges of the latter are to be [illegible] suture-like effect for engagement by matching grooves, and the [illegible] film is to be pressed against moist, and folded in the manner of [illegible] post-bound "envelope".

I expect that the drawings accompanying this advice which I [illegible] to have ready for this meeting on next week, but I will [illegible] by the very next meeting — which will be in a few days [illegible] have the materials on hand by next week-end, so that [illegible] to assume a little finish, excepting color and perhaps, a little [illegible] the legend and density of the letters.

You will recall that at our recent meeting we found the [illegible] a suggested finishing of cellulose acetate sheets in cooperation with the [illegible] 68 color negative, and an employing of the known light transmission [illegible] properties of such perhaps coloring materials as poly-methyl methacrylate, [illegible] polystyrene, etc., in connection with such a scheme was mentioned. [illegible] It was discussed as a possibility because the principle involved in [illegible] such a scheme would not be the filtration of all except the wanted [illegible] components of the light - namely, polychromatic (or white) light. Rather, [illegible] it was discussed that some color might be obtained by such [illegible] a scheme would consist of a dilution of the natural color [illegible] of the film, that calls the whole back for review and re-consideration [illegible] however, to the negative color-wise scheme which is being offered [illegible] because it is claimed that it gives "depth" and "life" to [illegible] ordinary black-and-white negative. It's easy to imagine [illegible] the validity of some of these claims, and it provides a re-[illegible] consideration of the above-mentioned "dilution scheme".

The "Colormix Scheme" gives a constant (or "dead") polychromatic effect via a stationary filter. If it gains a market with the drawbacks of an unchanging polychromatic effect, it would seem to me that a "live" dilution effect such as the above-described scheme projects would have a greater appeal. It would cost more than the Colormix, would necessitate its being used in conjunction with most of the components of the CBS scheme; but it should be cheaper than the whole of the CBS scheme with its color-disc and disc-operating mechanism.

I propose to detail such a scheme immediately after I have finished the drawings for the above-mentioned "endless belt" mechanism, — that is, unless you inform me that such a scheme would be out-of-question from a marketing point-of-view. It too would be adaptable to all size kinescopes.

Within the next few days, I will complete and dispatch the drawings for the "endless belt" motion. Until then, any questions which you may have concerning the enclosed or the above, I would appreciate.

Yours;
A.B.

P.S. As the material mentioned above reaches you, please keep it confidential, as portions of it will involve possible patent applications
A.B

P.P.S Please let Goldfarb have a copy of the enclosed paper. It might be helpful to him.
A.B

FD-141
(1-13-48)

BULKY EXHIBIT

Date received 6/23/51

ABRAHAM BROTHMAN, was

100-95068-1B
(Title of case)

Submitted by Special Agent JOHN M. COLLINS

Source from which obtained WARDEN E.E. THOMPSON

Address Federal Detention Headquarters, NYC

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Ultimate disposition to be made of exhibit Retained

Estimated date of disposition - To be decided at conclusion of case

List of contents:

121. Two photostatic copies of letter dated 6/23/51 from Brothman to "Dear Herman" together with two photostatic copies of each of two pages entitled "SCHEMATICS".

71

100-95068-1B

June 23, 1851

alignment (in Figs. II and III) of Lens 31 with Lens 32 will be the color-free section of Lens 32 if compliant the color-filter containing sections of Lens 32, as that a maximum application of the color-filter to the light-sensor of the Sensor is accomplished. Black-and-white exposure is desired, and by using the same optical alignment system will interpose the clear sections of the lens between the Sensor and the viewer, and the Lens will then alternately with their color-bearing sections as indicated above.

The process of exposing film will be as follows, starting from the all adjusted for black-and-white exposure:-

A) on the switching of the exposure button the film in the "color position, Lens 32 will be exposed to the exposure, and at the exposure, will be interrupted a position and that the color-filter sections of Lens 32 and 32 will upon first and initial and final positioning and movement exposures of the color-filter;

B) when it reaches the color-exposure position for the first Lens, Lens 32 will stop, and after a predetermined delay, the shutter will be finally triggered to expose the film exposed.

The process of exposing a gray form color to black and white will be as follows:-

A) on the switching of the clear-neutral density position Lens 32 the "black-and-white position" the sections of that lens will be altered to their exposure alignment;

B) the finally exposing lens will remain stationary with the clear sections of Lens 31 exposed to the viewer and the Lens 31 will be changed;

C) once Lens 31 has been changed Lens 32 moving to the clear and without color will be moved to the clear sections of the film for the finally exposure

Upon Bill to be drawn agreeable to (C) immediately drawn, & will also be signed, placing Bill & Letter in front of the Minister

Request to stop money, the balance will be settled to Name. Be available to be for the immediate transmission of all further instructions and subscriptions. Also to impress that goods available to be immediately, and that you follow all instructions immediately and implicitly

Yours

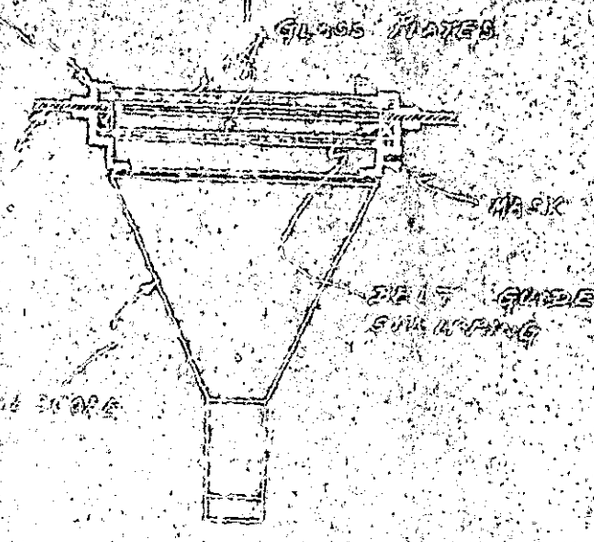


FIG. I PLAN SECTION VIEW WITHOUT COLOR BELT SHOWN

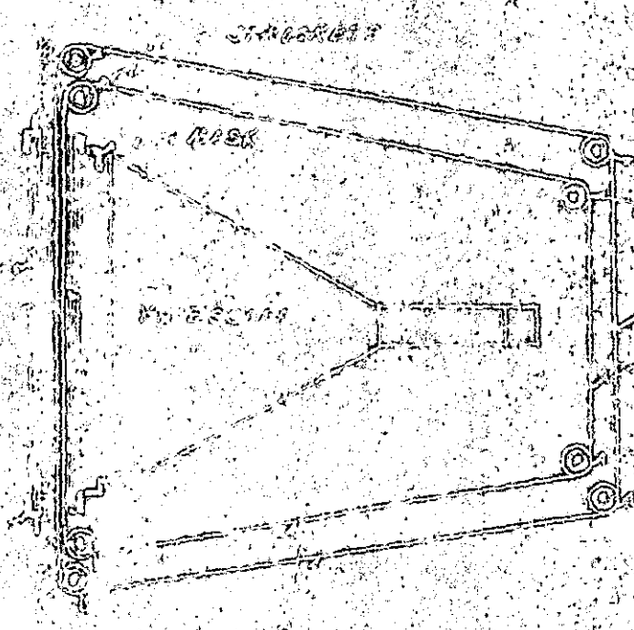
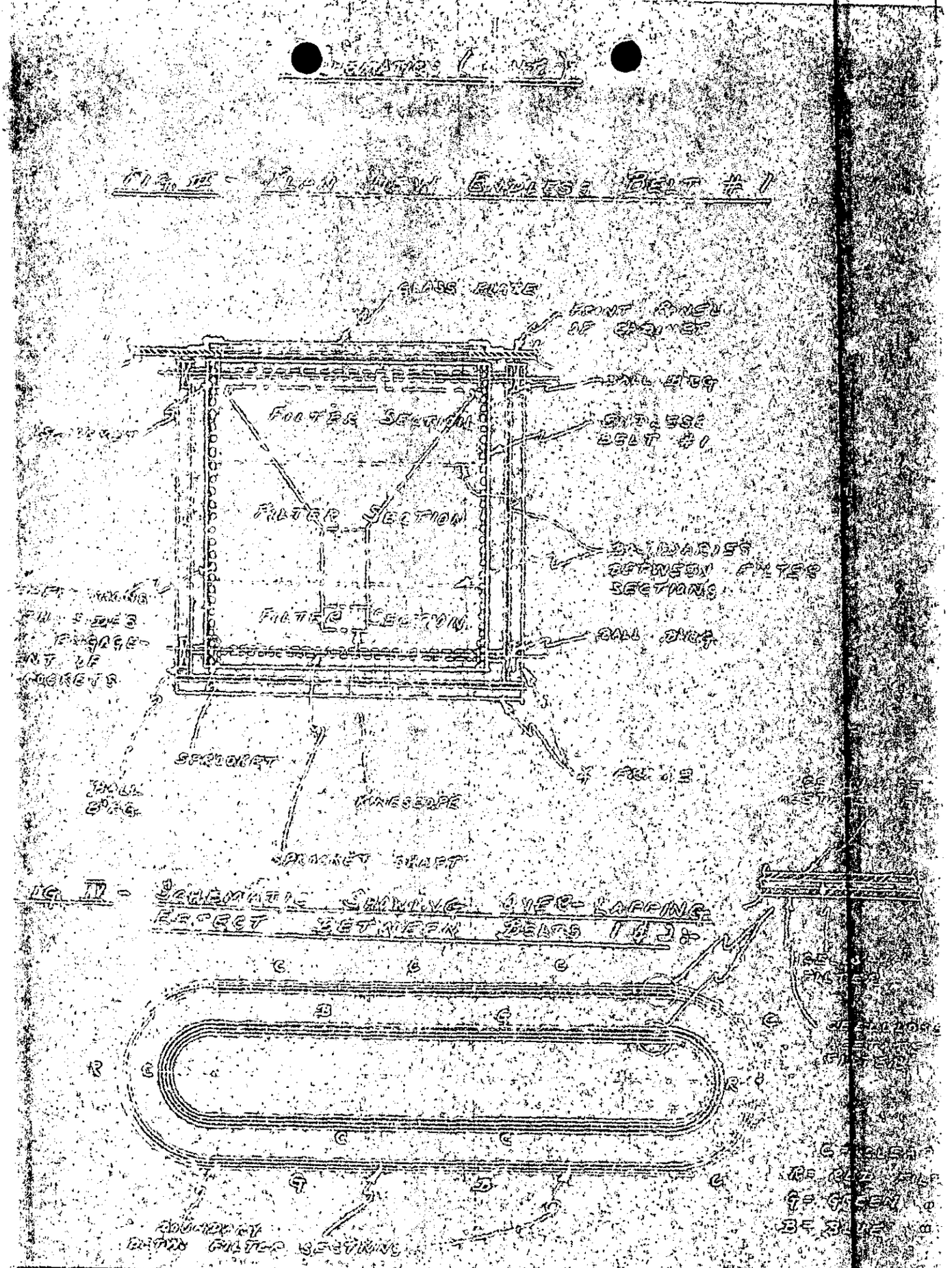


FIG. II SIDE ELEVATION VIEW SHOWING ... BELT ... (SECTION A-A)


GLASS PLATE
FILTER SECTION
FILTER SECTION
SPRINKLER
SPRINKLER SHAFT

June 23, 1951

Dear Herman,

Without much explanation, this is to inform you that J.F. requests that you take over the coordinating of the joint efforts of Minett and Tochaffer in bringing out the CBS-colorscope which is outlined below and in the enclosed schematics. I will detail your duties in connection with the project below, after I get thru with the outline material connected with the sketches; or, if the mailman calls before I can get the instructions down, then you will get the same from Naomi.

As about the sketches:-

The object of the scheme indicated on the sketches is to avoid the CBS color wheel and the limitations as to tube size which it imposes, and at the same time to provide to provide for color or black-and-white reception at will.

To avoid the limitations as to tube-size, an "endless belt principle" is proposed by the enclosed. The cabinet would have to be enlarged over present standard-size cabinets only to the extent of being able to accomodate the framework for the sprocket assembly mechanism shown or implied on the sketches. The chassis mounting would have to be changed to permit a separate supporting of the kinescope (NOTE:- from the sides of the cabinet), and a separate supporting of the chassis (NOTE:- the chassis would be placed underneath the endless belt mechanism framework, and connections from the face of the cabinet to the controls would be by way of flexible cables).

To provide for alternative color and black-and-white reception from the same kinescope a two-belt system is proposed. Part of each belt carries [illegible] red-green and blue filters, and the balance of each belt is "clear" permitting the unfiltered transmission of white light from the kinescope. When color reception is intended, a mechanism-actuated

alignment (as Figs. IE and IF) of Rib #1 will be as will be
the color-filter readings of Rib #E & F. Conversely the color-filter
reading readings of Rib #2, or Rib a succeeding application of
color-filter to the layer-images is accomplished.
Black-and-white reception is simply, merely by-passing the color-
detail adjustment apparatus while engaging the fine readings of the
Rib between the scanning and the viewer, and the Rib shall remain
stationary while they are being done as in the above.

The manner of apparatus will be as follows, starting from
the set adjusted for black-and-white reception:-

A) as the switching of the apparatus begins the fine-fine
Rib #1 color-filter, Rib #1 will be engaged to
alignment, and as the scan speed will be switched
to faster and that the color-filtering of Rib #1
and 2 will upon first and initial speed [illegible]
a continuous and successive application in proper time
of the color-filters;

B) once it reaches the color-application point for the
second Rib, Rib #2 will step, and after a very short
delay, the Rib will be firmly engaged to alignment
to scan speed.

The manner of application in going from color to black and white will be
as follows:-

A) as the switching of the color-filtered fine-pitch Rib #1
to "black-and-white" reception, the switching that Rib
will be released to their alignment clearance;

B) the fine-pitch Rib #2 will be disengaged until the
slow scan of Rib #1 engages to the slow scan the
Rib #1 will be disengaged;

and

C) once Rib #1 has been disengaged, Rib #2 assumes
its slow scan alignment and will then be stepped to
its slow scan position for the full scanning

After Bills No 2 have been engrossed as per (C) immediately above, it will
also be expedient, placing both these Bills in front of the Minutes
directed to stop money. The Minutes will be directed to
Messrs. Be available to her for the immediate Commencement of
all further instructions and descriptions. Thus as expeditious
Plot grounds available to be immediately, and that you follow
the instructions immediately and implicitly

Yrs.

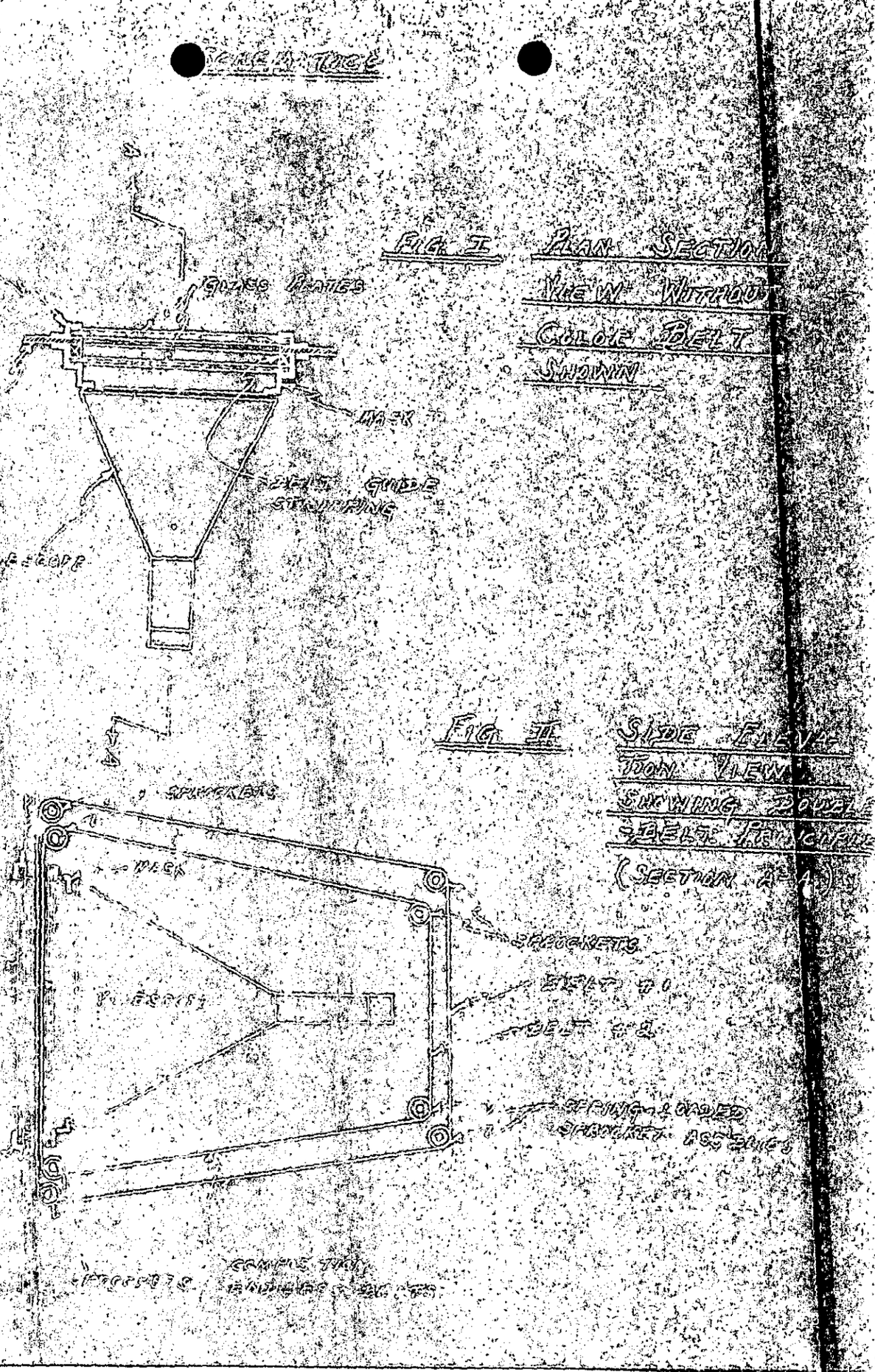
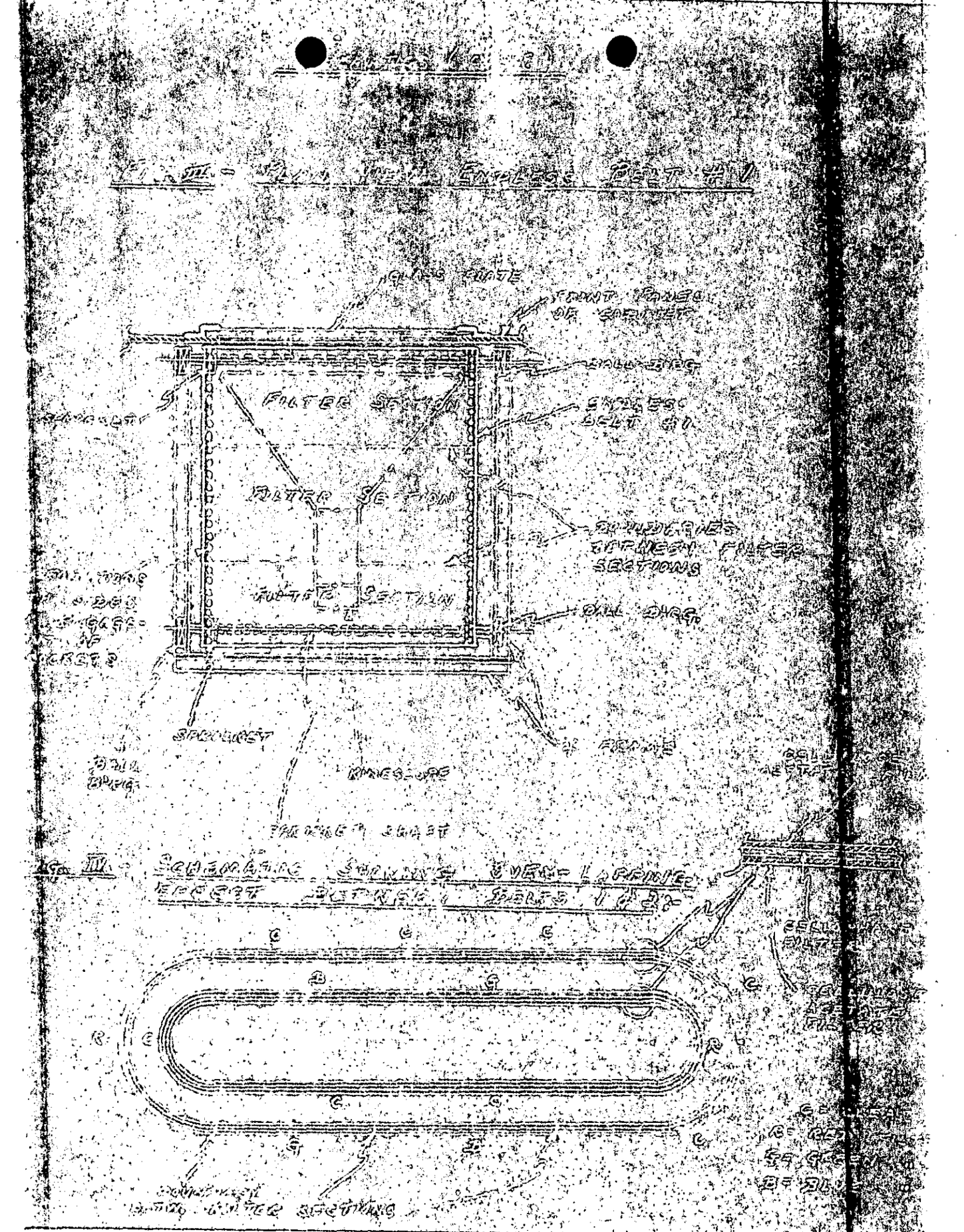


FIG. I
PLAN SECTION
VIEW WITHOUT
GUIDE BELT
SHOWING
FIG. II
SIDE ELEVATION
SHOWING ZONAL
SPRINKLERS
SPRINKLERS
SPRINKLERS



FD-141
(1-13-48)

BULKY EXHIBIT

Date received 6/30/51

ABRAHAM BROTHMAN, was

100-95068-1B
(Title of case)

Submitted by Special Agent JOHN M. COLLINS

Source from which obtained Warden A. E. Thompson

Address Federal Detention Headquarters, N.Y.C.

Purpose for which acquired Investigation

Location of bulky exhibit In cabinet with file

Ultimate disposition to be made of exhibit Retained

Estimated date of disposition - To be decided at conclusion of case

List of contents:

122. Two photostatic copies of "Drum Type Color Wheel for Black & White and Color TV".

123. Two photostatic copies of "Layout Sketches for 20" Tube.

124. Two photostatic copies of memorandum addressed to Joe F entitled " Projection" Job.

72

100-95068-1B

DRUM TYPE COLOR WHEEL FOR BLACK & WHITE & COLOR TV

Let us consider a drum composed of 6 sides (2 sides of the primary three) and let us assume that the drum will be used for a 20" tube. If

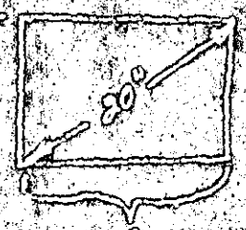


Fig. I

we use the following

$$l = 2.5h = l$$

Then

$$(2.5h)^2 + h^2 = 20^2$$

$$h^2 = \frac{400}{6.25} = 156.2$$

$$h = 12.5"$$

$$l = 1.25(12.5) = 15.6"$$

would be the dimensions of the sides. Now we must also see that the picture tube would be covering these

$$\frac{12.5}{2} = \frac{6.25}{2} = 12.5" = \text{radius}$$

of the drum.

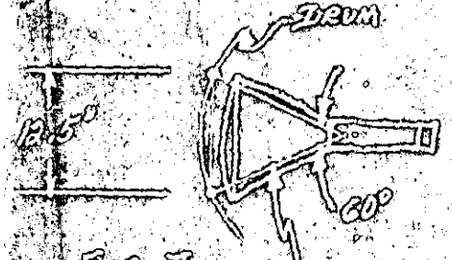


Fig. II

By measuring the drum is found to be as above as in Fig. 3, in which the slots are covered with color filters, and a motor spins the drum. There are three slots, and the number of the filters is two, and their lengths are 17", then each would have an area of

$$\text{area} = l\left[\frac{\theta}{360}\right]\pi = \frac{3\pi(12.5)(17)(60)\pi}{360}$$

$$= 139 \text{ cm}^2$$

and a specific gravity of 1.18, the

$$\frac{62.5 \text{ lb}}{1728 \text{ in}^3} \times 1.18 \times 45.7 \text{ in}^3 = 1.57 \text{ lb}$$

would be the weight of each slot, which is

63.5 lb/ft² in the direction of the

The motor would run 60 RPS (3 sets of 2 filters) and the

21,600 rpm. The motor will be geared

$\frac{1}{2}(21,600) = 10,800$ rpm for the 6-slot drum

The rotational speed of the engine is

$$\frac{14.40 \frac{rad}{sec} \left(\frac{60 sec}{min}\right)}{6.0 \frac{rad}{rev}} = 1508 \frac{rev}{min}$$

The centrifugal force acting on each shaft would then be:

$$F_c = \frac{W}{g} v^2 r$$

$$= \frac{0.5 \text{ lb}}{32.2 \frac{ft}{sec^2}} \cdot \left[14.40 \frac{rad}{sec}\right]^2 \frac{(2.5 in)}{12 \frac{in}{ft}}$$

$$= 4.10 \text{ lb}$$

and the maximum torque would therefore be equal to acting through a lever arm of

$$4.10 \text{ lb} \left((6 \text{ in})\right) = 3.640 \text{ in-lb}$$

Hence, the

$$\frac{3.640 \text{ in-lb}}{2 \text{ springs}} = 1820 \frac{\text{in-lb}}{\text{spring}}$$

If both the springs are identical, then the maximum allowable stress of 70,000 psi is not to be exceeded under the

$$\frac{1820 \text{ in-lb}}{0.75 \text{ in} \cdot (t)} = 70,000 \frac{lb}{in^2}$$

$$\frac{1820 \text{ in-lb}}{0.75 \text{ in} \cdot (70,000 \text{ lb/in}^2)} = 0.0258'' = t$$

Thickness. The shaft must also be designed as a uniformly loaded beam which is simply supported at each end:

$$W = wL$$

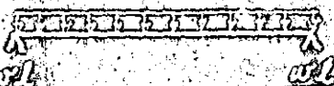


Fig. 701

$$M = \frac{wLx}{2}(L-x) = EI\left(\frac{d^2y}{dx^2}\right)$$

$$\frac{wL}{2}\left(Lx - x^2\right) = EI\left(\frac{d^2y}{dx^2}\right)$$

$$\frac{w}{2}\left(\frac{Lx^2}{2} - \frac{x^3}{3}\right) + C_1 = \frac{dy}{dx}$$

But $\frac{dy}{dx} = 0$, when $x = \frac{L}{2}$, and so:

$$\frac{w}{2}\left(\frac{L^3}{8} - \frac{L^3}{24}\right) + C_1 = 0$$

$$C_1 = -\frac{w}{2}\left(\frac{L^3}{12}\right) = -\frac{wL^3}{24EI}$$

and

$$\frac{dy}{dx} = \frac{w}{2EI}\left(\frac{Lx^2}{2} - \frac{x^3}{3}\right) - \frac{wL^3}{24EI}$$

$$y = \frac{w}{2EI}\left(\frac{Lx^3}{6} - \frac{x^4}{12}\right) - \frac{wL^3x}{24EI} + C_2$$

But, since $y = 0$ when $x = 0$, then

$$C_2 = 0$$

and

$$y = \frac{w}{2EI}\left(\frac{Lx^3}{6} - \frac{x^4}{12} - \frac{L^3x}{12}\right)$$

At $x = \frac{L}{2}$, it is clear that (y) would have its maximum value, and $(y)_{max}$ would be given by:-

$$y_{max} = \frac{w}{2EI}\left(\frac{L^4}{48} - \frac{L^4}{192} - \frac{L^4}{24}\right)$$

$$= -\frac{5wL^4}{384EI} = -\frac{5WL^3}{384EI}$$

This gives us a form for computing the deflection, and the stresses, in the slats when the slats have lag to full ___ speed. It is now necessary to develop the value of (I) for the slats.

Fig. II

It is clear that the mean radius between $r = 12\frac{1}{2}''$ and $12\frac{7}{8}''$ (which would be $12\frac{17}{32}''$) would be the radius of gyration of the slat indicated in Fig II with respect to the axis x'x'. The cross-sectional area of the slat is approximately

$$\frac{t(2\pi r_{mean})2\theta}{360} =$$

$$\frac{\frac{1}{16}(2\pi)(12\frac{17}{32})(60)}{360} = 0.822 \text{ in}^2$$

then (I) with respect to the x'x' axis would be

$$Ak^2 = 0.822\left(12\frac{17}{32}\right)^2 = 129 \text{ in}^4$$

The center of gravity of the slat would be given by:-

$$y_0 = \frac{r_{mean} \sin \theta}{\text{rad. } \theta}$$

$$= \frac{(12\frac{17}{32})(\sin 30°)}{\text{rad. } 30°} = \frac{12\frac{17}{32}''(0.5)}{0.5236} = 11.95''$$

I_y (EI) is the moment of inertia of the entire section about the centroidal axis.

$$I_{tot} = I_0 + Ad^2$$

and for

$$123 \text{ in}^4 = I_0 + 0.622(11.75)^2$$

$$123 - 0.622(11.25) = 123 - 117.5 = 11.5 \text{ in}^4$$

From this, it follows that

$$y_{max} = -\frac{5WL^3}{384EI} = -\frac{5(4\cdot10)(17)^3}{384(2)(10^3)(11.5)} = 0.0102 \text{ in.}$$

which is acceptable if the two end moments are inclusive stress.

$$y_{max} = \frac{5WL^3}{384EI}$$

and

$$M_{max} = \frac{WL^2}{8} = \frac{WL}{8}$$

Therefore

$$y_{max} = \frac{WL}{8} \cdot \frac{5L^2}{48EI} = \frac{5ML^2}{48EI}$$

But

$$M = SZ$$

where

M = Maximum moment in the beam = in-lbs
Z = Sectional modulus of the beam = in^3
S = Stress induced in the beam = lbs/in^2

and

$$\frac{I}{c} = Z$$

where

c = distance of the extreme fiber from the neutral axis of the beam

and therefore

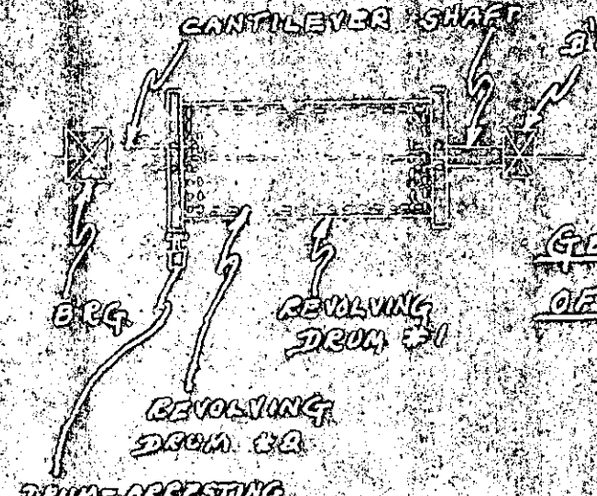
$$y_{max} = \frac{5(S)\left(\frac{I}{c}\right)L^2}{48EI} = \frac{5SL^2}{48Ec}$$

By the question,

$$0.0102 \text{ in.} = \frac{5\left(\frac{12}{11.5} - 1.03\right)(17^2)S}{48(2)(10^3)} = \frac{5(0.0435)(17^2)S}{48(10^3)(1.03)}$$

$$\frac{1.032\,(0.0102)(48)(10^3)}{5(0.0435)(17^2)} = S = 2.39 \text{ k/in}^2$$

NOTE:- DRUM #4 TO CONSIST OF 5 COLOR FILTERS, AND 1 WHITE LIGHT SLAT; DRUM #1 4 WHITE LIGHT SLATS, AND 1 COLOR SLAT COMPLETING 2 SERIES FOR DRUM #2

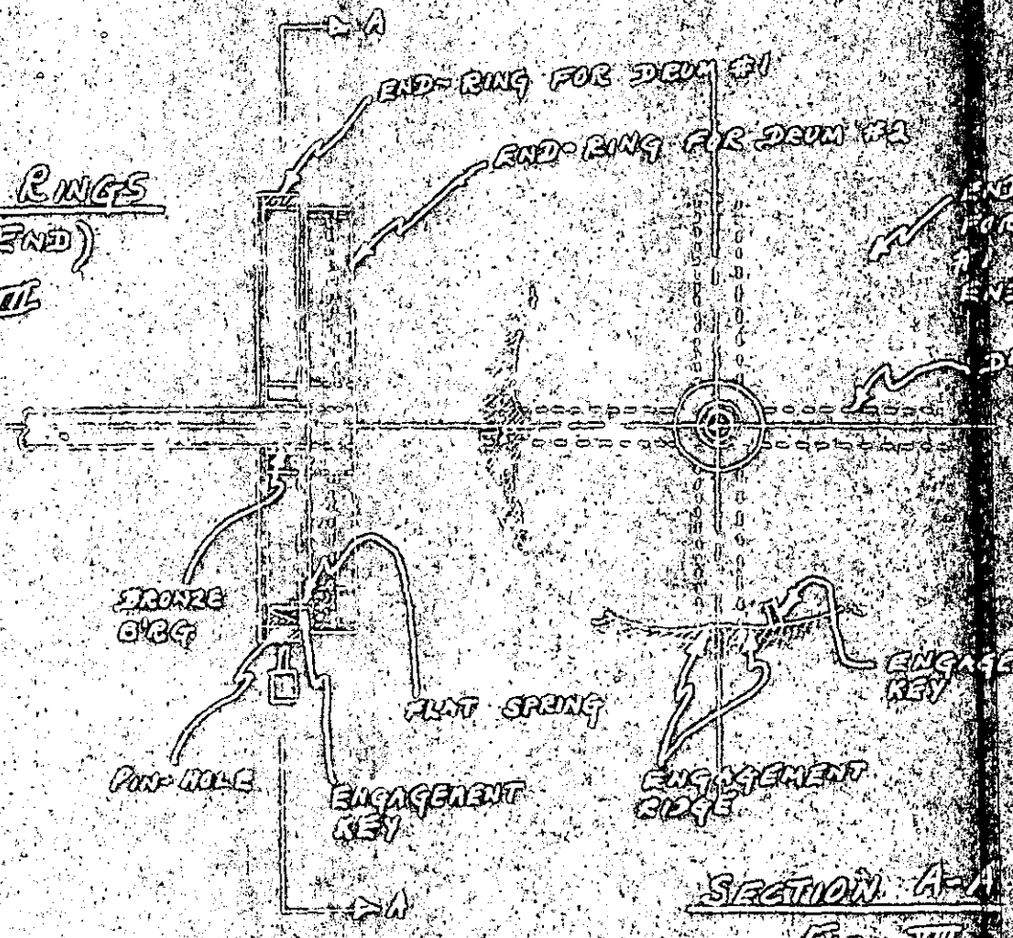


GENERAL ARRANGEMENT OF DRUM SUPPORT

FIG. II

DRUM RINGS (DRIVEN-END)

FIG. III



SECTION A-A

FIG. III

To approximate the combined weight of the driven pulley, we proceed as follows:

18 web = 17 lb/ft

$$\frac{2\pi r\,\theta}{360} = \frac{2\pi (12.5)(60)}{360} = 13.1 \text{ in}$$

and $\frac{1}{16}$" thick

would weigh

$$\frac{12(\pi)(13.1)(0.0625)(12.5)(0.28)}{1728} = 7.17 \text{ lb}$$

and, if we estimate the end rings at 2 lb, the driven ring would weigh 11 lb. If we assume a 1" wide rim of approximately 20" dia. this could be considered to have a radius of gyration of approximately 13", giving the driven a Σmr^2 of

$$\Sigma mr^2 = 20\left(\frac{13}{12}\right)^2 = 23.5 \text{ lb-ft}^2$$

Now such a driven to attain a velocity of 150.8 $\frac{\text{rad}}{\text{sec}}$.

$$\frac{23.5}{2(32.2)}(150.8)^2 = 16,700 \text{ ft-lb} = 8,350 \text{ ft-lb}$$

of energy is required in the form of flywheel energy. Since windage, the power to overcome a large motor, and it would be desirable to reduce the requirement to the order of the indicated figure, it is therefore desirable to reduce the weight of the driven, more particularly the rim, and the indicated radius of gyration by setting in 3" from the O.D. and using a web. In that case,

$$\frac{10.17}{20.5}\left(16,700\right) = 7,540 \text{ ft-lb} = 3620 \text{ ft-lb}$$

would be the required flywheel energy. If the unit supplied is 60 rpm

$$\frac{3620 \text{ ft-lb}}{(60 \text{ sec})\left(550 \frac{\text{ft-lb}}{\text{sec-hp}}\right)} = 0.105 \text{ hp}$$

motor-drive would be required.

In bringing the driven assembly to a stop, let us assume that 60 secs. is satisfactory. Then the negative acceleration of

$$a = \frac{\Delta V}{t} = \frac{0-(150.8-0)}{60} = -2.53 \frac{\text{rad}}{\text{sec}^2}$$

is involved, and the torque-capacity of the brake would have to be

$$\frac{10.17}{32.2}(2.53) = \text{[illegible]} \text{ ft-lb}$$

If a force is to be applied to a mechanical brake, the required area of a cylinder on a 12" radius is

$$\frac{(15\ \text{lb})(12\ \text{in})\left(\frac{1\ \text{ft}}{12\ \text{in}}\right)}{(0.3)} = 150\ \text{ft}^2$$

braking force. If an eddy-current brake were to be used, not much force is to be exerted at a

$$\frac{3(2\pi)}{60\left(\frac{\text{sec}}{\text{min}}\right)} = \frac{(2\pi)}{(\text{sec})}\ \frac{\text{ft-lb}}{\text{sec}}$$

energy consumption is present. The electrical rating of the brake would then have to be:

$$\frac{60\ \frac{\text{ft-lb}}{\text{sec}}}{550\ \frac{\text{ft-lb}}{\text{sec-hp}}}\left(0.746\ \frac{\text{kilowatt}}{\text{hp}}\right) = 0.0815\ \text{kW}$$

but because eddy current brakes are quite inefficient, the actual brake rating would have to be substantially larger. A maximum brake applied to the output shaft of the driving motor also deserves consideration.

The question arises of applying the braking force so that a given maximum speed is allowed, and then having it be the retarding force for it being the function for a full-step for the continual braking of a and disengagement of the drive from driving the motor. Use of a a ½" diameter round pin would a cantilever shaft of 2" by formulas (for cantilever beams)

$$M = Pl = SZ = S\frac{I}{c}$$

$$f = \frac{Pl^3}{3EI}$$

can become

$$f = \frac{Sl^2}{3Ec}$$

Using this formula, and an limit value in the 75% of the elastic limit, and taking the elastic limit to be 30,000 lb/in.^{2}, then for a material for which $E = 30(10^6)$

$$f = \frac{0.75(30{,}000\ \frac{\text{lb}}{\text{in}^2})(2\ \text{in})^2}{3(30\times10^6\ \frac{\text{lb}}{\text{in}^2})\left(\frac{1}{2}\ \text{in}\right)} = 0.0075\ \text{in}.$$

Similarly, the pin would be serving as a spring along with the shaft, and as $f''(x)$ represents the force that is the spring force of

deflection, then

$$W(\text{work stored in the spring}) = \int_{y=0}^{y=f} Ky\,dy = \frac{Kf^2}{2}$$

where f = the limiting deflection of the spring.

From the formula

$$f = \frac{PL^3}{3EI}$$

in the form

$$\frac{3EI}{L^3} = \frac{P}{f} = K = \frac{3\pi Ed^4}{L^3}$$

and from this

$$K = \frac{3\pi (29\times10^6\ \#/\text{in.}^2)(\tfrac{1}{4})^4}{(12)^3} = 119{,}500\ \#/\text{in.}$$

can be stored in the spring by a deflection of $0.0024''$ (round it off)

$$\frac{1}{2}(119{,}500\ \#/\text{in.})(0.0024)^2 = 0.508\ \text{in.-lb.}$$

or

$$\frac{0.508\ \text{in.-lb.}}{12\ \frac{\text{in.}}{\text{ft.}}} = 0.043\ \text{ft.-lb.}$$

of energy. This would limit the velocity of the plunger to

$$0.043 = \frac{10.0}{2(32)}v^2$$

$$\left[\frac{64(0.043)}{10.0}\right]^{\frac{1}{2}} = v = [2.75]^{\frac{1}{2}} = 1.66\ \text{ft./sec.}$$

With the positive gear on the end of the armature shaft, the clock would run 150.8 seconds fast per hour if the pendulum were allowed to swing through an arc of $4.0°$. This would be reduced to 1.66 seconds fast per hour if the pendulum were allowed to swing through an arc of $1.6°$. Assuming the use of a 4 to 1 transistor amplifier and assuming a $4.0°$ arc, the pendulum is to be provided with a bracket for blocking the swing, which can be moved to the edge of the second positioning wheel.

The velocity of the Drum #2 assembly at the end of the drive unit and 1200 strands can be computed by applying the ratio of the specified motor to the computed motor speed to the acceleration to obtain the computed motor speed in feet per minute, then the computed motor speed is converted to feet per second. Thus, the computed motor speed for the Drum #2 assembly from eqn. 1.0.6 and from (60 rpm), is as follows

$$(60\ rpm) = \frac{\pi}{30}\omega \quad (60)$$

$$\frac{3(1050\ ft)}{60} = 5.03\ \text{mile/hr}$$

Using a 0.125 HP motor in the place of the 0.083 HP computed requirements, we may obtain

$$\frac{(0.125\ HP)}{(0.083\ HP)}\left[5.03\ \text{mile/hr}\right] = 5.95\ \text{mile/hr}$$

Is the acceleration which the specified motor would apply to the 12.6" dia of strand constitutes a strand of

$$\frac{120}{360}(2\pi) = \frac{2}{3}\pi\ \text{radians}$$

The above-given acceleration of 5.95 mile/hour would be applied to the Drum assembly with a Σ mass of 10.17 lbs-(lb.²) which is the summation of the Drum shaft assembly and half of the Σ mass of strands (assuming the same mass-output figure) would be

$$2(5.95) = 11.96\ \text{mile/hr}^2$$

By

$$S = \frac{1}{2}at^2$$

$$\frac{2}{3}\pi = \frac{1}{2}(11.96)(t^2)$$

$$t = \left[\frac{2(2.09)}{3(11.96)}\right]^{1/2} = 0.35^{1/2} = 0.592\ \text{sec.}$$

would be the time required for motor from the initial rest and

$$\frac{1}{2}at^2 = \frac{1}{2}(11.96)((0.592)^2) = 2.09\ \text{mile/hr.}$$

would be the drum velocity at the conclusion of the arc of strand. Therefore there are four critical points that must be considered. Drum #2 with respect to Drum #1 may be computed. Then two critical points

If the first function which the hotel serves is (1) partly to steer the ships and partly to control Drum #1 when Hook-and-Eye valve is controlled, and (2) to the means by Drum #1 is controlled along with Drum #2 in water-driving in stopping Drum #2, after the Drum #1 has already been pressed, it must absorb the flywheel energy Drum #2, the would mean, since Emax. for each Drum has been taken at 5085 lb-ft., also

$$\frac{(5,085\ \text{lb-ft}^2)}{(32)\left(22\ \frac{\text{ft}}{\text{sec}^2}\right)}\ (5.57\ \text{radians/sec.}) = 0.362\ \text{ft-lbs.}$$

of energy would have to be absorbed. By reference to the previous calculations concerning the pin which positions Drum #1, it is clear that a member with a rectangular modulus equal to $\frac{1}{4}$" would suffice, if not more than the shearing force acting on the pin, but more margin than the shearing force acting on the pin, but more margin than this would be required at a minimum. It must a larger pin it

$$\frac{(10.17\ \text{lb-ft}^2)}{(32\ \text{ft/sec}^2)}\ [5.57\ \text{rad/sec.}] = 1.771\ \text{ft-lb}$$

or

$$(1.771\ \text{ft-lb})\left(12\ \frac{\text{in.}}{\text{ft.}}\right) = 21.25\ \text{in-lb.}$$

The main reason that the pin is made as small as 15 inches from the main gear is, the type material chosen might be of

$$\frac{21.25\ \text{in-lb.}}{\text{lb/in}^2} = 1125\ \text{in}^3$$

Which is the ending point. The pin 2" by 1" would mean the ending of a bending load of

$$1.77\ (2) = 3.54\ \text{in-lb.}$$

which is, in fact, many times greater than the computations. The key is the matter of the shafting by which the Drums are controlled. One disadvantage of the Hook, as pictured, it is practical from a superficial observation, is that in terms of a continuous shafting mounting of the Drums from end to end as per the figure below:-

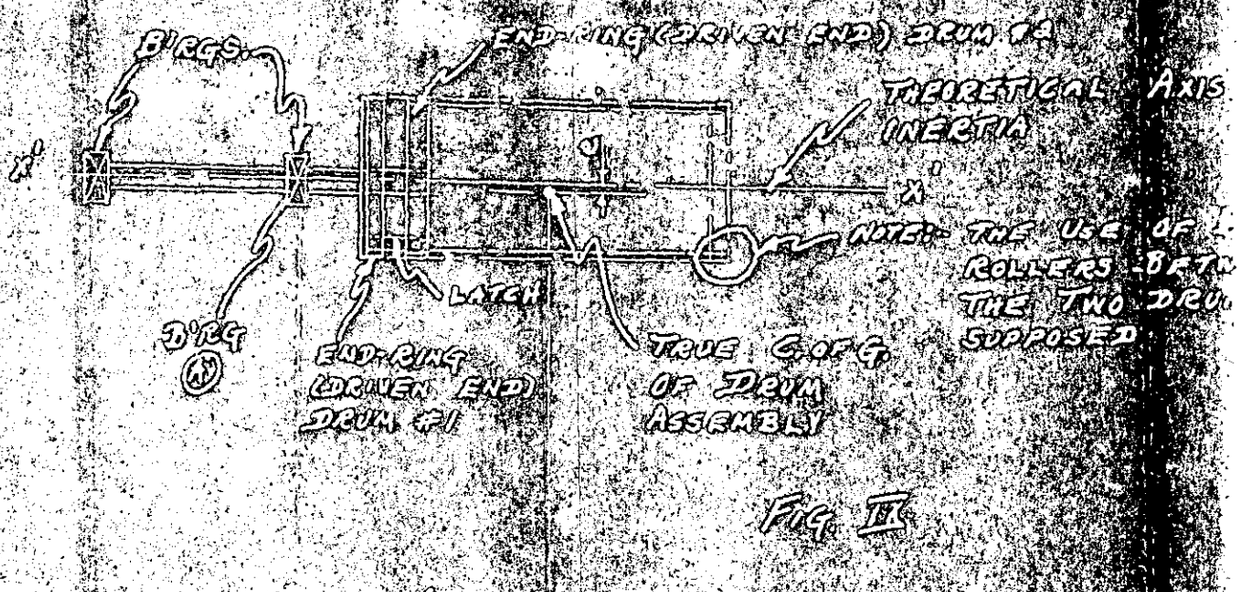


FIG. III

L

As previously stated, the rotor-drum assembly is considered as a rigid concentrated load on a resilient shaft, and the length of the shaft being taken as equal to the span between bearings (A) and (B) and the flexibility of the combined drum assembly. It was of space-relative to combine towards the stability of this equipment

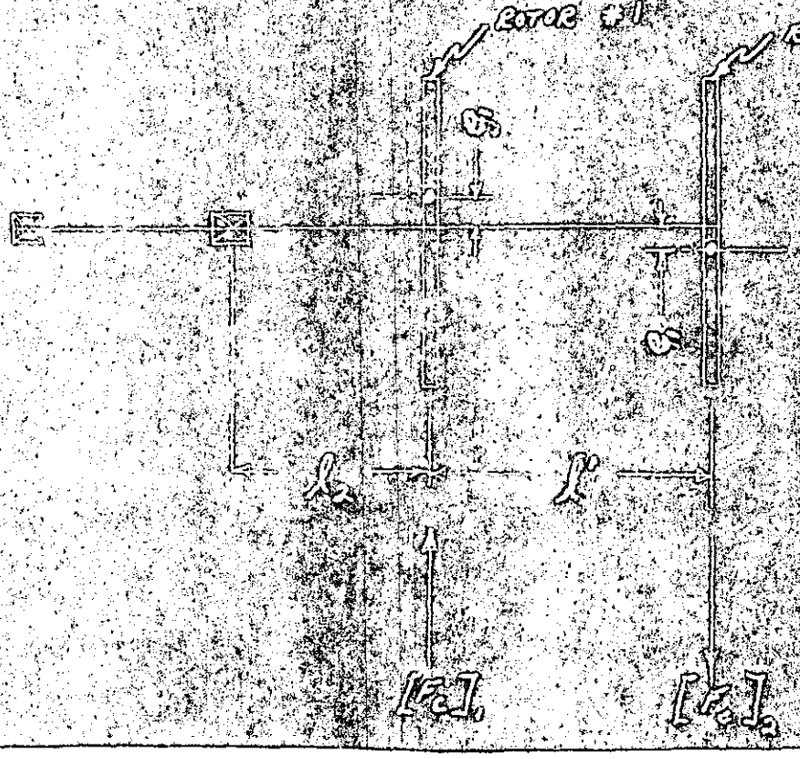
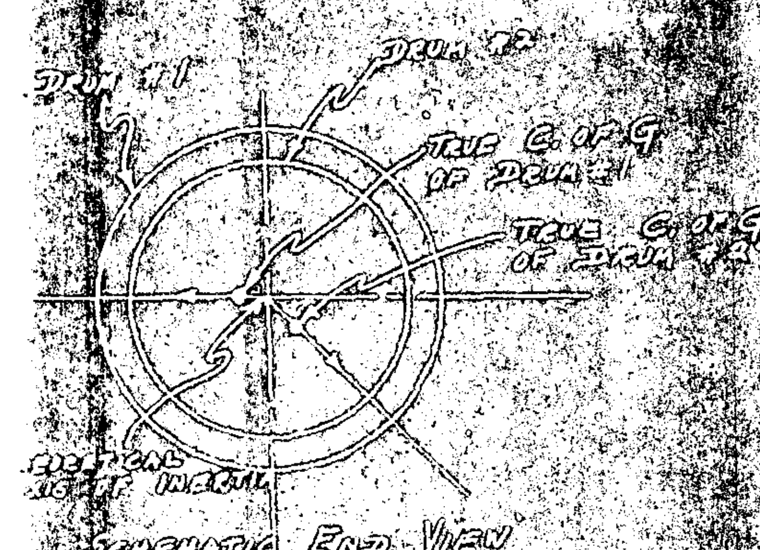


FIG.



SCHEMATIC END VIEW OF ASSEMBY (DRUMS)

FIG. II

The viewpoint taken above is, fundamentally, a simplified and idealized one. It is in opposition to the view which considers the shaft to carry two distinct concentrated loads. Considering the shaft as carrying two distinct concentrated loads, there is room for only two possibilities (assuming that each drum has been fabricated to identical tolerances so as to balance). These possibilities are illustrated in Figs. 10 and II, where:-

a. Fig. 10 illustrates the situation in which two rotors of identical weight having diametrically-opposed identical eccentricities are mounted on the same shaft;

and,

b. Fig. II illustrates the situation in which two rotors of identical weight have their identical eccentricities acting in different axial planes.

Analyzing the situation presented by Fig. X, it is clear that since the eccentricities of both rotors are identical, each would — to begin with — exert a centrifugal force on the shaft, as given by:-

$$F_{c_1} = F_{c_2} = \frac{W}{g}\omega^2 e$$

But since (F_{c_1}) and (F_{c_2}) act in opposite directions, in consequence of their diametrically-opposed eccentricities, they would constitute a rotational moment (or rotational couple) of magnitude

$$\frac{W}{g}\omega^2 e l$$

For so long as the rotational couple persists, it would subject each and every section of the shaft ~~to strain — which in turn~~ to the left of ($l_3 + l/2$) to an upward rotation, and every section to the right of ($l_3 + l/2$) to a downward rotation. Quite obviously the mentioned portions of the span would present different resistances to the couple, and would consequently result in

adjustment of stiffness for the flexibility of the two sets of bearings. Let $x = l_2$ and $x = l_2 + l'$ be the different magnitude and the relative magnitudes of (F_{c_1}) and (F_{c_2}) the couple would be distributed and the actual reactions would be that shown pictorially below

Fig. XCI

In other words, a reaction is added the forces (F_{c_1}) and (F_{c_2}) are produced according to

$$\frac{(F_{c_1})(l' + l_{2_1}) - (F_{c_1})l_{2_1}}{(R_2 + l')} = F_{c_2}$$

into a resultant force (F_{c_2}) acting at a lever arm of $(l_2 + l$ Fig. (A). The moment acting on any section of the beam would be given by:-

$$M_x = F_{c_2}(l' + l_2 - x) = EI\frac{d^2y}{dx^2}$$

which, after two successive integrations, would take the form

$$y = \frac{F_{c_2}}{EI}\left(\frac{[l' + l_2]x^2}{2} - \frac{x^3}{6}\right)$$

To give the shaft, when considered as a spring, a K value

$$K = \frac{EI}{\left[\frac{(l' + l_2)x^2}{2} - \frac{x^3}{6}\right]}$$

From Fig. XCI, it follows that

$$F_{c_1} = \frac{W}{g}(y_1 - e_1)w^2$$

and

$$F_{c_2} = \frac{W}{g}(y_2 + e_1)\omega^2$$

Moreover, since

$$F_{c_2} + F_{c_1} = K y_2$$

we may write

$$\frac{W}{g}(y_2 - e_1)\omega^2 + \frac{W}{g}(e_1 + y_2)\omega^2 = K y_2$$

which will reduce to

$$\omega^2(y_1 + y_2) = \frac{K_2}{W} y_2 g$$

$$\frac{\omega^2 y_1}{\frac{K_2}{W} - \omega^2} = y_2 = \frac{y_1}{\left(\frac{K_2}{W\omega^2}\right) - 1}$$

The significance of the final equation is that

a) as (ω^2) approaches $\left(\frac{K_2}{W}\right)$ in value, (y_2) would attain extremely large values, becoming infinite when $\omega^2 = \frac{K_2}{W}$ (i.e. the shaft would fail);

and

b) since (y_2) is expressed in terms of (y_1) with $\left[\frac{K_2}{W\omega^2} - 1\right]$ as a multiplier, it is also true that when $\omega < \left(\frac{K_2}{W}\right)$ approaches 1, but is increased, the position of y_2 will be in the normal sense, while $\omega > \left[\frac{K_2}{W}\right]$, the final equation becomes

$$y_2 = \frac{y_1}{1 - \frac{K_2}{W\omega^2}}$$

means that the motion of the shaft above is for the critical speed.

The interpretation of Fig. a is equally simple if analytic [illegible] to note the double-throw crankshaft should be considered as two [illegible] independent concentrated loads, each being simply supported, [illegible] combine the force caused by the unbalance of the throw opposite the [illegible] with the force caused by the unbalance of the throw opposite the [illegible] Thus (F_1) is actually equal to $F(l_2 + l')$, the load [illegible] concentrated load F_2 is $F(l_1 + l')$. Then the shaft [illegible]

Between (y1) and (y2) in feet of line as above by the normal stress
and the bending moment between (y1) and (y2) by the dynamic
deflection between (y1) and (y2) by similar figures, by the principle
of specific gravity, by the first moment area, and by the Theorem of
Area, the force of attraction between the two masses upon the
unit mass, the Young's Modulus, assuming a single concentrated load,
the mass per square inch, the specific gravity and a single concentrated load, by the
area moment of inertia, load, by the

Referring to Fig. 12, we have

$W = 10.17$ lb.
$L = 14$ in.
$S = 15,000$ lb./sq. in.
$\omega = 150$ lb. per cu. ft.
$E = 30 \times 10^6$ lb. per sq. in., modulus of elasticity
Dynamic deflection at $x = 0.125(2.5) = 0.31$ in.

$$g = \left[32.2 \frac{\text{ft.}}{\text{sec.}^2}\right]\left[12 \frac{\text{in.}}{\text{ft.}}\right] = 386 \text{ in./sec.}^2$$

$F_1 = 2.6(10^6)$ lb./sq. in.

Then using Eq. (17) we have, by the principle of Virtual Work

$$\frac{\pi S_1 d^4}{32 L W \omega^2} - F d = \frac{2 S L^2}{3 E_1}$$

$$\frac{\pi (15{,}000)(386) d^4}{32 (14)(10.17)(150)^2} - 0.31 d = \frac{2(15{,}000)(14)^2}{3(2.6)(10^6)}$$

$$0.115 d^4 - 0.31 d - 0.0754 = 0$$

$$d^4 - 0.5 d - 0.43 = 0$$

In the above equation,

$4A = 0.0$; $A = +0.0$
$6B = 0$; $B = +0.0$
$-0.5 = -4C$; $C = +0.13$
$D = -0.43$; $D = -0.43$

Then, solving

$$g = A^2 - B = 0 - 0 = 0$$
$$h = B^2 + C^2 - 2ABC + D = 0 + 0.07 - 0 + 0 = 0.07$$

$$\lambda = \tfrac{1}{3}AC - B^2 = -\tfrac{1}{3}D = 0 - 0 + \tfrac{0.43}{3} = 0.143$$

$$\mu = \tfrac{1}{2}\left[h + \left[h^2 + \lambda^3\right]^{1/2}\right]^{1/3} + \tfrac{1}{2}\left[h - \left[h^2 + \lambda^3\right]^{1/2}\right]^{1/3} =$$

$$\tfrac{1}{2}\left[0.07 + \left(0.0016 + 0.0029\right)^{1/2}\right]^{1/3} + \tfrac{1}{2}\left[0.07 - \left(0.0016 + 0.0029\right)^{1/2}\right]^{1/3} =$$

$$\tfrac{1}{2}\left[0.07 + 0.16i\right] + \tfrac{1}{2}\left[0.07 - 0.10i\right] =$$

$$0.102 + 0.071 = 0.176$$

$$u = g + \mu = 0 + 0.176 = 0.176$$

$$v = \bar{g} + \mu = 0 + 0.176 = 0.176$$

$$w = \tfrac{1}{2}u + \tfrac{3}{2}k = \tfrac{1}{2}(0.176) + \tfrac{3}{2}(0.143) - \tfrac{1}{2}(0) =$$

$$= \tfrac{1}{2}(0.031) + 0.429 = 0.016 + 0.429 = 0.573$$

Now, the four roots would be:

$$d_1 = -A + u^{1/2} + (v + w^{1/2})^{1/2}$$

$$d_2 = -A - u^{1/2} + (v - w^{1/2})^{1/2}$$

$$d_3 = -A + u^{1/2} - (v + w^{1/2})^{1/2}$$

$$d_4 = -A - u^{1/2} - (v - w^{1/2})^{1/2}$$

and now,

$$d_1 = -0 + 0.176^{1/2} + (0.176 + 0.573^{1/2})^{1/2} = 0.42 + (0.176 + 0.757)^{1/2}$$

$$= 0.42 + 0.934^{1/2} = 0.42 + 0.966 = 1.386''$$

By inspection, the four other roots would be in the order of increasing or improper value. Checking

$$d^4 - 0.43d - 0.43 = 0$$

$$1.386^4 - 0.43(1.386) - 0.43 = 0$$

$$3.67 - 1.083 - 0.43 \neq 0$$

and, thus the above value is incorrect. Taking d_1) as follows:

$$\mu = \tfrac{1}{2}\left[a + (b^2 + \lambda^3)^{1/2} + \tfrac{1}{2}\left[a - (b^2 + \lambda^3)^{1/2}\right]\right] =$$

$$\tfrac{1}{2}\left[0.07 + 0.16i + \tfrac{1}{2}(0.04 - 0.16i)\right] =$$

$= \frac{1}{2}[0.204 - \frac{1}{2}(0.142)] = [0.102 - 0.062]^{1/2} =$

$\pm [0.142] = 0.071$

$u = 0.071$

$v = 0.071$

$w = 4(0.071)^2 + 0.43 = 4(0.005) + 0.43 =$

$0.02 + 0.43 = 0.45$

$d_1 = 0.071^{1/2} + (0.071 + 0.45^{1/2})^{1/2} = 0.276 + (0.071 + 0.67)^{1/2}$

$= 0.276 + 0.741^{1/2} = 0.276 + 0.86 = 1.136$

Checking:

$d^4 - 0.126 - 0.43 = 0$

$1.66 - 0.4(1.136) - 0.43 = 0$

$1.66 - 0.9088 - 0.43 \neq 0$

Again, taking $[h + (h^2 + k^3)^{1/3}]^{1/3} + [h - (h^2 + k^3)^{1/3}] =$

$\frac{1}{2}[h + (h^2 + k^3)^{1/3}]^{1/3} + [h - (h^2 + k^3)^{1/3}] =$

$\frac{1}{2}[0.204] + \frac{1}{2}[-0.134] = 0.102 - 0.062 = 0.04$

$u = 0.04$

$v = 0.04$

$w = 4(0.04)^2 + 0.43 = 4(0.0016) + 0.43 =$

$0.0056 + 0.43 = 0.4356$

$d_1 = 0.04^{1/2} + (0.04 + 0.4356^{1/2})^{1/2} =$

$0.2 + (0.04 + 0.66)^{1/2} = 0.2 + 0.7^{1/2} =$

$0.2 + 0.835 = 1.035$

Checking:

$d^4 - 0.12 - 0.43 = 0$

$1.14 - 0.3(1.035) - 0.43 = 0$

$1.14 - 0.828 - 0.43 = 0$

The answer may be taken as the mean of the two values obtained, or one could use a weighted mean of the two values depending on the accuracy required.

The previously found 22.7 hp. must be increased by the ratio of the Service Factors to be of the order of 22.7 hp. The "Shock Torque" to be used for the motor, according to Eq. 56 of "Shafts from a Dynamic Viewpoint"

$$22.7\left[\frac{H_2}{H}\right]^{1/3} = 22.7\left[\frac{2.5(15)}{1.2(10.0)}\right]^{1/3} =$$

$$0.827\left[\frac{33.75}{n}\right]^{1/3} = 0.827(1.15) = 0.921''$$

which would be required to yield not more than a 1°/2 diameter of twisting limit. Finally, we find, by Eq. 56 of "Shafts from a Dynamic Viewpoint"

$$\frac{16\,M_2}{\pi d^3} = S_s$$

If, for the motor $H_2 = 2.5(15)$ hp. "shock torque" and $d = 1.125''$ (as previously computed),

$$\frac{16(1.15)(2.5)(15)}{\pi(1.125)^3} = \frac{2.1(2.5)(15)}{\pi(1.75)} \Rightarrow 12.1 \text{ ft/in}^2$$

would be the shear stress due to torque. The combined stress due to torque and bending would then be:-

$$[15{,}000 + 12.1^2]^{1/2} = [2.25(10^8) + 147(10^4)]^{1/2} =$$

$$15{,}000 \text{ ft/in}^2$$

and hence a 1 1/8" diameter shaft satisfies the principle design conditions. Let us however check the value of maximum speed which we could expect. The maximum speed is given by $\left[\frac{S_s}{W}\right]^{1/2}$ according to Eq. (27) of "Shafts from a Dynamic Viewpoint", since

$$K = \frac{SEI}{L} = \frac{3(2.6)(10^6)(\pi)(1.125)^4}{64(14)^3} =$$

$$\frac{\pi^2(10^6)(\pi)(1.27)}{64(2.72)^3} = 2210 \text{ ft/in}$$

Then,

$$\left[\frac{K_2}{W}\right]^{1/2} = \left[\frac{2210(32.2)}{10.17}\right]^{1/2} = [8350]^{1/2} = 91 \text{ r.p.s. allowable}$$

per shaft mass

Eq.

$$\frac{1}{f} = \frac{\omega_1^2}{\omega_2^2} - 1$$

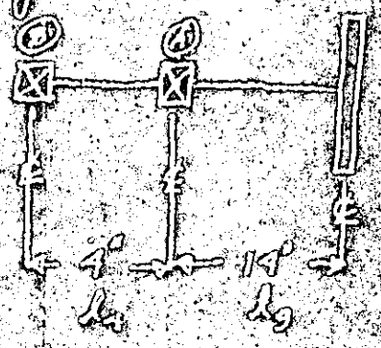
as for Eq. (50) of "Vibration Theory & Practice Supplement",

$$f = \frac{1}{\left(\frac{\omega_2}{\omega_1}\right)^2 - 1} = \frac{1}{\frac{25.1}{15.8} - 1} = \frac{1}{2.54 - 1}$$

and since $\omega = 0.157$, k_2

$$f = \frac{0.157}{15.8} = 0.00994$$

The lamp on the floor, supporting the bearings and having a spring of about 4" spring (deflection) between the two main bearings.



The computed shaft diameter, with a factor of safety of 1.5 per unit (0.035" diameter and such a shaft would exhibit at the given shaft would be:

$$M = SZ = S\pi d^3/32 =$$

$$\frac{15,000(\pi)(0.035)^3}{32} = \frac{15,000(\pi)(0.0429)}{32} =$$

$$1650 \text{ in-lbs} = M_2$$

Taking moments about (2),

$$\frac{M}{l_2} = \frac{1650}{4} = 412.5 \text{ lbs} = \text{load on brg (3)}$$

Taking moments about (3),

$$\frac{M(l_2+l_1)}{l_2\, l_1} = \frac{1650(4+14)}{(4)(14)} = 530 \text{ lbs} = \text{load on brg (1)}$$

The formula dealing with the principal computations found above will be referred until follow as part of the layout computations.

20m TYPE COLOR WHEEL FOR BLACK & WHITE & COLOR TV

Let us consider a drum composed of 6 slots (2 more of the same) and let us assume that the drum will be used for a 20" TV and will have

$1.25h = l$

Then

$(1.25h)^2 + h^2 = 20^2$

$h^2 = \frac{400}{2.56} = 156.2$

$h = 12.5"$

$l = 1.25(12.5) = 15.6"$

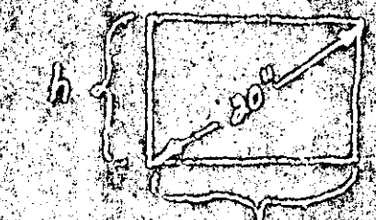


Fig. I

would be the dimensions of the drum. Now we must also find the diameter of the drum would be assuming that

$\frac{12.5}{\sin 60} = \frac{12.5}{.5} = 12.5" = r$

of the drum.

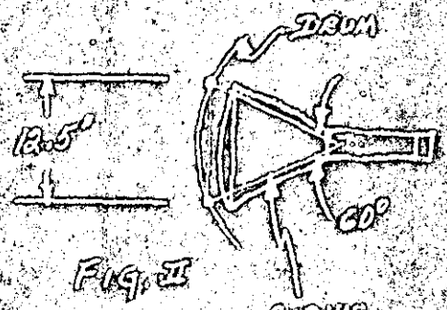


Fig. II

In the accompanying figure the drum is formed by a metal drum as in Fig. 3, in which the slots are formed. Assume that there are 6 slots, the slots are to consist of 1/6 the width of the slot, and their length is to be 17", then the load would have a volume of

$2\pi r l \left[\frac{\theta}{360}\right] t = \frac{2\pi(12.5)(17)(60)t}{360}$

$= 137 \text{ in}^3$

and a specific gravity of 1.18, the

$\frac{62.5 \frac{lb}{ft^3}}{1728 \frac{in^3}{ft^3}} \times 1.18 \times 137 in^3 = 5.74 lb$

would be the mass of each slot, where

$62.5 \frac{lb}{ft^3}$ is the density of the

In the standard 525 line drum, 9 discs (3 sets of 3 each) are at 4.10 rpm. This would give a speed

$\frac{1}{6}(4.10) = 2.10 \text{ rpm}$ for the 6-slot drum

The rotational speed for engine velocity of

$$\frac{1700 \frac{mi}{hr} \left(2\pi \frac{rad}{rev}\right)}{60 \frac{min}{hr}} = 1508 \frac{rad}{min}$$

The centrifugal force acting on each shaft journal is:

$$F_c = \frac{W}{g} \omega^2 r$$

$$= \frac{0.5 \text{ Tn-lb}}{32 \frac{ft}{sec^2}} \left[1508 \frac{rad}{min}\right]^2 \frac{12 in}{ft}$$

$$= 4410 \text{ lb}$$

and both actuator rings could therefore be said to exert a load of

$$4410 \frac{lb}{shaft} (6 \text{ shafts}) = 26{,}460 \text{ lb}$$

Applied, and

$$\frac{26{,}460 \text{ lb}}{\text{actuator ring}} = 13{,}230 \frac{lb}{ring}.$$

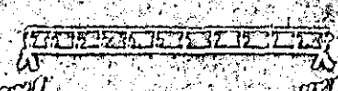
If both the female sleeves in each ring are to be of the same material subject to a value of 70,000 #/in² with a ½" wide ring thickness equivalent a

$$\frac{13{,}230 \text{ lb}}{0.75 in. (t)} = 70{,}000 \frac{lb}{in^2}$$

$$\frac{13{,}230 \text{ lb}}{0.75 in. (70{,}000 \#/in^2)} = 0.125 in = t$$

Each ring. The shaft must also be designed as a simply loaded beam which is simply supported at both ends:

$$W = wl$$



$$\frac{wl}{2} \qquad \frac{wl}{2}$$

Fig. 10

$$M = \frac{wx}{2}(l-x) = EI\left(\frac{d^2y}{dx^2}\right)$$

$$\frac{w}{2}(lx - x^2) = EI\left(\frac{d^2y}{dx^2}\right)$$

$$\frac{w}{2}\left(\frac{lx^2}{2} - \frac{x^3}{3}\right) + C_1 = \frac{dy}{dx}$$

But $\frac{dy}{dx} = 0$, when $x = \frac{l}{2}$, and:

$$\frac{w}{2}\left(\frac{l^3}{8} - \frac{l^3}{24}\right) + C_1 = 0$$

$$C_1 = -\frac{w}{2}\left(\frac{l^3}{12}\right) = -\frac{wl^3}{24} = EI$$

and

$$\frac{dy}{dx} = \frac{w}{2}\left(\frac{lx^2}{2} - \frac{x^3}{3}\right) - \frac{wl^3}{24EI}$$

$$y = \frac{wx}{24EI}\left(\frac{L^3}{6} - \frac{x^3}{12} - \frac{L^2x}{4}\right) + \frac{wL^3x}{24EI} + C_2$$

But, since $y = 0$ when $x = 0$, then

$$C_2 = 0$$

and

$$y = \frac{wx}{24EI}\left(\frac{L^3}{6} - \frac{x^3}{12} - \frac{L^2x}{4}\right)$$

At $x = \frac{L}{2}$, the slope, y, would have its maximum value, and $(y)_{max}$ would be given by:

$$y_{max} = \frac{w}{24EI}\left(\frac{L^4}{48} - \frac{L^4}{192} - \frac{L^4}{96}\right)$$

$$= -\frac{5wL^4}{384EI} = -\frac{5WL^3}{384EI}$$

The figure on the right is for computing the deflection, and the diagram, on the right, shows the data known by the full lines. It is necessary to develop the value of (I) for the shaft.

Fig. II

It is clear from the figure that the maximum deflection between $I = 12\frac{1}{2}$" and $12\frac{1}{2}$" (which would be $12\frac{1}{2}$") would be the same if operating by the shaft rotating in the opposite direction. It would appear from the figure that the maximum deflection of the shaft is approximately

$$\frac{\frac{1}{2}(2\pi r)_{max}}{360} =$$

$$\frac{\frac{1}{2}(2\pi)(12\frac{1}{2})(60)}{360} = 0.82 \text{ in.}$$

The value (I) would depend on the x axis and would be

$$0.82\left(12\tfrac{1}{2}\right)^2 = 128 \text{ in}^4$$

The value of y_0 of the shaft would be given by:

$$y_0 = \frac{y_{max}\, x_{max}}{x_{max}\, 0}$$

$$= \frac{(12\frac{1}{2})(\sin 30°)}{\sin 30°} = \frac{12\frac{1}{2}(0.5)}{0.5236} = 11.95$$

$y(I_0)$ is the amount of sag of the neutral surface about its own centroidal axis, due to gravity, thus

$$I_{dep} = I_0 + Ay_0^2$$

and for

$$12.1 in.^4 = I_0 + 0.822(11.75)^2$$

$$I_0 = 0.822(4.25) = 12.1 - 11.75 = 0.35 in.^4$$

From this, it follows that

$$\delta_{max} = \frac{5wL^4}{384EI} = \frac{5(4.10)(17)^4}{384(3)(10^6)(0.35)} = 0.0824 in.$$

which is acceptable if the shaft mounts are precision bearings.

$$\delta_{max} = \frac{5wL^4}{384EI} =$$

and

$$M_{max} = \frac{wL^2}{8} = \frac{WL}{8}$$

therefore

$$\delta_{max} = \frac{WL}{8} \cdot \frac{5L^2}{48EI} = \frac{5WL^3}{384EI}$$

but

$$M = SZ$$

where

M = Moment developed in the beam — in-lbs
Z = Section modulus of the beam — in.^{3}
S = Stress developed in the beam — psi

and

$$\frac{I}{c} = Z$$

where

c = distance of the extreme fiber from the neutral axis of the beam

and therefore

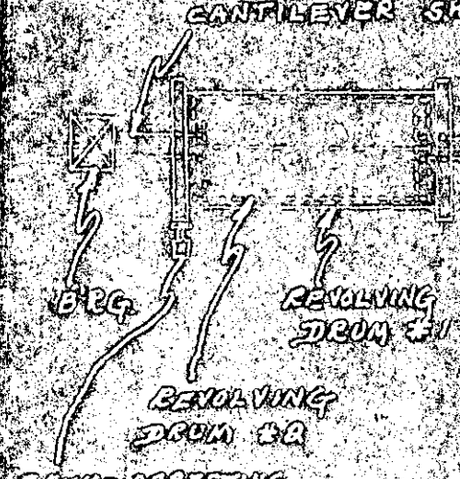
$$\delta_{max} = \frac{5(S)\left(\frac{L}{c}\right)L^2}{48EI} = \frac{5SL^2}{48Ec}$$

By this equation:

$$0.0824 in. = \frac{5\left(\frac{(12)(32 - 11.5)}{2}\right)(17^2)S}{48(3)(10^6)} = \frac{510 - 2(11^2)S}{96(10^6)(1.032)}$$

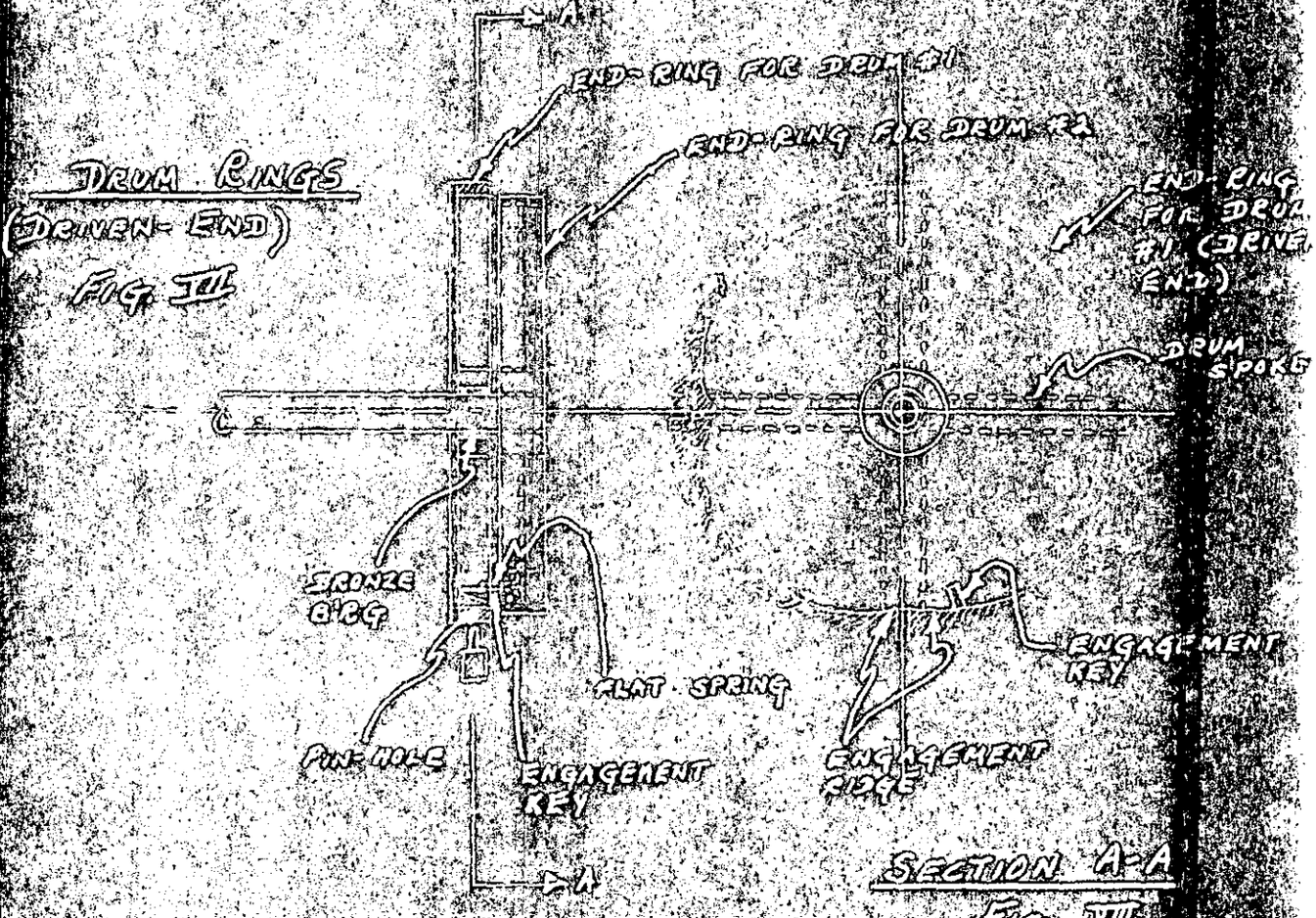
$$\frac{1.032(0.0824)(96)(10^6)}{510 - 242} = S = \frac{3.38}{in.^2}$$

NOTE:- DRUM #2 TO CONSIST OF 5 COLOR FILTERS, AND 1 WHITE LIGHT SLAT. DRUM #1 5 WHITE LIGHT SLATS AND 1 COLOR SLAT COMPLETING 2 SERIES FOR DRUM #2



GENERAL ARRANGEMENT OF DRUM SUPPORT

FIG. II



DRUM RINGS (DRIVEN-END)

FIG. III

SECTION A-A

FIG. III

The approximate total horsepower of the system, then, would be as follows:

Propeller = 17 hp

$$\frac{2\pi r \cdot 60}{360} = \frac{2\pi (12.5)(60)}{360} = 13.1'' \text{ travel}$$

and $\frac{1}{16}$" thick would weigh

$$\frac{12 (17)(3.1)(0.06)(.5)(62.5)(0.18)}{1728} = 7.17\#$$

and, if we estimate end plates and ring at 3#, then the drum group would weigh 13.2 in lbf. If we add weight of approximately 20#, this could be used to start a rough estimate of inertia of approximately 13, giving the drum a total of -

$$\Sigma mr^2 = 20\left(\frac{12.5}{12}\right)^2 = 23.5 \text{ lb-ft}^2$$

For such a drum to attain a velocity of 150.8 $\frac{\text{rad}}{\text{sec}}$,

$$\frac{23.5}{2(32.2)}(150.8)^2 = 16,700 \text{ ft-lb} = 8,350 \text{ ft-lbs}$$

of energy is required in the form of rotational energy. Since inertia, the moment of inertia is large enough, and the speed is slow enough, it should be easy to reduce the horsepower to a value of the indicated figure. Let us therefore reduce the weight of the drum, more particularly the weight at the indicated radius of gyration, by setting it at 3# limit for the 4 end rings in total. In that case,

$$\frac{10.47}{5.5}(14.7\pi) = \frac{724.0}{2} \text{ ft-lbs} = 3620 \text{ ft-lbs}$$

would be the required flywheel energy if the load were supplied in 60 secs.

$$\frac{362.0 \text{ ft-lbs}}{(60 \text{ sec})\left(5.50 \frac{\text{ft-lbs}}{\text{sec-hp}}\right)} = 0.105 \text{ hp}$$

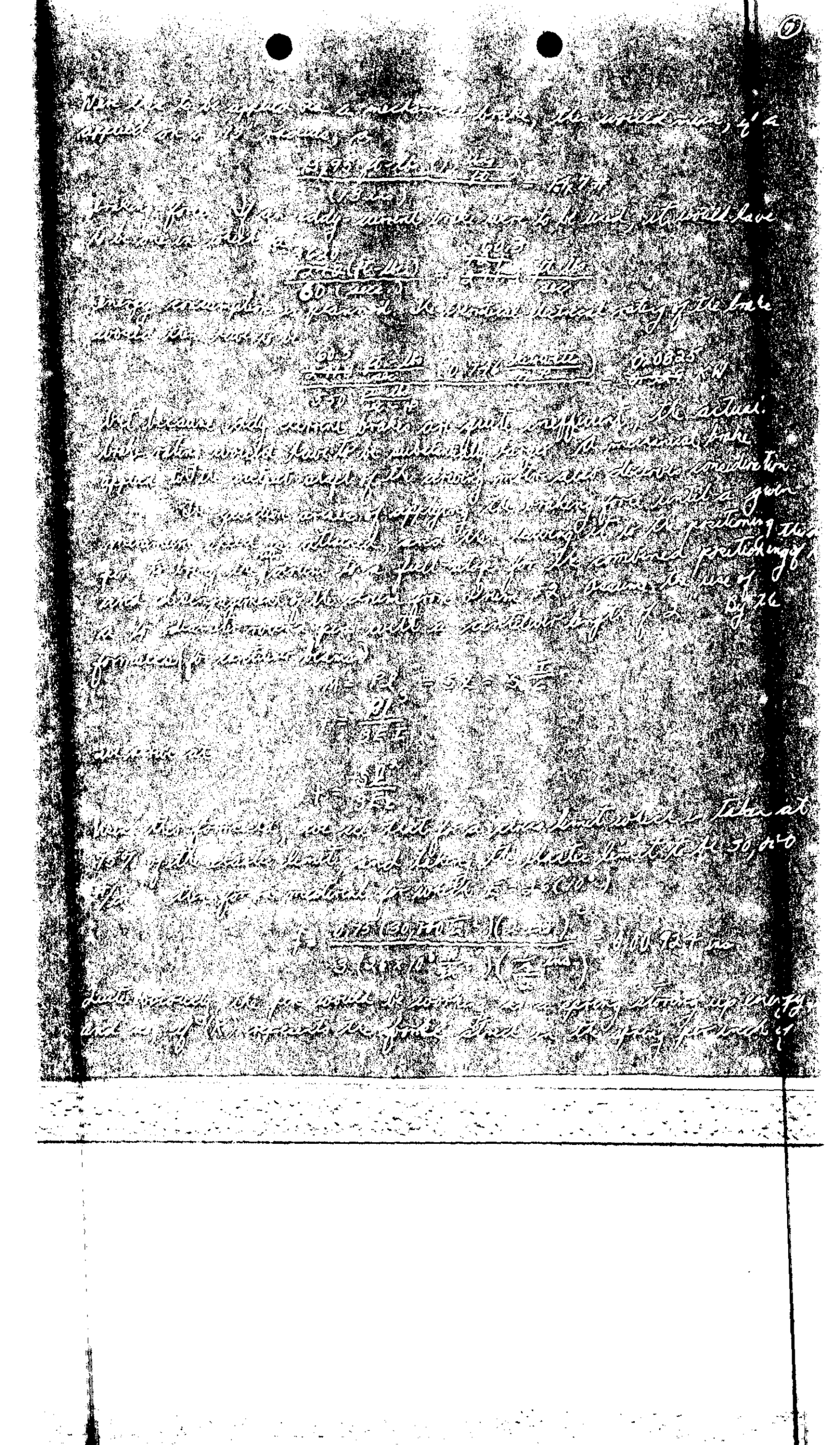
motor-drive would be required.

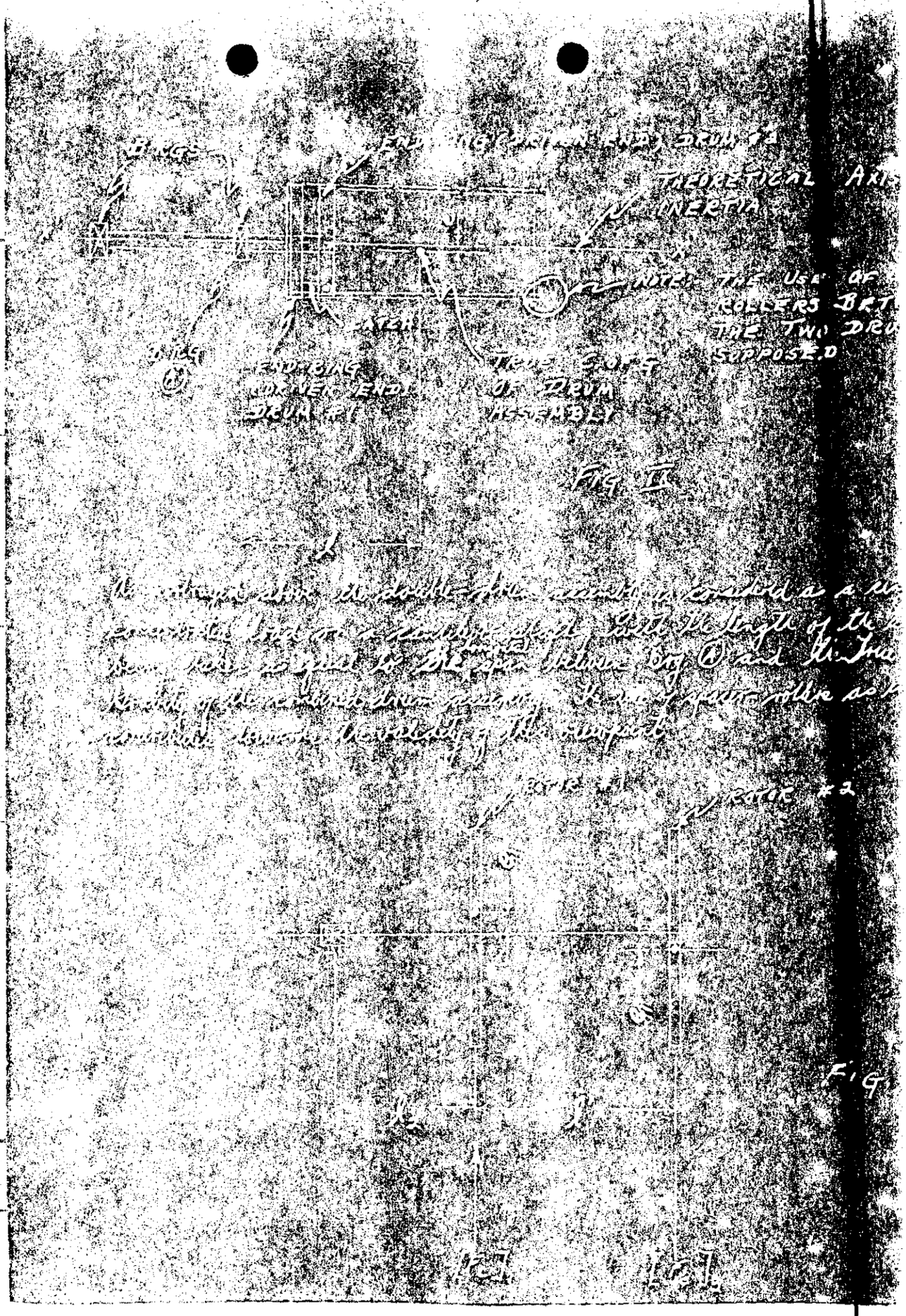
In keeping the drum-assembly to a slip, let us assume that 60 secs. is adequate. Then the angular acceleration of

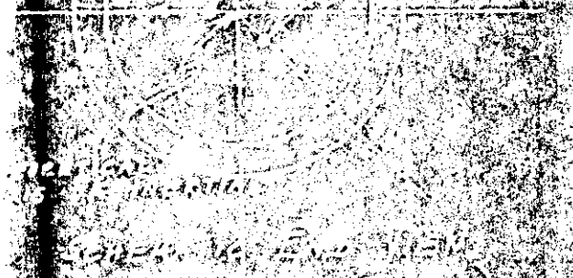
$$\alpha = \frac{\Delta V}{t} = \frac{2(150.8 - 0)}{60} = 5.03 \frac{\text{rad}}{\text{sec}^2}$$

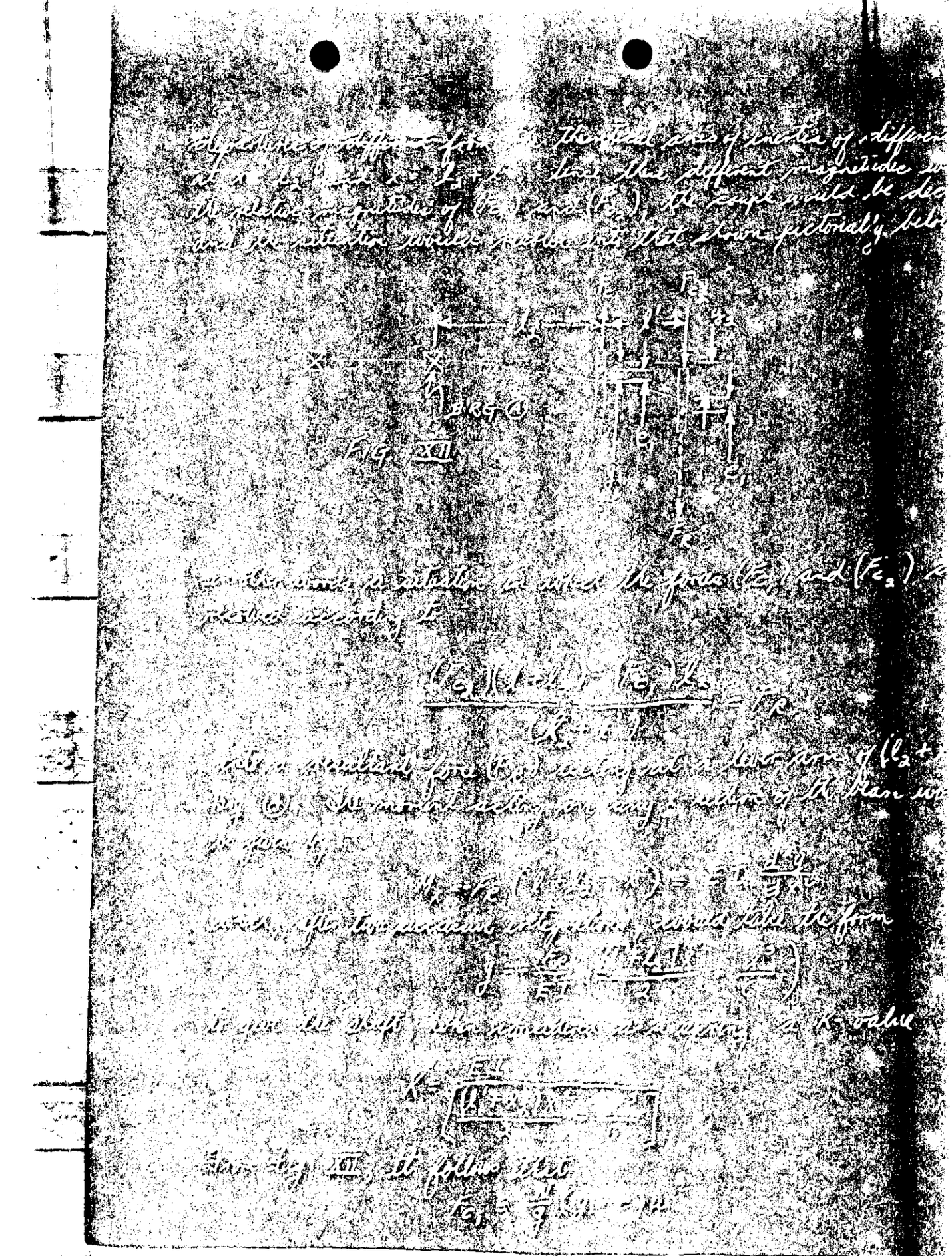
is available, and the torque-ability of the load would have to be

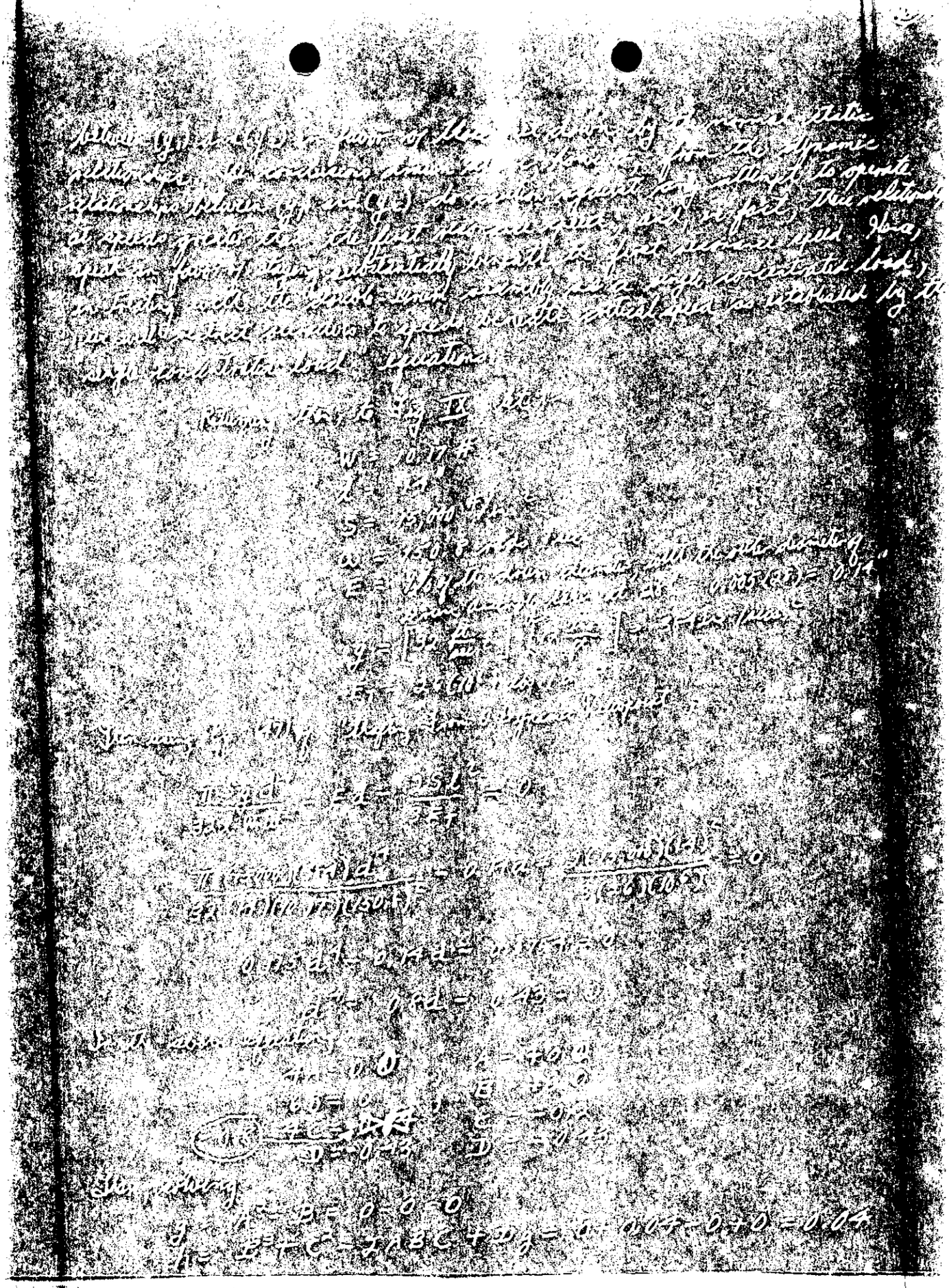
$$\frac{10.47}{32.2}(5.03) = 1.635 \text{ ft-lbs}$$




THEORETICAL
INERTIA
FIG. II.







We previously found the torque in accelerating the Drum to be of the order of 22.45 in-lbs. Taking the "shock-torque" to be 1.5 times the rating according to Eq. 56 of "Lifting From A Dynamic Viewpoint",

$$.227\left[\frac{T_s}{\tau}\right]^{1/3} = .227\left[\frac{22.45(1.5)}{12(125)}\right]^{1/3} =$$

$$0.227\left[\frac{33.675}{12}\right]^{1/3} = 0.227(1.415) = 0.321'' \text{ \&}$$

shaft would be required to yield not more than a 1°/20 diameters of shafting twist. Finally, we find, by Eq. 58 of "Lifting From A Dynamic Viewpoint",

$$\frac{16\, T_s}{\pi d^3} = S_s$$

if again we set T_s = to the "shock torque" and d = 1.125" (as previously suggested)

$$\frac{16(1.5)(22.45)}{\pi(1.125)^3} = \frac{[illegible]}{\pi(1.42)} = 121 \#/in^2$$

would again be allowable as to torsion. The combined stress due to torsion and bending would then be —

$$\left[15000^2 + 121^2\right]^{1/2} = \left[225(10^6) + 1.47(10^4)\right]^{1/2} =$$

$$15000 \#/in^2$$

and hence a 1 1/8" diameter shaft satisfies the principle design condition. Let us however check the value of resonance speed which we could expect. The resonance speed is given by $\left[\frac{Kg}{W}\right]^{1/2}$ according to Eq. 37 of "Lifting From A Dynamic Viewpoint". Since

$$K = \frac{3EI}{l^3} = \frac{3(30)(10^6)(\pi)(1.125)^4}{64(14)^3} =$$

$$\frac{90(10^6)(\pi)(1.60)}{64(2740)} = 2210 \#/in$$

then

$$\left[\frac{Kg}{W}\right]^{1/2} = \left[\frac{2210(386.4)}{10.17}\right]^{1/2} = \left[83,500\right]^{1/2} = 914 \text{ oscillations per } 2\pi \text{ sec.}$$

$$y = \frac{EI}{\quad} \left(\frac{\quad}{\quad} \right) - \frac{\quad}{\quad} + C_2$$

but, since $y = 0$ when $x = 0$, then

$$C_2 = 0$$

and

$$y = \frac{\quad}{EI} \left(\frac{\quad}{\quad} - \frac{\quad}{\quad} \right)$$

or $x =$ [illegible] Point (2) [illegible] maximum value, and

(4) [illegible]

$$y = \frac{\quad}{EI} \left(\frac{\quad}{\quad} - \frac{\quad}{\quad} \right)$$

[illegible] the selected [illegible] to develop [illegible] radius between [illegible] which would [illegible] the number of [illegible] in Fig [illegible] the area of the

For I

$$= \frac{(\quad)(\quad)(\quad)}{(\quad)} = 1.82 \text{ in.}$$

[illegible] the scale [illegible]

$$y = \frac{\quad}{\quad}$$

$$= \frac{(\quad)(\quad)(\quad)}{(\quad)} = 1.95$$

NOTE:- DRUM #2 TO CONSIST OF 5 COLOR FILTERS AND 1 WHITE LIGHT SLAT. DRUM #1 4 WHITE LIGHT SLATS AND 1 COLOR SLAT COMPLETING 5 SERIES FOR DRUM #2

GENERAL ARRANGEMENT OF DRUM SUPPORT

FIG. VI

FIG. VII