

1988

IRECO Incorporated v. Megabar Corporation : Unknown

Utah Court of Appeals

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UTAH COURT OF APPEALS
BRIEF

UTAH
DOCUMENT

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DOCKET NO.

88-0069-CA

ADDENDUM

(attached to and a part of the Brief
of Respondent filed on behalf of
IRECO Incorporated on September 30, 1986)

88-0069-CA

- I. Memorandum Decision
- II. Findings of Fact and Conclusions of Law
- III. Injunction
- IV. Partial Order, Decree and Judgment
- V. Employment Agreement
- VI. Letter to M. Garfield Cook from M. Taylor Abegg
- VII. Letter to M. Taylor Abegg from M. Garfield Cook, with
Termination Statement attached
- VIII. Letter to Harvey Jessop from Jay W. Butler
- IX. Megabar's Method Patent Application
- X. Megabar's Apparatus Patent Application
- XI. Plaintiff's Exhibit 16
- XII. Letter agreement between Megabar and JRC
- XIII. License Agreement between Megabar and Aerojet General
- XIV. Letter to Megabar shareholders from Jay W. Butler

IN THE DISTRICT COURT OF THE THIRD JUDICIAL DISTRICT
IN AND FOR SALT LAKE COUNTY, STATE OF UTAH

IRECO INCORPORATED, a Delaware corporation,	:	
	:	
Plaintiff,	:	
	:	
vs.	:	MEMORANDUM DECISION
	:	
MEGABAR CORP., a Utah corporation, MEGABAR EXPLOSIVES CORP., a Utah corporation, WESTERN BRINE RESEARCH LABORATORY, INC., a Utah corporation, and M. TAYLOR ABEGG,	:	CIVIL NO. C 84-4168
	:	
Defendants.	:	

This matter came on regularly for trial before the Court sitting without a jury commencing June 4, 1985 and continuing from day to day thereafter until completed. Appearances on behalf of the plaintiff were Gordon L. Roberts, Frances W. Wikstrom and John A. Anderson of the firm of Parsons, Behle & Latimer. Appearances on behalf of the defendants were Peter W. Billings, Gordon W. Campbell and Michelle Mitchell of the firm of Fabian & Clendenin. The matter was fully presented, argued and submitted and thereafter the decision and ruling thereon was taken under advisement by the Court. The Court having thereafter fully reviewed the file, the exhibits and the evidence presented now makes its ruling and decision thereon as follows.

The Court finds that the greater weight of the evidence supports the claims of the plaintiff that the defendants' knowledge and technology concerning cast explosive compositions was not obtained nor created independent of the knowledge and technology obtained by Jessop and Abegg while they were employed at Ireco. The Court feels that there is no question but that Megabar benefitted from the experimentation and technology of Ireco.

The Court finds that the knowledge and technology of Ireco was a trade secret as defined by the existing law. The Court further finds that the defendants' claim that Ireco's technology was not a trade secret because it was taught by patents as prior art and was part of the public domain is not supported by the evidence nor does the Court find that the defendants' claim that its technology is different from Ireco's and can be distinguished on the basis of the emphasis on perchlorates as an oxidizer salt. Additionally the Court finds in support of the previous findings that the defendants own patent applications distinguish the prior art from their technology; and these perchlorates was part of the experimentation and anticipated technology of the plaintiffs.

Based upon the foregoing the Court determines and finds that the plaintiff is entitled to the relief requested in its Complaint and that it is entitled to the equitable relief of an injunction prohibiting defendants from researching, developing, disclosing, selling, licensing or using in any way cast explosive compositions and related technology and that Ireco is entitled to an assignment of Megabar's patent applications and patents.

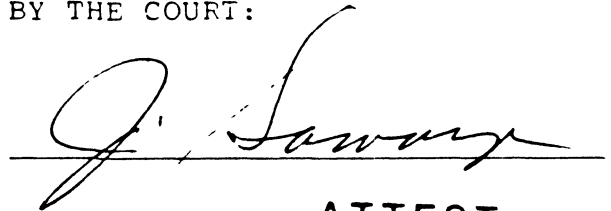
The Court's foregoing findings and rulings are based upon the Court's findings that the defendants have converted the plaintiff's trade secrets as claimed and further that the defendants are guilty of a tortious interference and inducement to breach of an employment contract.

The Court however is of the opinion that plaintiff is not entitled to a permanent injunction as requested but is entitled to an injunction only for a term of years. The Court therefore reserves for further hearing the issues of the period of time which the Court's injunction should be in affect and the damages sustained by plaintiff as a result of defendants' actions, if any.

Counsel for plaintiff is requested to prepare appropriate Findings of Fact, Conclusions of Law, Decree and Judgment consistent with the foregoing findings and ruling of the Court.

Dated this 25th day of July, 1985.

BY THE COURT:

A handwritten signature in cursive script, appearing to read "J. Sawyer", is written over a horizontal line.

Copies mailed to counsel

ATTEST
H. DIXON HINDLEY
Clerk

By 
Deputy Clerk

FILED IN CLERK'S OFFICE

SEP 12 1 15 PM '85

U.S. DISTRICT COURT

SALT LAKE COUNTY

[Signature]

GORDON L. ROBERTS (A2770)
FRANCIS M. WIKSTROM (A3462)
JOHN A. ANDERSON (A4464)
of and for
PARSONS, BEHLE & LATIMER
Attorneys for Plaintiff
185 South State Street, Suite 700
Post Office Box 11898
Salt Lake City, Utah 84147
Telephone: (801) 532-1234

IN THE THIRD JUDICIAL DISTRICT COURT OF SALT LAKE COUNTY

STATE OF UTAH

* * * * *

IRECO INCORPORATED, a Delaware)
corporation,)

Plaintiff,)

vs.)

MEGABAR EXPLOSIVES CORP., a)
Utah corporation, MEGABAR)
CORP., a Utah corporation,)
WESTERN BRINE RESEARCH)
LABORATORY, INC., a Utah)
corporation, and M. TAYLOR)
ABEGG,)

Defendants.)

FINDINGS OF FACT AND
CONCLUSIONS OF LAW

Civil No. C-84-4168

Hon. James S. Sawaya

* * * * *

Certain issues in the above-captioned matter came on regularly for trial for the Court sitting without a jury commencing June 4, 1985 and continuing from day to day thereafter until completed. Plaintiff was represented by its attorneys, Gordon L. Roberts, Francis M. Wikstrom and John A.

Anderson of the firm of Parsons, Behle & Latimer. Defendant were represented by Peter W. Billings, Gordon W. Campbell, and Michelle Mitchell of the firm of Fabian & Clendenin. The Court having fully considered the evidence presented, the memoranda and arguments of the parties, and having rendered its Memorandum Decision under date of July 25, 1985, hereby enters the following:

FINDINGS OF FACT

1. Plaintiff IRECO Incorporated, formerly IRECO Chemicals (hereinafter referred to as "IRECO"), is a corporation organized under the laws of the State of Delaware and is qualified to do business in the State of Utah. Its principal place of business is in Salt Lake County, Utah.

2. Defendants Megabar Explosives Corporation and Megabar Corporation (hereinafter collectively referred to as "Megabar") are Utah corporations with their principal places of business in Salt Lake County, Utah.

3. Western Brine Research Laboratories, Inc. ("Western Brine Research") was a Utah corporation, with its principal place of business in Salt Lake County, Utah. At all times, Western Brine Research was controlled by Megabar and there was a free flow of technical information from Western Brine to Megabar.

4. Defendant M. Taylor Abegg ("Abegg") is an individual who resides in Salt Lake County, Utah.

5. For many years IRECO has been engaged in the business of researching, developing, manufacturing and selling explosives, explosive products and related equipment used in mining and military applications, and in licensing explosives technology.

6. The explosives industry is a high-technology industry in which there are a number of competitors, and technological advancements can provide a significant competitive edge for market participants.

7. IRECO, through research and development extending over several years and the expenditure of substantial sums of money, has developed commercially valuable trade secrets and confidential information concerning the research, development, formulation, manufacturing and processing of certain castable explosive compositions that were characterized by IRECO as "cast explosive compositions" that are formed from an intermediate water-in-oil or oil continuous emulsion that is fluid when initially prepared at elevated temperatures, but which becomes unstable, breaks down or weakens, and hardens when allowed to cool to ambient temperatures. As developed at IRECO by August, 1983, cast explosive compositions and related manufacturing equipment constituted a significant improvement over the prior art and were a valuable commercial asset of

IRECO. Numerous formulations of cast explosive composition were tested, developed and envisioned by IRECO. The product showed particular applicability to the military market for use as munition fills or nuclear simulation explosives. IRECO has used due diligence to keep those trade secrets and confidential information secret, with restrictions on their use and disclosure by all those to whom that information has become known.

8. Harvey Jessop (hereinafter "Jessop"), an employee of IRECO from 1963 to August 29, 1983 (now deceased as a result of an accident in May, 1984), was extensively involved in research and development of cast explosive compositions at IRECO and was in possession of IRECO's trade secrets and confidential information concerning those explosives. Jessop was a signatory to an employment agreement which provided inter alia, that he would not compete with IRECO for at least two years following termination of his employment, that he would not disclose IRECO's trade secrets and confidential information, and that all inventions discovered by him during a period of one year following termination of his employment would belong to IRECO unless he could prove independent subsequent development.

9. During the summer of 1983, draft patent applications were prepared at IRECO covering certain types of cast

explosive compositions. Such applications were reviewed by Jessop prior to his resignation and he made suggestions for additions and changes. After leaving IRECO, Jessop signed, as "sole inventor," the final IRECO patent applications for certain cast explosive compositions.

10. In connection with the development of cast explosive compositions, Jessop also devised and built a prototype of a continuous processor which was designed so that cast explosive compositions could be safely and continuously mixed and manufactured as opposed to being manufactured in batches. The processor was essentially complete and ready for trial runs by August of 1983 when Jessop left IRECO.

11. Abegg has had an extensive career in the explosives industry and was employed by IRECO from July, 1981, to August, 1983, as Director of Government Operations for the purpose of marketing IRECO's military products and establishing and maintaining military customer contacts. In April, 1983, Abegg was elected Vice President of Defense Systems, Inc., then a wholly-owned subsidiary of IRECO and now a division of IRECO, which was formed for that purpose. In the course of his duties with IRECO and Defense Systems, Inc., during 1981-1983, Abegg became familiar with IRECO's trade secrets and confidential information concerning cast explosive compositions. During his employment, Abegg knew of and accepted IRECO's policy of

secrecy with respect to its trade secrets and confidential information and Abegg acknowledged his obligation to maintain that secrecy upon terminating his employment at IRECO.

12. In February of 1983, Abegg decided to leave IRECO and thereafter began searching for alternative employment opportunities. This decision was not disclosed to others at IRECO and, in consequence, Abegg continued to have complete access to IRECO's proprietary work in connection with cast explosive compositions, including work in the lab and experimental work during the summer of 1983.

13. By August of 1983, the development of cast explosives compositions and the continuous processor at IRECO together with IRECO's marketing plans, consisted of a compilation of knowledge and information, including plans, formulas, processes, and devices, which was not generally known in the explosives industry and which constituted a commercial advantage to IRECO over competitors. No one other than IRECO was at that time working with cast explosive compositions.

14. In February, 1983, Jay W. Butler ("Butler") formerly general counsel of IRECO and generally familiar with the nature of IRECO's business, formed, with others, Megabar Explosives Corporation. Abegg, Butler and others formed Megabar Corporation on August 3, 1983, and Abegg terminated his employment at IRECO on August 9, 1983. Abegg, Butler and

others formed Western Brine Research on September 13, 1983. Abegg and Butler are or were officers and directors of Megabar Explosives Corporation, Megabar Corporation and Western Brine Research.

15. In July and August, 1983, Butler and Abegg intentionally proceeded with a scheme to exploit IRECO's cast explosive composition technology and to hire Jessop, knowing that Jessop possessed IRECO's trade secrets and confidential information concerning cast explosive compositions. Jessop left IRECO on August 29, 1983, and joined Western Brine Research, which was formed at least partly in an attempt to insulate Jessop from apparent association with Megabar.

16. As of the time that Jessop joined Western Brine Research, Butler, Jessop and Abegg were all aware of the terms of Jessop's employment contract with IRECO. Jessop and Abegg were aware that IRECO regarded its cast explosive composition formulations and its continuous processor as proprietary and trade secret information.

17. Thereafter, Abegg, Butler and others at Megabar induced and allowed Jessop to disclose IRECO's trade secrets and confidential information to Megabar and to work on cast explosive compositions and a continuous processor based upon that developed at IRECO. Jessop continued to work on cast explosive compositions at Western Brine Research, and Jessop

and Abegg disclosed IRECO's trade secrets and confidential information to persons at Western Brine Research and Megabar.

18. Both Jessop and Abegg could have found reasonable remunerative employment with other businesses which would not have involved their disclosure of IRECO's proprietary information.

19. Without notice to or consent of IRECO, Megabar through Western Brine Research, immediately commenced work on both cast explosive compositions and the preparation of a continuous processor. The formulations of explosives developed and tested at Megabar during the period following September of 1983 were substantially identical to, or obvious extensions of formulations and experiments theretofore done at IRECO on cast explosive compositions. In doing additional laboratory work preparing patent applications, and pursuing business exploitation of the cast explosive compositions Megabar extensively used and substantially benefited from the proprietary information that Jessop and Abegg obtained at IRECO.

20. On February 8, 1984, only five months after Jessop left IRECO, Megabar filed patent applications for cast explosive compositions which were founded upon technology developed at IRECO. Jessop deliberately delayed signing IRECO's patent applications for cast explosive composition until after the Megabar applications were filed.

21. Abegg and Megabar knowingly and intentionally interfered with the contract relations between Jessop and IRECO as set forth in Jessop's employment contract, by causing or permitting Jessop to compete with IRECO on behalf of Megabar, by causing Jessop to disclose IRECO's trade secrets and confidential information to others at Megabar, and by claiming as inventions of Megabar, explosives which were actually invented by Jessop while at IRECO.

22. Megabar's version of cast explosive compositions (referred to by Megabar as "Microknit Composite Explosive, method 2") is not distinguishable from that developed at IRECO and Megabar's use of perchlorates as oxidizing agents or in the oxidizer solution, does not distinguish Megabar's compositions. IRECO had extensive knowledge and understanding with respect to the use of perchlorates, either alone or in combination with nitrates as an oxidizer agent in explosives, and IRECO had plans and had conducted preparatory experiments to include perchlorates as an ingredient in the oxidizer solution phase of the subject explosives. IRECO never abandoned its plans to use perchlorates in cast explosive compositions or as a part of the oxidizer solution thereof.

23. Cast explosive compositions were not taught or disclosed by prior art. The prior art does not teach the

principles embodied in the concept of cast explosive compositions. The teachings of the prior art are clearly distinguishable from cast explosive compositions and both of the parties IRECO and Megabar, have made the same distinctions to the U.S. Patent Office in pursuit of their respective patents covering cast explosive compositions. Moreover, Megabar did not rely upon or use prior art in developing its version of cast explosive compositions but, rather, utilized proprietary information gained from Abegg and Jessop's prior employment at IRECO.

24. The U.S. Patent Office determined that cast explosive compositions constitute a patentable invention.

25. Megabar has filed patent applications concerning methods and apparatus for the continuous production of composite explosives. The claims in Megabar's applications are anticipated by the processor developed at IRECO.

26. Megabar has made disclosures or proposals concerning cast explosive composition technology to several actual or potential licensees, customers or competitors of IRECO, including Aerojet General Corp., Jet Research Center Inc., I.C.I. (N.E.C.), Atlas Powder Co., Morton Thiokol, Inc. Industrias Cardoen, Hercules, Inc., Schlumberger Well Services United States Air Force, Center for Explosives Technology Research of the New Mexico Institute of Mining and Technology

Mining Services International, Dynamit Nobel, Nitro Nobel, S.N.P.E., E.R.T., E. & C.P., Explosives Development, Ltd., Royal Ordnance Factories, and P.R.B. Such disclosures have been made by Megabar purporting, itself, to have developed and invented the technology and Megabar has obtained from certain potential customers non-disclosure agreements whereby they have agreed to maintain, as proprietary, the information obtained from Megabar regarding cast explosive compositions. Megabar has various agreements with certain customers whereby Megabar has received funds from them or may receive funds in the future from them in consideration for the sale of cast explosive compositions technology.

27. Defendants have acted willfully and intentionally in using what they knew to be IRECO's trade secrets, in inducing Jessop to breach his employment contract and in interfering with the contractual relationship between IRECO and Jessop.

28. IRECO has been and will be irreparably harmed by defendants' actions unless defendants are enjoined.

Based on the foregoing Findings of Fact, the Court hereby makes the following:

CONCLUSIONS OF LAW

1. IRECO's information and technology concerning cast explosive compositions and the continuous processor constitute trade secrets which are the property of IRECO.

2. Defendants' conversion, acquisition, and use of the trade secrets were wrongful.

3. Defendant Abegg owed a fiduciary duty to IRECO to refrain from disclosing or using its trade secrets.

4. Defendant Abegg breached these fiduciary duties to IRECO.

5. Harvey Jessop's employment contract was reasonable and enforceable.

6. Defendants wrongfully induced Harvey Jessop to breach the contract.

7. Defendants tortiously interfered with the contractual relationship between IRECO and Harvey Jessop.

8. IRECO has suffered and will continue to suffer irreparable harm for which there is no adequate remedy at law and is entitled to an immediate injunction prohibiting defendants, their officers, agents, employees, assigns or anyone acting in concert or participation with them, from researching, developing, disclosing, selling, licensing or using in any way cast explosive compositions and related technology, including equipment, for a term of years to be determined at a further hearing.

9. IRECO is entitled to an assignment of Megabar's patent applications and patents that pertain to or include Method 2 for making Microknit Composite Explosives.

10. IRECO is entitled to damages if it can establish at a further hearing that damages were sustained as a result of defendants' actions. Pending further proof on Megabar's net worth, IRECO is entitled to punitive damages.

11. IRECO is entitled to an order requiring defendants to account for and hold in constructive trust for the benefit of IRECO all revenues heretofore or hereafter derived from defendants' development, manufacture, sale or other commercial exploitation of cast explosive compositions and related technology and equipment and directing defendants to pay over to IRECO any such revenues.

12. IRECO is entitled to an order requiring defendants to immediately notify all persons or entities to whom they have made disclosures concerning cast explosive compositions of the ruling of the Court in this matter.

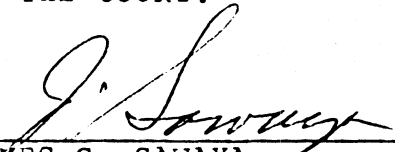
13. IRECO is entitled to an assignment of Megabar's rights under its contracts with its various customers, including the right to enforce any and all nondisclosure agreements.

14. A further hearing should be held to resolve all remaining issues in this matter.

15. A Partial Order, Decree and Judgment and an Injunction should enter in accordance with these findings of fact and conclusions of law.

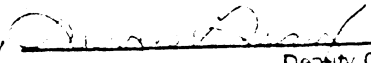
DATED this 12 day of Sept., 1985.

BY THE COURT:


JAMES S. SAWAYA
DISTRICT JUDGE

7610L

ATTEST
H. DIXON HINDLEY
Clerk

By 
Deputy Clerk

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B. Susan D. [Signature]
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GORDON L. ROBERTS (A2770)
FRANCIS M. WIKSTROM (A3462)
of and for
PARSONS, BEHLE & LATIMER
Attorneys for Plaintiff
185 South State Street, Suite 700
Post Office Box 11898
Salt Lake City, Utah 84147
Telephone: (801) 532-1234

IN THE THIRD JUDICIAL DISTRICT COURT OF SALT LAKE COUNTY
STATE OF UTAH

* * * * *

IRECO INCORPORATED, a Delaware)
corporation,)

Plaintiff,)

vs.)

MEGABAR EXPLOSIVES CORP., a)
Utah corporation, MEGABAR)
CORP., a Utah corporation,)
WESTERN BRINE RESEARCH)
LABORATORY, INC., a Utah)
corporation, and M. TAYLOR)
ABEGG,)

Defendants.)

INJUNCTION

Civil No. C-84-4168

Hon. James S. Sawaya

* * * * *

The Court having duly considered the materials in the file, the exhibits and the evidence presented at trial; having heretofore entered its Memorandum Decision and Findings of Fact, Conclusions of Law and Partial Order, Decree and Judgment, and the Court having found that this Injunction is appropriate in the premises,

NOW, THEREFORE, IT IS HEREBY ORDERED that defendant together with their agents, employees, servants, representatives and attorneys and all those in active concert or participation with them who receive actual notice of this injunction be and hereby are ordered immediately to cease, desist and refrain from researching, developing, manufacturing, selling, licensing, disclosing to others, or using or exploiting in any way the processes, formulas, formulations, technology or manufacturing equipment related to cast or castable explosive compositions that are formed from an intermediate water-in-oil or oil continuous emulsion that is fluid when initially prepared at elevated temperatures, but which becomes unstable, breaks down or weakens, and hardens when allowed to cool to ambient temperature, including but not limited to compositions formed by the process defendants have denominated "Method T" in their patent applications or patents.

IT IS FURTHER HEREBY ORDERED that defendants, together with their agents, employees, servants, representatives, attorneys and all those in active concert or participation with them who receive active notice of this injunction, be and hereby are ordered immediately to cease, desist and refrain from researching, developing, manufacturing, selling, licensing, disclosing to others, using or exploiting in any way apparatus for continually producing composite explosives comprising the following elements:

(a) at least two heatable reservoirs,
(b) means for heating reservoirs to temperatures as high as melting points of ingredients,
(c) static mixing chamber for receiving and mixing molten ingredient streams,
(d) means for pumping molten streams from reservoirs to static mixing chamber, and
(e) means for statically mixing the molten streams in static mixing chamber to produce explosive, or a method for continuously producing composite explosives comprising the steps of:

(a) melting at least one oxidizer to create a pumpable liquid;

(b) melting at least one organic fuel to create a separate pumpable liquid;

(c) pumping said liquids simultaneously into a mixing chamber;

(d) subjecting the combined liquids to controlled turbulence within said mixing chamber to achieve an intimate and uniform mixture; and

(e) expelling the product from the mixing chamber.

This injunction shall be interpreted to apply to the cast or castable explosive compositions, apparatus, and methods

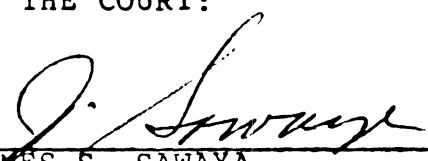
defined above as well as any obvious or merely colorab
variation or modification thereof.

The court shall reserve jurisdiction over this ca
for the purpose of insuring compliance with this injunction.

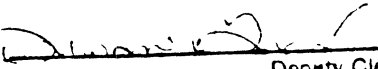
This injunction shall be in force until further ord
of this Court.

DATED this 17 day of Sept., 1985.

BY THE COURT:


JAMES S. SAWAYA
DISTRICT JUDGE

ATTEST
H. DIXON HINDLEY
Clerk

By 
Deputy Clerk

7622L

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H. DELOACH HANLEY CLERK
3RD DIST. COURT

BY [Signature]
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GORDON L. ROBERTS (A2770)
FRANCIS M. WIKSTROM (A3462)
JOHN A. ANDERSON (A4464)
of and for
PARSONS, BEHLE & LATIMER
Attorneys for Plaintiff
185 South State Street, Suite 700
Post Office Box 11898
Salt Lake City, Utah 84147
Telephone: (801) 532-1234

IN THE THIRD JUDICIAL DISTRICT COURT OF SALT LAKE COUNTY

STATE OF UTAH

* * * * *

IRECO INCORPORATED, a Delaware)
corporation,)

Plaintiff,)

vs.)

MEGABAR EXPLOSIVES CORP., a)
Utah corporation, MEGABAR)
CORP., a Utah corporation,)
WESTERN BRINE RESEARCH)
LABORATORY, INC., a Utah)
corporation, and M. TAYLOR)
ABEGG,)

Defendants.)

PARTIAL ORDER, DECREE
AND JUDGMENT

Civil No. C-84-4168

Hon. James S. Sawaya

* * * * *

Certain issues in the above-captioned matter came on regularly for trial for the Court sitting without a jury commencing June 4, 1985 and continuing from day to day thereafter until completed. Plaintiff was represented by its attorneys, Gordon L. Roberts, Francis M. Wikstrom and John A.

Anderson of the firm of Parsons, Behle & Latimer. Defendants were represented by Peter W. Billings, Gordon W. Campbell, and Michelle Mitchell of the firm of Fabian & Clendenin. The Court having fully considered the evidence presented, the memoranda and arguments of the parties, having rendered its Memorandum Decision under date of July 25, 1985, and having heretofore entered its Findings of Fact and Conclusions of Law, now, therefore,

IT IS HEREBY ORDERED, ADJUDGED AND DECREED as follows:

1. Defendants shall forthwith grant to IRECO, Inc an exclusive, royalty-free, irrevocable license with respect to compositions prepared by Method 2 as described in defendants patent applications and patents entitled Microknit Composite Explosives and Processes for Making Same, Serial No 06/578,177; Perchlorate Based Microknit Composite Explosives and Processes for Making Same, Serial No. 06/578,178; and Eutectic Microknit Composite Explosives and Processes for Making Same, Serial No. 06/578,179, which were filed on or about February 8, 1984, and for which Notices of Allowance issued on or about May 29 and 31, 1985, (and any equivalent foreign patents or patent applications) together with the exclusive right to sublicense and to sue infringers thereof Defendants shall forthwith grant to IRECO an exclusive royalty-free, irrevocable license with respect to defendants

patent applications entitled Apparatus for the Continuous Production of Composite Explosives and Propellants, Serial No. 06/644,525, and Method for the Continuous Production of Composite Explosives and Propellants, Serial No. 06/644,526, filed on or about August 27, 1984 (and any equivalent foreign patents or patent applications). Such licenses for serial nos. 06/644,525 and 06/644,526 shall become non-exclusive upon expiration of the injunction granted in this matter relating to use of defendant's processor and method. Defendants are hereby ordered to execute and deliver to plaintiff any and all documents necessary to effectuate said licenses.

2. Defendants shall hold in constructive trust for the benefit of plaintiff any and all revenues heretofore or hereafter derived from defendants' development, manufacture, licensing, sale or other commercial exploitation of cast explosive compositions and related technology and equipment. Defendants shall account for and pay over all such revenues to IRECO within sixty days of the entry of this Order.

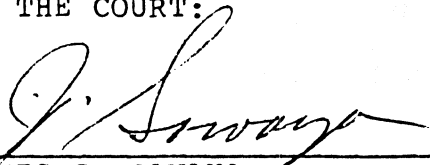
to be inserted
3. This matter is set for further hearing on the _____ day of _____, 1985, commencing at _____ .m., to resolve all remaining issues.

4. Defendants shall immediately notify all persons and entities to whom they have disclosed information relating to cast explosive compositions of the ruling of the Court and

shall provide them with a copy of this Partial Order, Decree
and Judgment and with a copy of the Injunction entered herein.

DATED this 18 day of Sept., 1985.

BY THE COURT:



JAMES S. SAWAYA
DISTRICT COURT JUDGE

ATTEST
H. DIXON HINDLEY
Clerk

By 
Deputy Clerk

7625L

EMPLOYMENT AGREEMENT

CONFIDENTIAL

This document covered by protective
order of Utah Third District Court.
Available only to designated counsel.

This Agreement is between Harvey Jessop, ("Employee"),
and IRECO Chemicals and/or its affiliates, ("Employer").

In consideration of Employee's employment by Employer (or pro-
motion to a position requiring access to and knowledge of information
of the type described in paragraphs 5 and 6 below) and of the salary
to be paid Employee, Employee agrees for the benefit of Employer, its
successors and assigns, as follows:

1. Employee represents and warrants that he is free to enter into
this contract and that no person, firm or corporation other than Employer
has any claim in respect to the services of Employee covered by this con-
tract, or to any improvements or inventions which he may make.

2. Employee represents and warrants that he has listed on the last
page hereof: (a) all the patents, patent applications and unpatented in-
ventions which Employee made prior to entering into Employer's employ
and which Employee desires to remove from the operation of this Agree-
ment; and (b) all agreements with others than Employer which Employee
has heretofore entered into pertaining to improvements and inventions
made by him or to keeping information confidential.

3. Employer hereby employs Employee and Employee hereby accepts
such employment, or if already employed by Employer agrees to continue
in its employ, and agrees to serve Employer faithfully and to the best
of his ability during the term of his employment hereunder, under the
direction of the Board of Directors and officers of Employer and to
this end agrees to devote his entire energy and skill during regular
working hours to such employment, and not to work for others at any

CONFIDENTIAL

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This document covered by protective
order of Utah Third District Court.
Available only to designated counsel.

other time during such employment without the written permission of an officer of Employer.

4. Employee's duties shall be such as are assigned to him from time to time by Employer. In carrying out research, development, and productive activities for Employer, he shall accurately record the precise nature thereof and the data derived therefrom, and all such data and records shall be and remain the sole and exclusive property of Employer.

5. All inventions, discoveries, and improvements, whether patentable or unpatentable, made, devised, or discovered by Employee, whether by himself or jointly with others, from the time of entering Employer's employ until one (1) year after the termination of his employment, relating or pertaining in any way to the business of his employment, shall be promptly disclosed in writing to Employer and are to inure to the benefit of Employer and become and remain its sole and exclusive property, unless proved by Employee to have been conceived, discovered or made after termination of his employment with Employer. Employee agrees to execute any assignments to Employer or its nominee of his entire right, title, and interest in and to any such inventions, discoveries, and improvements and to execute any other instruments and documents requisite or desirable in applying for and obtaining patents, at the cost of Employer, with respect thereto in the United States and in all foreign countries that may be requested by Employer. Employee further agrees, whether or not in the employ of Employer, to cooperate to the extent and in

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the manner requested by Employer in the prosecution or defense of any patent claims or any litigation or other proceeding involving any inventions, trade secrets, processes, discoveries, or improvements covered by this Agreement, but all expense thereof shall be paid by Employer.

6. Employee covenants and agrees that he will not (except as required in the course of his employment with Employer), while in the employ of Employer or thereafter, communicate or divulge to, or use for the benefit of himself or any other person, firm, association, or corporation, without the consent of Employer, any information concerning any inventions, discoveries, improvements, processes, formulas, apparatus, equipment, methods, trade secrets, research, secret data, costs of uses or purchasers of Employer's products or services, or other confidential matters possessed, owned, or used by Employer that may be communicated to, acquired by, or learned of by Employee in the course of or as a result of his employment with Employer. All records, files, memoranda, reports, price lists, customer lists, drawings, plans, sketches, documents, equipment, and the like, relating to the business of Employer, which Employee shall use or prepare or come into contact with, shall remain the sole property of Employer.

7. Employee further agrees that improper disclosure of any of the information listed in paragraph 6 above and/or use thereof could be highly detrimental to Employer. Therefore, Employee agrees that for a period of two (2) years after termination of such employment he will not either for himself or for others than Employer engage in

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any business competitive with Employer's business, including but not limited to the developing, making, selling and using of explosives, ~~preparing boreholes for the use of explosives, providing drilling and blasting services for mining and other types of commercial blasting or manufacturing and producing or combining raw materials that are used in explosives;~~ or advise others concerning any such business (except by way of lectures and publications available to the public) in the United States or in any foreign country in which Employer is at the time of Employee's termination and thereafter engaged, either directly or indirectly through agreements with third parties, in doing business or deriving revenues therefrom.

HJ 150
28 OCT

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8. This Agreement may not be changed or terminated orally, and no change, termination, or attempted waiver of any of the provisions hereof shall be binding unless in writing and signed by both Employee and the President of Employer. Employee's compensation may be increased or his capacity changed at any time by Employer without in any way affecting any of the terms and conditions of this Agreement, which in all respects shall remain in full force and effect.

9. Employee will not disclose to Employer, or induce it to use, any confidential information or material belonging to others.

10. The continuance of Employee in the employ of Employer for any definite period is not hereby made obligatory upon either party as a condition hereof.

11. This Agreement shall be binding upon Employee, his heirs, administrators, executors and other legal representatives.

12. This Agreement shall be interpreted according to the laws of the State of Utah.

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Signed at West Jordan this 15th day of October, 1976

Witness Lex L. Udy Employee Harvey A. Jensen

Accepted this 27th day of October, 1976.

IRECO CHEMICALS AND ITS AFFILIATES

By Paul F. Williams
Employer

List here patent applications, patents, inventions and agreements
referred to in paragraph 2 above:

5 August 1983

M. Garfield Cook, President
Ireco Chemicals
7th Floor, Kennecott Building
Salt Lake City, Utah 84133

Dear Garfield,

This letter constitutes my resignation from Defense Systems and Ireco Chemicals.

Events of the past several months have led me to conclude that I shall likely never be able to realize my expectations here. I have also come to doubt management's intentions regarding the upgrading of my position as agreed in pre-employment discussions.

To assist Ireco and Defense Systems in phasing in someone else to replace me, I am willing to stay on for up to two additional months. However, I am ready to leave immediately if management should prefer it that way.

Upon leaving it is my intent to safeguard and protect Ireco's trade secret and proprietary information to which I have had access and to observe all pertinent nondisclosure requirements.

I have enjoyed my experience with Ireco and Defense Systems and sincerely hope the contributions I have made and the new business I was instrumental in bringing into the companies will continue to be of benefit to all concerned. I have no ill feelings toward anyone and extend to you and your associates my best personal regards along with my desire for the continued success of both companies.

Please convey to Dr. Gary M. Thornlev my warm feelings of appreciation for the pleasure I experienced in working under his direction; also, to Jay M. Anderson for the pleasure I have had in working with him.

With kindest regards,

M. Taylor Abegg

EXHIBIT A

VI-1





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SEVENTH FLOOR KENNECOTT BUILDING • SALT LAKE CITY, UTAH 84133 TELEPHONE: (801) 364-4800 TELEX: 38-8353

M. Garfield Cook
PRESIDENT

10 August 1983

Mr. M. Taylor Abeg
794 16th Avenue
Salt Lake City, Utah 84103

Dear Taylor:

I was surprised to receive your letter of resignation last Friday afternoon. Only a week earlier you and I had had a review in my office of your feelings regarding your job and future at IRECO and nothing of dissatisfaction surfaced at that time.

I was particularly surprised at your inference that management had not filled some agreement reached in pre-employment discussions. I am unaware of any agreement or promise made with you in any discussions, pre-employment or otherwise, other than the agreed re-employment of you in IRECO's government projects (military explosives) area, at the agreed salary administered under the standard compensation program of the company. I would certainly welcome a review of this matter with you if you so desire.

I was personally disappointed at the inference in view of the generosity of IRECO in even considering your rehire request in the first place. As you know, IRECO has a strict policy regarding rehiring. I worked for over a year with GRE and IRECO management in order to justify it.

Nevertheless, I wish you well in your future endeavors and would only remind you of your continuing obligations as an employee and officer of IRECO and Defense Systems respectively, to keep confidential their strategic business plans and technology.

Sincerely,

A handwritten signature in cursive script, appearing to read "Garfield", written over the typed name.

M. Garfield Cook

MGC:naa

cc: J. M. Anderson
G. M. Thornley

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TERMINATION STATEMENT

In connection with my resignation as an employee of IRECO Chemicals, I hereby state that all records, files, memoranda, reports, price lists, customer lists, drawings, plans, sketches, documents, equipment, trade secret documents, and like materials, and copies of any of the foregoing materials, relating to the business of IRECO Chemicals, which I prepared or came in contact with or which are in my possession shall remain the sole property of IRECO and have been or upon my resignation will be returned to the Security Department or an authorized IRECO employee and that following my termination I will cooperate with IRECO in confirming the return of such materials.

DATE 8/8/83

M. V. Allen

CONFIDENTIAL

23 August 1983

Harvey A. Jessop
2180 West 14200 South
Bluffdale, Utah 84069

Dear Harvey:

I am authorized to offer you employment as a research chemist upon the following terms and conditions:

1. Salary: \$45,000 per year, payable bi-weekly, reviewable annually.
2. Royalty: For so long as your employment continues (a) where the patents or trade secrets are owned by the manufacturer, one percent (1%) of net profit from sales of any product embodying any patented or trade secret innovation made or discovered by you in the course of your employment. For this purpose net profit shall mean sales price less manufactured cost, and (b) where the manufacturer shall pay a royalty to the owner of the patent or trade secret, one percent of the royalty received by such owner.
3. Health Insurance: One-half of the premium payable for health insurance coverage for you and members of your immediate family, assuming \$100 per person per year deductible coverage.
4. Starting Date: September 1, 1983.
5. Duties: You will act as a research chemist on such projects as may be assigned to you from time to time by means of written work orders. Your employment will be full-time and you will not accept any outside full- or part-time employment.
6. Ownership of Technology: You hereby assign to your employer or the person or persons contracting for your work, as they may determine, all right, title and interest in and to any patentable inventions or trade secret technology which you may make or develop while so employed.
7. Secrecy: You will keep secret and preserve the confidentiality of any and all proprietary information, however recorded or embodied, which you may create or acquire or which may come to your attention during the course of your employment.

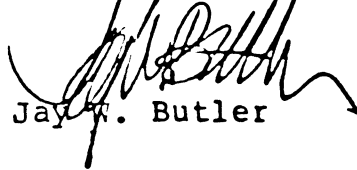
001040

VIII-1

Harvey A. Jessop
23 August 1983
Page Two

If these terms and conditions are acceptable to you, please so indicate by signing and returning to me one copy of this letter.

Very truly yours,



Jay R. Butler

Accepted

Harvey A. Jessop

001041

FILING RECEIPT



U.S. PATENT & TRADEMARK OFFICE
 RECEIVED
 OCT 22 1984
 WASHINGTON, DC 20501

SERIAL NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	CHY DS	TOT CL	IND CL
06/644,526	08/27/84	223	\$ 150.00		0	17	1

K. S. CORNABY
 559 EAST SOUTH TEMPLE
 SALT LAKE CITY, UT 84102

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Receipt is acknowledged of the patent application identified herein. It will be considered in its order and you will be notified as to the examination thereof. Be sure to give the U.S. SERIAL NUMBER, DATE OF FILING, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this transmittal.

Applicant(s) JOHN A. PETERSON, BRIGHAM CITY, UT; M. TAYLOR ABEGG,
 SALT LAKE CITY, UT.

* SMALL ENTITY *

TITLE
 METHOD FOR THE CONTINUOUS PRODUCTION OF COMPOSITE EXPLOSIVES AND
 PROPELLANTS

K. S. CORNABY
 OCT 22 1984
 Attorney at Law

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37. Code of Federal Regulations, 5.11

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001276

FILING RECEIPT

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark OfficeAddress: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20531

SERIAL NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DEWGS	TOT CL	IND CL
06/644,525	08/27/84	134	\$ 150.00		3	19	1

K. S. CORNABY
559 EAST SOUTH TEMPLE
SALT LAKE CITY, UT 84102

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Applicant(s) JOHN A. PETERSON, BRIGHAM CITY, UT; M. TAYLOR ABEGG,
SALT LAKE CITY, UT.

* SMALL ENTITY *

TITLE
APPARATUS FOR THE CONTINUOUS PRODUCTION OF COMPOSITE EXPLOSIVES AND
PROPELLANTS

K. S. CORNABY

OCT 22 1984

Attorney at Law

(see reverse)

IX-3

001277

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SPECIFICATION

To all whom it may concern:

Be it known that we, JOHN A. PETERSON, a citizen of the United States of America, and residing in Brigham City, Utah, and M. TAYLOR ABEGG, a citizen of the United States of America, and residing in Salt Lake City, Utah, have invented a new and useful improvement in

METHOD FOR THE CONTINUOUS PRODUCTION OF
COMPOSITE EXPLOSIVES AND PROPELLANTS

of which the following constitutes a full specification.

001279

BACKGROUND OF THE INVENTION

The present invention relates to a method for the continuous production of composite explosives and propellants.

Composite energetic materials, e.g., explosives and propellants, are typically composed of separate fuel and oxidizer portions. The making of certain composite energetic materials requires that the oxidizer salts be molten when mixed with the fuel. For example, the Microkmit Composite Explosives and propellants taught by U.S. patent applications No. 578,177, No. 578,178 and No. 578,179 are anhydrous compositions of inorganic oxidizer salts, organic fuels and surfactants. The making of these compositions requires that the oxidizer be in a molten state prior to blending with the other ingredients. The resulting mixtures are supercoolable and, upon crystallization, become hard.

In the production of these compositions the melting of the oxidizer salts prior to blending with the other ingredients has several benefits. As the molten oxidizers are blended with fluid hydrocarbon fuels and surfactants a high degree of intimacy of fuel and oxidizer can be achieved. This, in turn, improves explosive performance, yielding energies near theoretical maximum. The supercoolability of the composite mixture to ambient or near ambient temperature permits the filling of containers in a manner that minimizes cast shrinkage, an important consideration in munition fills, rocket propellants and shaped charges for

industrial applications. Finally, by using elevated temperatures of oxidizer salts process temperatures may be kept below levels at which certain ingredients may be thermally unstable.

In certain of these compositions it may be useful to add, as solid, insoluble particulate ingredients, additional fuels and oxidizers. Among such added solids are insoluble self-explosives and metallic fuels.

It is frequently useful in connection with the production of composites to remove entrained gasses from the fluid composition. Entrained gas affects both the density of the composition and its sensitivity, both of which influence performance. The removal of entrained gas also improves accuracy in pumping and metering the material in process.

Among the ingredients which may be employed in these compositions are certain self-explosives, e.g., monoethanolamine nitrate and ethylenediamine dinitrate, which may be added or made in situ. When made in situ, it may be desirable to remove any resulting gaseous by-product. Such self-explosives are sensitive in varying degrees to friction, impact and excessive heat, and it is therefore desirable that the method of preparation avoid exposing these materials, both before and after the synthesis of the composition, to these types of provocation. Considerations of safety also suggest restricting the diameter of the material in process to less than the critical diameter necessary for a detonation to propagate in the material.

While certain of the characteristics of composite explosives and propellants can be achieved in a batch process, in which a quantity of the requisite ingredients is placed in a container and mechanically blended, several disadvantages are attendant upon batch processing, particularly where heating of the materials in process is required. Batch processing is typically performed in melt kettles containing large quantities of neat explosives or propellant. Uniform blending requires lengthy mechanical agitation of heated materials in large volumes, thus creating a more or less acute safety hazard, depending upon the sensitivity of the composition to various kinds of provocation. Because governmental and industrial standards require distancing of explosives facilities in proportion to the quantity of energetic material in process, extensive facilities having high capital costs are generally required for such batch process operations. It is therefore desirable for reasons both of safety and of economics that these materials be processed continuously in such a manner that the minimum amount of material be involved at each stage of the process.

While the composite energetic materials of principal concern in the foregoing discussion are comprised of separate fuel and oxidizer portions, the method of continuous processing described herein is equally applicable to composites in which one of the separate portions consists of or contains a molten self-explosive.

It is an objective of this invention to provide a

means for the safe, continuous production of composite explosives and propellants in which ingredients in process are required to be molten.

It is a further objective to blend two or more fluid streams, one or more molten oxidizer streams and one or more fuel streams, in such a manner as to achieve a high degree of intimacy of the fuel and oxidizer portions. One of the streams may be or may include a molten self-explosive.

It is a further objective to achieve the minimum process temperature consistent with maintaining the material in the process in a fluid state.

It is a further objective to impart to the product of the process the characteristic of supercoolability such that the material remains fluid for some period of time at or near ambient temperature.

It is a further objective to so supercool the product, partially or completely, before it exits the process.

It is a further objective to admix insoluble particulate solids into the fluid material before or after supercooling.

It is a further objective to control the level of, or to eliminate, entrained gas from the product.

It is a further objective to minimize provocation of the material in process by friction, impact and heat.

It is a further objective to restrict the diameter of the material in process below the critical diameter necessary for the propagation of an explosive reaction.

It is a further objective to minimize the residence time and the mass of material in process over the production methods of prior art.

It is a further objective to allow easy flexibility in the kinds of ingredients used, and in the weight percentages of each in the composition.

Finally, it is an objective to obtain a highly refined composite explosive or propellant which is homogeneous, uniform and free from voids or other manufacturing defects.

DESCRIPTION OF THE INVENTION

The present invention consists of a method for the continuous manufacture of composite explosives and propellants in which the ingredients are first melted and separate fluid streams of such molten ingredients are then mixed in such a way that the resulting composition is characterized by a high degree of intimacy of such ingredients. Optionally, stages may be included in the process in which the composition or the fluid ingredients are deaerated and in which the composite is rapidly cooled following mixing. The method also applies to composites in which one of the streams is or contains a molten self-explosive.

The method of the invention consists, at a minimum, of the following steps: First, two or more separate reservoirs are filled with the ingredients. Typically, an oxidizer is placed in one such reservoir and an organic fuel and one or more surfactants or crystal habit modifiers are placed in another reservoir. Alternatively or in

addition, a variety of other ingredients may be placed in one or another of the ingredient reservoirs, separately or in combination. Such ingredients may include dry particulate solid fuels and molten or particulate, soluble or insoluble self-explosives or ingredients from which such self-explosive may be synthesized in situ.

Either before introduction into such reservoirs or while resident therein, the ingredients are heated to a temperature above that at which all such ingredients are molten. To insure uniformity of the material in the reservoirs, it may be useful to stir mechanically the contents of the reservoirs before the materials are discharged therefrom.

The fluid materials are then driven by means of a pumping system through a mixing chamber where sufficient turbulence is introduced to achieve an intimate and uniform intermixture of the ingredients, following which the composition is expelled from the mixing chamber and loaded into waiting containers or assemblies.

Optionally, following the heating of the ingredients in the separate reservoirs, the fluid materials may be passed through a deaeration device such that entrained gasses are drawn off and disposed of prior to mixing. It is also optional, following mixing, to pass the composition through a cooling device such that the composition is cooled or supercooled but maintained in a fluid state until loaded into containers or assemblies.

In order to effect the method of the invention, process equipment having some or all of the following characteristics may be employed: The process may employ a closed system such that a vacuum may be introduced for the purpose of drawing off entrained gasses and differential pressures may be employed to assist in the movement of material through the process. Reservoirs, mixing chambers, valves and process tubing may be heated to preserve constant and uniform process temperatures. Pumps and valves may be of such types and materials as to involve no frictional metal to metal contact in the presence of materials in process. The diameter of materials in process may be maintained below the critical diameter of any explosive material being processed. The mixer may consist of a static mixer in which there are no moving parts and in which turbulent flow and intermixture of the ingredients are achieved by the geometrical configuration of the mixer.

EXAMPLE

To illustrate the process of the invention, eighteen (18) kg of a blended dry oxidizer powder comprising 14.0 kg ammonium nitrate, 2.4 kg sodium nitrate, and 1.6 kg potassium perchlorate was introduced into the oxidizer melt hopper. The temperature control on the oil temperature was set at 130°C and oil was circulated through the heating jacket at 50% of pump RPM, or approximately 4 liters/minute. After two hours, a vacuum of 10 mm Hg was drawn on the melt chamber. After an additional 30 minutes, the oxidizer

was melted and ready for further processing. The stirring motor was energized at 150 RPM for the last 10 minutes.

Near the completion of the melting of the oxidizer sub-mix, two (2.0) kg of a fuel sub-mix comprising 0.5 kg surfactant and 1.5 kg hydrocarbon fuel was introduced into the fuel chamber. The temperature, oil flow rate, vacuum conditions and stirring were the same for the oxidizer melt, but were applied for a total of only approximately 30 minutes. For the time period during which the vacuum was on the melt chambers, oil at 130°C was admitted into the lower chamber.

After the apparatus had equilibrated in temperature, a vacuum of 15 mm Hg was placed on the melt chamber, 10 mm Hg on the deaeration chamber and the slide valves were opened. After 30 seconds, the pumping action was started.

The pumps were set to maintain a ratio of 1:9 fuel to oxidizer by weight and produced a total of 1700 ml of emulsified material per stroke, with each stroke taking seven seconds. The return stroke was 10 seconds, using 17 seconds for a complete cycle. 6,000 ml of product were produced each minute of operation.

ABSTRACT OF THE DISCLOSURE

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A method for continuously producing composite explosives and propellants, in which at least two separate streams of ingredients, such as an oxidizer and an organic fuel, are heated to achieve a molten state. The streams of molten material can be mechanically stirred to achieve uniformity of content. As an optional feature, the streams may be subjected to deaeration at this stage. The streams are then pumped through a mixing chamber into which sufficient turbulence is introduced to achieve an intimate and uniform intermixing of the ingredients contained in the streams, and the admixed composition is then discharged. Following discharge, the composition can be cooled or supercooled in a cooling step prior to loading into containers or assemblies.

CLAIMS

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We Claim:

1. A method for continuously producing composite explosives and propellants comprising the steps of:

- melting at least one oxidizer to create a pumpable liquid;
- melting at least one organic fuel to create a separate pumpable liquid;
- pumping said liquids simultaneously into a mixing chamber;
- subjecting the combined liquids to controlled turbulence within said mixing chamber to achieve an intimate and uniform mixture; and
- expelling the product from the mixing chamber.

2. A method as set forth in Claim 1, wherein more than two separate pumpable liquids are combined to produce a desired product.

3. A method as set forth in Claim 1, wherein the oxidizer is in the form of dry, granular powder prior to being heated to a temperature above its melting point.

4. A method as set forth in Claim 1, wherein the organic fuel is initially introduced at ambient temperature and then is heated to a temperature above the melting point of any solid constituent in the fuel.

5. A method as set forth in Claim 1, wherein a self-explosive material is a component of the pumpable liquid, and is initially introduced at ambient temperature

and is subsequently heated to a temperature above its melting point.

6. A method as set forth in Claim 5, wherein a self-explosive material is made in situ and heated to or maintained at a temperature above its melting point.

7. A method as set forth in Claim 1, wherein insoluble, solid, particulate ingredients are introduced into one or more of the fluid streams which remain solid throughout the process, but which are dispersed in the fluid streams in such a way that the product remains fluid.

8. A method as set forth in Claim 7, wherein at least one insoluble, solid, particulate ingredient is introduced into one of the fluid streams before the streams are mixed.

9. A method as set forth in Claim 7, wherein at least one insoluble, solid, particulate ingredient is introduced into the product before cooling the product.

10. A method as set forth in Claim 9, wherein at least one insoluble, solid, particulate ingredient is introduced into the product after the produce is supercooled, but before the product hardens.

11. A method as set forth in Claim 1, wherein at least one fluid stream is passed through a deaeration device which extracts entrained gasses from the stream.

12. A method as set forth in Claim 1, wherein said pumping and mixing steps are accomplished without friction and metal-to-metal contact.

13. A method as set forth in Claim 1, wherein the

diameter of conduits through which the material in process is moved is restricted to diameters below the critical diameter of the product produced.

14. A method as set forth in Claim 1, wherein the process temperatures are controlled so as to maintain uniform process temperatures within a range sufficiently high to keep the material in process in a fluid state but not so high as to cause thermal degradation of any ingredient during processing.

15. A method as set forth in Claim 1, wherein the material in process is supercooled to a temperature at or near ambient temperature before it exists the process.

16. A method as set forth in Claim 1, wherein said controlled turbulence is accomplished by means of mechanical stirring.

17. A method as set forth in Claim 1, wherein said controlled turbulence is accomplished by means of the flow of the fluid streams simultaneously through a static mixing unit.

SPECIFICATION

To all whom it may concern:

Be it known that we, JOHN A. PETERSON, a citizen of the United States of America, and residing in Brigham City, Utah, and M. TAYLOR ABEGG, a citizen of the United States of America, and residing in Salt Lake City, Utah, have invented a new and useful improvement in

APPARATUS FOR THE CONTINUOUS PRODUCTION OF
COMPOSITE EXPLOSIVES AND PROPELLANTS

of which the following constitutes a full specification.

001292

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for producing explosives and propellants.

The present invention consists of an apparatus for the continuous production of composite energetic materials in which separate fluid streams of molten ingredients are mixed in such a way that the resulting composition is characterized by a high degree of intimacy of such ingredients.

Composite energetic materials, e.g., explosives and propellants, are typically composed of separate fuel and oxidizer portions. The making of certain composite energetic materials requires that the oxidizer salts be molten when mixed with the fuel. For example, the Microknit Composite Explosives and propellants taught by co-pending U.S. patent applications Serial Nos. 578,177, 578,178 and 578,179, are anhydrous compositions of inorganic oxidizer salts, organic fuels and surfactants. The making of these compositions requires that the oxidizer be in a molten state prior to blending with the other ingredients. The resulting mixtures are supercoolable and, upon crystallization, become hard.

In the production of these compositions the melting of the oxidizer salts prior to blending with the other ingredients has several benefits. As the molten oxidizers are blended with fluid hydrocarbon fuels and surfactants, a high degree of intimacy of fuel and oxidizer can be

achieved. This, in turn, improves explosive performance, yielding energies near theoretical maximum. The supercoolability of the composite mixture to ambient or near ambient temperature permits the filling of containers in a manner that minimizes cast shrinkage, an important consideration in munition fills, rocket propellants and shaped charges for industrial applications. Finally, by using eutectic mixtures of oxidizer salts, process temperatures may be kept below levels at which certain ingredients may be thermally unstable.

In certain of these compositions it may be useful to add, as solid, insoluble particulate ingredients, additional fuels and oxidizers. Among such solids are insoluble self-explosives and metallic fuels.

It is frequently useful in connection with the production of composites to remove entrained gasses from the fluid composition. Entrained gas affects both the density of the composition and its sensitivity, both of which influence performance. The removal of entrained gas also improves accuracy in pumping and metering the material in process.

Among the ingredients which may be employed in these compositions are certain self-explosives, e.g., monoethanolamine nitrate and ethylenediamine dinitrate, which may be added or made in situ. When made in situ, it may be desirable to remove any resulting gaseous by-product. Such self-explosives are sensitive in varying

degrees to friction, impact and excessive heat, and is therefore desirable that the manufacturing apparatus avoid exposing these materials, both before and after the synthesis of the composition, to these types of provocation. Considerations of safety also suggest restricting the diameter of the material in process to less than the critical diameter necessary for a detonation to propagate in the material.

While certain of the characteristics of composite explosives and propellants can be achieved in a batch process, in which a quantity of the requisite ingredients is placed in a container and mechanically blended, several disadvantages are attendant upon batch processing, particularly where heating of the materials in process is required. Batch processing is typically performed in melt kettles containing large quantities of neat explosive or propellant. Uniform blending requires lengthy mechanical agitation of heated materials in large volumes, thus creating a more or less acute safety hazard, depending upon the sensitivity of the composition to various kinds of provocation. Because governmental and industrial standards require distancing of explosives facilities in proportion to the quantity of energetic material in process, extensive facilities having high capital costs are generally required for such batch process operations. It is therefore desirable for reasons both of safety and of economics that these materials be processed continuously in such a manner that

the minimum amount of material be involved at each stage of the process.

While the composite energetic materials of principal concern in the foregoing discussion are comprised of separate fuel and oxidizer portions, the apparatus for continuous processing described hereinafter is equally applicable to composites in which one of the separate portions consists of, or contains, a molten self-explosive.

Prior art does not address continuous processing of molten composite energetic materials in integral, self-contained, processing apparatus. Certain aspects of continuous processing have been treated. For example, U.S. Patent 4,213,712 teaches a method of blending two liquid component streams by means of a mixing rotor. The patent is silent on aspects of explosives production other than mixing.

U.S. Patent number 4,207,126 teaches a method of continuous processing of watergel explosives containing microspheres of expanded thermoplastic. The explosives formed by this method are aqueous gels; a eutectic oxidizer melt is used as a premix to properly expand the microspheres, but no molten salts are used in the final processing.

The prior art discloses no teaching of continuous processing of composite explosives or propellants by blending heated liquid component streams.

It is an objective of this invention to provide an apparatus for the safe, continuous production of composite

explosives and propellants in which ingredients in process are required to be molten.

It is a further objective to blend two or more fluid streams, one or more molten oxidizer streams and one or more fuel streams, in such a manner as to achieve a high degree of intimacy of the fuel and oxidizer portions. Alternatively, one of the streams may be or may include a molten self-explosive.

It is a further objective to achieve the minimum process temperature consistent with maintaining the material in the process in a fluid state.

It is a further objective to impart to the product of the process the characteristic of supercoolability such that the material remains fluid for some period of time at or near ambient temperature.

It is a further objective to so supercool the product, partially or completely, before it exists the process.

It is a further objective to admix insoluble particulate solids into the fluid material before or after supercooling.

It is a further objective to control the level of, or to eliminate, entrained gas from the product.

It is a further objective to minimize provocation of the material in process by friction, impact and heat.

It is a further objective to restrict the diameter of the material in process below the critical diameter necessary for the propagation of an explosive reaction.

It is a further objective to minimize the residence time and the mass of material in process over the production

methods of prior art.

It is a further objective to allow easy flexibility in the kinds of ingredients used, and in the weight percentages of each in the composition.

Finally, it is an objective to obtain a highly refined composite explosive or propellant which is homogeneous, uniform and free from voids or other manufacturing defects.

SUMMARY OF THE INVENTION

An apparatus for continuously producing composite explosives and propellants has means for continuously heating at least two separate respective streams of an oxidizer and a fuel to their respective molten states. A surfactant can be included as can insoluble particulate ingredients, additional fuels, including organic fuels and other oxidizing salts. Moreover, self-explosives can be introduced into the streams or may be made in situ as additional ingredients or in lieu of one of the above-named ingredients.

Each of the molten streams is continuously pumped by pumping means into a blending chamber for agitation of the streams to achieve intimate mixing of the streams without the presence of mechanical mixing blades which cause friction and heat buildup. Following thorough mixing the processed material is pumped by pumping means preferably through deaeration means, such as slit plates or the like, to remove entrained air to a receiving chamber for storage under heated conditions prior to removal for further processing or use.

The processed material can also be exposed to means for cooling or supercooling the mixture, such as a heat exchanger or the like, prior to leaving the apparatus.

THE DRAWING

Preferred embodiments of the invention are shown in the accompanying drawing, in which:

FIG. 1, is a perspective view of an apparatus of the invention;

FIG. 2, a schematic drawing of the apparatus, depicting the flow of material through the apparatus; and

FIG. 3, an exploded perspective view of a slit-plate deaeration assembly used in a preferred embodiment of the apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The major components of the apparatus in a preferred embodiment are shown in FIGS. 1, and 2, and include at least two ingredient reservoirs 10, 11 fitted with respective stirrers 12, 13 and equipped with vacuum-tight removable closures 14, 15. Reservoirs 10, 11 are connected through appropriate vacuum lines to modulating valves 16, 17 and from there to vacuum sources 18, 19.

A pair of heated circulating oil baths 20, 21 surround ingredient reservoirs 10, 11 to maintain the temperature in the reservoirs above the melting points of the ingredients. This embodiment has a pair of deaeration assemblies 22, 23 communicating with respective ingredient reservoirs 10, 11. Deaeration assemblies 22, 23 are further

defined in connection with FIGS. 2 and 3. The ingredients are then pumped into a static mixing chamber 40 and rolling diaphragm pumps 34, 35 are employed to mix the two streams to produce the processed material.

Static mixing chamber 40 joins and blends the streams from the pumps and incorporates check valving such that the direction of flow is always constrained to be from the pumps toward the mixing chamber. A homogenizing valve 25 is disposed downstream of static mixer 40, and a common heated circulating oil bath 26 surrounds the deaeration assemblies, valving, pumps and static mixer 40.

In this preferred embodiment, a heat exchanger 27 is provided to extract heat from the efflux of homogenizing valve 25.

As shown in a flow diagram of the apparatus, FIG. 2, the reservoirs 10, 11 are respectively charged with separate quantities of the ingredients of the explosive or propellant composition. The top closures 14, 15 are installed and sealed by means of clamps 14a, 15a and the circulating heating baths 20, 21 are turned on. The temperature of the heating baths 20, 21 surrounding the ingredient reservoirs 10, 11 (which are independent of the heating bath which surrounds the remainder of the apparatus) is regulated to be slightly higher than the melting temperature of the ingredients.

After a suitable interval, respective stirrers 12, 13 in each reservoir are energized, and a vacuum is drawn

inside each reservoir 10, 11 through the modulating valves 16, 17 from vacuum sources 18, 19. This, in combination with the stirring, serves to remove air from the molten ingredients and assists in obtaining a more refined product.

Following heating, stirring, and subjecting both reservoirs 10, 11 to vacuum, the respective slide valves 28, 29 at the bottom of reservoirs 10, 11 are opened and the ingredient streams flow through the deaeration assemblies 22, 23. As shown in detail in FIGS. 2 and 3, deaeration assemblies 22, 23 have respective slit plates 30, 31 through which the streams flow into the deaeration chambers 32, 33. The pressure in deaeration chambers 32, 33 is typically a vacuum of from 1 to 50 mm Hg, and the flow rates are regulated by adjusting the pressure in reservoir chambers 10, 11 to be higher than the pressures in the deaeration chambers 32, 33. The slit plates 30, 31 divide the incoming fluids into ribbon-like streams where essentially the total mass is exposed to the vacuum in the deaeration chambers 32, 33. This permits any entrained gasses to escape from the incoming fluid through vacuum-producing sources 24.

After the deaeration chambers 32, 33 are charged with the proper quantities of each constituent, the slide valves 28, 29 are closed. The rolling diaphragm pumps 34, 35 are then actuated. The pumps 34, 35 are in the minimum volume position at this time and as the rolling diaphragms are withdrawn, fluids flow from the deaeration chambers 32, 33 into the pump bodies 34, 35.

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After the pumps 34, 35 are charged, the automatic check valves 36, 37 communicating with the deaeration chambers 32, 33 close, and similar valves 38, 39 communicating with the static mixer 40 open. Under appropriate command, the servoactuators 41, 42 move in such a way that the two streams are precisely blended in the correct ratio in the mixing section 40. When the bottom of the stroke is reached, valves 38, 39 communicating with the static mixer 40 close and valves 36, 37 which communicate with deaeration chambers 32, 33 open, and the sequence repeats. The charging of deaeration chambers 32, 33 from the melting reservoirs 10, 11 can occur simultaneously with the expelling stroke of the pumps 34, 35.

As the mixed fluid emerges from the static mixer 40, a homogenizing valve 25 is provided in this embodiment to accept the flow from static mixer 40 if additional refining is required.

Outside of the common heating reservoir 26, is a heat exchanger 27, wherein the homogeneous mixed product is cooled. The use of the homogenizing valve 25, the heat exchanger 27 or both is optional depending upon the formulation.

A microprocessor (not shown) is used to control the sequence of operations summarized above.

ABSTRACT OF THE INVENTION

An apparatus for continuously producing composite explosives and propellants in small continuous streams has at least two reservoirs for containing and heating separate streams of ingredients to their respective melting points. The reservoirs can be attached to a vacuum source to aid in removing entrained air. The ingredients are pumped by appropriate pumping means to a static mixing chamber where the two streams are continuously intermixed by non-mechanical means to produce the desired explosive or propellant product material. The streams are preferably deaerated with a deaeration assembly having a multiple slit plate prior to mixing, and preferably have means for cooling or supercooling following intermixing.

CLAIMS

We Claim:

1. An apparatus for continuously producing composite explosives and propellants, comprising in combination:

- at least two heatable reservoirs for holding separate volumes of ingredients;
- means for heating said reservoirs to temperatures at least as high as the melting points of the ingredients;
- a static mixing chamber for receiving the molten ingredient streams and intimately intermixing the streams;
- means for pumping the molten ingredient streams from said reservoirs to said static mixing chamber; and
- means for statically mixing the molten ingredient streams within said static mixing chamber to produce a composite material.

2. An apparatus as set forth in Claim 1, including means for deaerating the ingredient streams prior to mixing in said static mixing chamber.

3. An apparatus as set forth in Claim 2, wherein said deaeration means includes a multiple slit plate through which the ingredient streams flow to form ribbons of ingredient material.

4. An apparatus as set forth in Claim 2, including vacuum means for deaerating the ingredient streams.

5. An apparatus as set forth in Claim 1, including means for inducing a vacuum into said heatable reservoirs.

6. An apparatus as set forth in Claim 1, wherein said heatable reservoirs are surrounded by a heated oil bath for heating the ingredients to temperatures above their respective melting points.

7. An apparatus as set forth in Claim 1, including heat exchanger means for cooling the product following discharge from said mixing chamber.

8. An apparatus as set forth in Claim 1, wherein a self-explosive is introduced into a heating reservoir and subsequently maintained at a temperature at least as high as its melting point.

9. An apparatus as set forth in Claim 1, wherein a self-explosive material is made in situ and maintained in a molten state.

10. An apparatus as set forth in Claim 1, wherein the ingredient reservoirs contain stirring mechanisms for refining the separate ingredient streams.

11. An apparatus as set forth in Claim 1, including pumps, valves and mixers which are constructed and function in such a manner that friction and metal-to-metal impact in the presence of the material in process is avoided.

12. An apparatus as set forth in Claim 11, wherein said pumps are of the rolling diaphragm type.

13. An apparatus as set forth in Claim 1, wherein said mixing means consists of a static mixer with no moving

parts, in which turbulent flow and intermixture of the molten streams are achieved by the geometrical configuration of said mixing chamber.

14. An apparatus as set forth in Claim 1, wherein a homogenizing valve is employed to further refine the composition following mixing.

15. An apparatus as set forth in Claim 1, wherein a heat exchanger is employed to extract heat from the composition following mixing.

16. An apparatus as set forth in Claim 1, wherein the diameter of conduits through which the material-in-process is moved is restricted to diameters below the explosive critical diameter of the material.

17. An apparatus as set forth in Claim 1, wherein the process temperatures are controlled so as to maintain uniform process temperatures within a range sufficiently high to maintain the material in process in a fluid state, but not so high as to cause thermal degradation of any ingredient during processing.

18. An apparatus as set forth in Claim 1, wherein the sequence, duration and magnitude of operational steps in the apparatus are controlled by microprocessors.

19. An apparatus as set forth in Claim 1, wherein one or more of the ingredients is preheated in a separate chamber and continuously fed as a liquid into said ingredient reservoir.

COMPARISON OF PATENT CLAIMS

I. Independent Claims

Megabar 000480

(Claims 1 & 43)

a. "[A] solid, microcrystalline explosive
... comprising"

b. "an essentially anhydrous mixture of
surfactant(s), hydrocarbon fuel(s) and
inorganic oxidizer salt(s)"

c. "explosive ... is made by formation
of an oil-continuous emulsion as a
preliminary step, followed by a controlled
disruption of the oil-phase continuum ...
with subsequent solidification"

IRECO A-34 Application

(Claim 1)

a. "A cast explosive composition, which
comprises"

b. "inorganic oxidizer salt ... organic
liquid fuel; less than about 5% water ...
and an emulsifier"

c. "which allows the formation of a
water-in-oil emulsion at an elevated
formulation temperature but which allows
the emulsion to weaken . to produce a
cast composition"

II. Main Dependent Claims

Megabar 000480

- a. metallic fuels (Claim 4)
- b. inorganic nitrates constitute major portion of oxidizer salt (Claim 6)
- c. AN is principal (Claim 7)
- d. Other salts are alkali or alkaline earth nitrates or perchlorates (Claim 9)
- e. surfactants are emulsifiers having R-groups > 12 carbon atoms and ordinarily used to form oil-continuous emulsions (Claim 25)
- f. soluble fuels or compound explosives may be employed in oxidizer portion of originally fluid mixture (Claim 29)
- g. insoluble solids may be added (Claim 30)
- h. added solid is compound explosive including nitrate or perchlorate adduct of an alkylamine or alkanolamine (Claims 31 and 33)
- i. density control or sensitization is achieved by microballoons, perlite, fumed silica, entrained gas or gas generated in situ (Claim 40)

IRECO A-34 Application
(Claims and specification)

- a. metallic fuels (Claim 6, page 6)
- b. oxidizer salt primarily a nitrate (all claims, page 6, all examples)
- c. salt is primarily AN (all claims)
- d. other salts are alkali and alkaline earth nitrates or perchlorates (Claims 10 and 11, page 5)
- e. water-in-oil emulsifiers having R-groups ranging from 12 to 22 carbon atoms (page 7)
- f. water-miscible organic liquid fuels and water soluble compound explosives in oxidizer phase (pages 6 and 7)
- g. solid fuels and sensitizers may be added (pages 6 and 7)
- h. added solid is molecular explosive such as amine nitrates and perchlorates or alkanolamine salts (page 7)
- i. density control or sensitization achieved by small hollow particles such as plastic glass spheres, perlite, gas generated in situ or entrained gas (page 8)

(Essentially all other Megabar claims also correlate directly to IRECO's specification and claims or other documents)

MEGABAR PATENT APPLICATION

000460 - 000479

Megabar Patent Claims

The claims are the same as those in 000480 except that AN and soluble explosive(s) are required so as to form eutectic mixture of AN and soluble explosive .

IRECO A-34 Application

Oxidizer salt is primarily AN (page 5, all claims, all examples) and soluble explosive(s) may be added (page 6: "analogous nitrogen-containing liquids," page 7: "molecular explosives are water soluble salts such as amine nitrates or perchlorates and alkanolamines.")

MEGABAR PATENT APPLICATION

000424 - 000446

Megabar Patent Claims

The claims are the same as those in 000480 except that the explosives are "perchlorate based."

IRECO A-34 Application

Perchlorates may be employed up to 40 percent (page 5, claim 11).

MEGABAR PATENT APPLICATION
000507 - 521 (APPARATUS)

Megabar Claim 1

Apparatus for continually producing explosives, comprising:

- a. at least two heatable reservoirs,
- b. means for heating reservoirs to temperatures as high as melting points of ingredients,
- c. static mixing chamber for receiving and mixing molten ingredient streams,
- d. means for pumping molten streams from reservoirs to static mixing chamber, and
- e. means for statically mixing the molten streams in static mixing chamber to produce explosive.

IRECO Disclosures

Paper entitled "Cast Emulsion Unit Process System" and attachments disclose:

Apparatus for continually producing explosives, comprising:

- a. at least two reservoirs designed to be heated,
- b. means for heating reservoirs,
- c. static mixing chamber,
- d. pumps for pumping streams from reservoirs to static mixing chamber, and
- e. means for statically mixing the streams in static mixing chamber to produce explosive.

See also Weekly Reports of Marlan D. Lo dated Jan 7, 14, 21, 28, Feb 7, 14, 22, 29, 2000; HAJ Weekly Reports July 6, 12, 18, Aug 1, 15, 31, 1983; HAJ Weekly Reports Sep 29, 1982 and Jan 6, 2000; HAJ Progress Report "Cast Emulsions" Oct 1982 pp. 15-16; HAJ Interim Report "Cast Emulsions" May 1983 pp. 7-10 and HAJ Memorandum 26 July 1983.

MEGABAR PATENT APPLICATION (METHOD)
001279 - 001291

Megabar Claim 1

1. A method for continuously producing composite explosives and propellants comprising the steps of:

- melting at least one oxidizer to create a pumpable liquid;
- melting at least one organic fuel to create a separate pumpable liquid;
- pumping said liquids simultaneously into a mixing chamber;
- subjecting the combined liquids to controlled turbulence within said mixing chamber to achieve an intimate and uniform mixture; and
- expelling the product from the mixing chamber.

IRECO Patent Application

"The compositions are formulated (in a continuous manner)"

"by first forming a melt ...of the oxidizer salt(s) at an elevated temperature..."

"melt is added to a solution of the emulsifier and the immiscible organic liquid fuel..."

"with sufficient vigor to produce an emulsion...until the formulation is uniform"

JRC

LETTER AGREEMENT

Gentlemen:

By this letter we agree as follows, subject to the preparation of a definitive contract and subject to JRC capital expenditure budget approval by Halliburton:

1. Not later than the First Quarter of 1985 JRC will purchase from Megabar continuous processing equipment (including hydraulic power unit, hot oil system and spares as listed in Schedule A, the "Processor") capable of producing 50 lbs./min. of composite explosive having performance (initiability and detonation velocity) equivalent to nitromethane in JRC's newly designed Quick Dredge charges.
2. Megabar will deliver the Processor within 90 days following execution of the definitive contract with a penalty if delivered after 150 days.
3. JRC will pay \$100,000 for the Processor, payable \$50,000 on execution of the definitive contract and \$50,000 on acceptance by JRC.
4. JRC may purchase one additional processor as a backup machine and replacements of confiscated machines as needed for the price of \$75,000 per machine excluding spares adjustable annually for U.S. wholesale price inflation.
5. In connection with initial start-up of the Processor, Megabar will supply at Megabar's cost sufficient of its proprietary fuel-phase premix for 1,000 Quick Ditch charges. Thereafter, Megabar guarantees that JRC's total ingredient costs (F.O.B. U.S. domestic supplier as quoted in Chemical Week) including premix will not exceed \$.55/lb., adjustable annually for U.S. wholesale price inflation. Premix will have a non-explosive classification for shipping purposes.
6. Megabar will grant to JRC an exclusive license for shaped charge applications in underwater blasting and warrants Megabars ownership of patents and know-how required for such application. Megabar will take appropriate action, including litigations, to defend such patents against infringement by competitors of JRC.

XII-1

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7. JRC will pay Megabar royalty on through-put of the Processor, its backup and replacement machines at the following rates annually:

<u>QUANTITY</u>	<u>DATE</u>
1st, 500,000 lbs./yr.	\$.30/lb.
2nd, 500,000 lbs.	\$.25/lb.
3rd, 500,000 lbs./yr.	\$.20/lb.
Over 1,500,000 but less than 3,000,000 lbs./yr.	\$.15/lb.
Over 3,000,000 lbs./yr.	\$.10/lb.

8. Modifications of the Processor following delivery necessary to make the Processor meet the specifications of paragraph 1, above, will be at Megabar's expense.
9. Megabar will provide JRC with know-how and a non-exclusive license sufficient to manufacture a low-cost bulk explosive for sale to underwater drilling and blasting contractorssubject to (a) payment by JRC to Megabar of a reasonable royalty and (b) exclusive rights to Megabar technology granted to third parties in a given country.

Please indicate your agreement to these terms by signing below.

Very truly yours,
Jet Research Center, Inc.

By: 
6/15/84

Accepted:
Megabar Explosives Corporation

By: 
6/15/84

000567

LICENSE AGREEMENT

THIS AGREEMENT is made this ____ day of August 1984 between MEGABAR EXPLOSIVES CORPORATION, a Utah corporation (together with its Subsidiaries, "Megabar"), and AEROJET-GENERAL CORPORATION, an Ohio corporation (together with its Subsidiaries, "Aerojet").

1. RECITALS

1.1. Megabar is engaged in research and development and holds proprietary technology relating to Subject Composite Materials.

1.2. Aerojet manufactures or employs energetic materials for military and aerospace markets and applications.

1.3. The purpose of this agreement is to set forth the terms and conditions upon which Megabar and Aerojet intend to cooperate in the development of Subject Composite energetic materials for use and sale by Aerojet.

IN CONSIDERATION of the mutual covenants and promises contained in this agreement, it is agreed:

2. DEFINITIONS

2.1. "Subsidiary" means a person or entity which is controlled by a party to this Agreement.

2.2. "Field" means the design, development, manufacture, sale, and use of Subject Composite Materials for military and aerospace applications.

2.3. "Territory" means that part of the earth's surface which is under the sovereign control and jurisdiction of the government of the United States of America.

2.4. "Subject Composite Materials" means (a) energetic composites comprising a non-aqueous solution, dispersion, or emulsion of at least one molten inorganic oxidizer salt and at least one organic fuel, which composites are claimed in any Subject Patent or described in or made with the use of Subject Technical Information; and (b) materials formed by solidification of such energetic composites.

2.5. "Subject Technical Information" means the technical information and knowledge of Megabar relating to the formulation,

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production, or use of Subject Composite Materials and machinery for manufacturing the same. Subject Technical Information does not include information developed pursuant to contracts with third parties or which Megabar is not free to disclose without payment to third parties, nor does it include information which has entered or hereafter enters the public domain other than by an unauthorized act of Aerojet.

2.6. "Subject Patents" means all patents and patent applications now or hereafter filed by or issued to Megabar in the United States of America relating to Subject Composite Materials or to machinery for making and using the same, excluding, however, patents acquired from third parties. As of the date of this Agreement the Subject Patents consist of the patent applications listed in Schedule 2.6, attached.

2.7. "Subject Product" means a product manufactured by or for Aerojet consisting of or containing Subject Composite Materials, which is sold by Aerojet as a deliverable item using DD Form 250 or its equivalent intended to evidence acceptance.

2.8. "Net Sales Revenues" means, for a given period, the sum of the invoice prices of Subject Products sold by Aerojet excluding taxes, insurance and freight and less returns, if any.

3. LICENSES

3.1. (a) Megabar grants to Aerojet for the life of this Agreement the following licenses for use in the Field in the Territory:

- (i) A license of the Subject Technical Information and
- (ii) A license of the Subject Patents, including the right to make or have made, use and sell Subject Products and including the right to make or have made and use, but excluding the right to sell, machinery embodying the inventions of the Subject Patents or the Subject Technical Information.

(b) Megabar also grants to Aerojet a non-exclusive right to sell Subject Products anywhere in the world where such sales may be made pursuant to local laws, regulations and decrees and in accordance with applicable laws and regulations of the United States of America.

3.2. The licenses of Section 3.1(a) shall be sole and exclusive in the Field in the Territory, except that such licenses shall be non-exclusive (a) with respect to products or markets listed in Schedule 3.2, attached, as modified from time to time by an instrument or instruments in writing signed by Aerojet and Megabar and (b) with respect to rights to make and

use machinery embodying the inventions of the Subject Patents and the Subject Technical Information. At the election of Aerojet the exclusive license granted hereby may be converted to a non-exclusive license in respect of all products or markets in the Field upon written notice by Aerojet to Megabar, which notice shall take effect upon the last day of the fourth full calendar quarter next following the delivery of such notice. Aerojet shall thereafter be entitled to practice the Subject Technical Information and Subject Patents pursuant to the terms hereof on a non-exclusive basis without obligation to pay to Megabar the minimum royalties called for by Section 4.1 hereof.

3.3 No license is hereby granted by implication or otherwise of any patents or patent applications other than those specifically falling within the definition of Subject Patents, nor of any technical information other than that falling specifically within the definition of Subject Technical Information.

3.4. In the event that the manufacture, use, or sale of Subject Composite Material in a Subject Product shall be finally adjudicated by a court of competent jurisdiction to infringe any valid patent issued in the Territory to some third party and such adjudication requires Aerojet to pay a royalty or license fee to such third party, whether prospective or retroactive, such royalty or license fee paid to a third party shall be an offset against royalty payable to Megabar in respect of such Subject Product.

3.5. In the event that (a) neither the Subject Composite Material in a Subject Product nor the method used by Aerojet for making it is either (i) the subject of a valid claim in any Subject Patent or (ii) made or practiced with the use of information which is then Subject Technical Information; and (b) the total lawful sales of substantially the same product by one or more third parties equals 30% or more of Aerojet's sales or likely sales of the Subject Product, Aerojet shall have no further obligation to pay royalties to Megabar in respect of such Subject Product.

4. ROYALTIES

4.1. As consideration for the grant of the licenses pursuant to Section 3.1, above, Aerojet will pay to Megabar at its principal corporate offices in the State of Utah a royalty equivalent to 1.5% of Aerojet's Net Sales Revenues derived from sales of Subject Products. Subject Products are considered sold upon receipt of payment from the customer, whether in a single sum or installments. Where the contracting regime does not permit determination of a delivered or unit price for Subject Products, the parties will consult to determine the imputed net

sales value of such Subject Products. In the event that the percentage royalties in any year shall not equal the amounts shown in the table below, Aerojet shall pay such Additional Amount as, when added to the percentage royalties called for hereby, equals the annual amounts shown in such table. The Additional Amounts payable in each year during the life of this Agreement shall be paid quarterly in four estimated installments commencing with the fourth calendar quarter of 1984, to be adjusted at year end.

Year	Amount
First	\$100,000
Second	175,000
Third	250,000
Fourth	325,000
Fifth and subsequent	400,000

4.2. Aerojet shall keep full and accurate records and shall render quarterly statements in substantially the form attached to this Agreement as Schedule 4.2 on or before the 15th days of February, May, August and November for the periods October-December, January-March, April-June and July-September, respectively, of Net Sales Revenues.

4.3. At the time of rendering the quarterly statements referred to in Section 4.2, Aerojet shall make the payments required by this Article 4 of royalties accrued during the preceding calendar quarter, including Additional Amounts called for by Section 4.1 in excess of percentage royalties, if any.

4.4. Minimum royalties payable in any year will be changed, in proportion to the change in an index to be agreed, from the date of this Agreement to the anniversary in question.

4.5. Aerojet will permit its records relating to sales of Subject Products to be examined from time to time at Megabar's expense by a firm of independent certified public accountants in order that Megabar may verify the accuracy of Aerojet's statements and of the payments required to be made by this Agreement.

5. TECHNICAL EXCHANGE AND TECHNICAL SERVICES

5.1. Aerojet and Megabar will exchange all technical information relating to Subject Composite Materials, however obtained, which they are free to disclose. For the purpose of insuring the fullest possible cooperation and exchange of information between the parties, there shall be constituted a technical exchange committee consisting of not more than three representatives of Megabar and three representatives of Aerojet

which shall be responsible for (a) the identification of areas of common technical interest, (b) allocation of responsibility for research and development activities relating to such areas of common technical interest and (c) the exchange of information resulting from such research and development activities. The committee shall meet from time to time as a majority of its members may determine, but not less often than bi-monthly unless both Megabar and Aerojet agree. Alternate such meetings shall be held at facilities of Megabar and of Aerojet, and the parties shall bear the expenses of their respective representatives. In addition, the committee will devise mutually agreeable means to insure timely and current exchange of technical information relating to Subject Composite Materials.

5.2. Megabar will provide to Aerojet an employee of Megabar skilled in Subject Technical Information for service under Aerojet's direction for reasonable periods during the life of this Agreement at such times and for such periods as not to interfere unduly with Megabar's business. Aerojet will pay to Megabar the cost of transportation of such employee (and his family, providing that such employee stays for a period exceeding three months) from and to his permanent place of employment by Megabar, his reasonable living expenses while in Aerojet's service and an amount equal to 200% of such employee's base salary or wages for the period in question.

5.3. Aerojet may, should it so elect, send its own employees to Megabar's facilities in the State of Utah where they will be trained by Megabar without charge, providing that Aerojet shall pay all transportation and living expenses of such employees.

6. IMPROVEMENTS

6.1. If Megabar or any person, firm or corporation on its behalf shall, at any time during the life of this Agreement, invent, discover or make any improvement or invention relating to Subject Composite Materials or the design of plant or equipment for the manufacture or use thereof, such improvement or invention, whether or not patented or patentable, shall be a subject of the licenses granted pursuant to Section 3.1, and Megabar will communicate such improvement or invention to Aerojet and will give to Aerojet full and sufficient information and instructions respecting the manner and process of making and using the same and will render the same available to Aerojet.

6.2. If Aerojet or any person, firm or corporation on its behalf shall, at any time during the life of this Agreement, invent, discover or make any improvement or invention relating to Subject Composite Materials or the design of plant or equipment for the manufacture or use thereof, Aerojet will communicate such

improvement or invention to Megabar and will give to Megabar full and sufficient information and instructions respecting the manner and process of making and using the same and will render the same available to Megabar. As to all such improvements and inventions Aerojet will grant to Megabar a royalty-free, non-exclusive license therefor with the right to grant sublicenses in such other countries as Megabar may require.

6.3. If Aerojet and Megabar, each acting directly or through any person, firm or corporation on its behalf, shall, at any time during the life of this Agreement, jointly invent, discover or make any improvement or invention relating to Subject composite Materials or the design of plant or equipment for the manufacture or use thereof, whether or not patented or patentable, they shall jointly own such invention or improvement and any patent granted thereon, subject to applicable restrictions on disclosure and licensing established in this Agreement for the benefit of either party. Any patent applications shall be filed and prosecuted jointly.

6.4. In respect of patentable improvements the parties will consult as to the advisability of filing patent applications.

6.5. If a patent application is filed on any improvement made by either party or jointly, then (a) expenses of filing and prosecution of any United States application through issuance or final rejection shall be shared equally, but neither party shall be required to share expenses of further prosecution in the United States; and (b) expenses of filing and prosecution of any foreign application shall be borne solely by Megabar.

7. JOINT LICENSING

7.1. With respect to the subject matter of the exclusive licenses granted to Aerojet by Megabar and Aerojet may agree jointly to license the Subject Technical Information and Subject Patents (including improvements) or portions thereof to third parties, in which case Megabar shall be entitled to the higher of (a) 1.5% of Net Sales of the licensee from its sales of Subject Products or (b) one-third of the total royalties paid by the licensee.

7.2. No such license to a third party shall be granted except upon terms and conditions acceptable to both Megabar and Aerojet.

7.3. Any such license may take the form of a direct license granted by Megabar or a sublicense granted by Aerojet or a joint license granted by Megabar and Aerojet; provided, however, that no such formal arrangements shall affect the division of royalties contemplated by Section 7.1, above.

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7.4. (a) Megabar will upon request of Aerojet directly grant or permit Aerojet to grant, at Aerojet's option, a non-exclusive license in form to be agreed to Aerojet's affiliate under the Subject Technical Information and the Subject Patents (or their Australian counterparts) to manufacture in Australia in plants owned, operated or licensed by such affiliate.

(b) Megabar agrees not to license the Subject Technical Information or Subject Patents (or their Canadian counterparts) to any Canadian licensee under terms which would permit such licensee to sell Subject Products in the Field to the United States government except for products wholly developed by such licensee.

8. WARRANTY OF TITLE; INFRINGEMENT; ETC.

8.1. Megabar warrants that it owns the Subject Technical Information and the Subject Patents free of any material obligation in favor of third parties and that it is free to grant the licenses granted by Section 3.1 of this Agreement; to the best of its knowledge, information and belief, the manufacture, use, or sale of Subject Products, or the practice of the Subject Technical Information or the Subject Patents, does not infringe any adversely held patent.

8.2. In the event of legal proceedings, being threatened or instituted against either Megabar or Aerojet which purport to question either party's rights to the Subject Patents or the Subject Technical Information, the parties shall promptly consult as to the appropriate response to be made by either or both of them to such proceedings.

8.3. In the event either party shall determine that there is reasonable cause to believe that the Subject Patents or any of them are being infringed by third parties or that Subject Technical Information has been misappropriated by third parties, the parties shall promptly consult as to appropriate steps to be taken to remedy such infringement or misappropriation.

9. OBLIGATIONS OF SECRECY

9.1. Certain Subject Technical Information is in the nature of proprietary information and trade secrets of Megabar. Aerojet will (a) protect and keep confidential all such Subject Technical Information, (b) take all reasonable precautions to avoid disclosure of such information by agents, employees, sub-licensees and independent contractors of Aerojet, and (c) will obtain or cause to be obtained from such agents, employees, sub-licensees and independent contractors their written agreement to such effect; provided, however, that the obligations of this

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section shall not apply to information which Aerojet can demonstrate was in its possession prior to disclosure by Megabar, which enters the public domain by the act of a person or persons other than Aerojet or with respect to which Aerojet acquires from a third party a valid right of disclosure.

9.2. The obligation of Aerojet to hold Subject Technical Information confidential and not to disclose the same to third parties shall survive any such termination and any such return.

9.3. In the event of disclosure of Subject Technical Information in violation of this Agreement, Megabar may apply to a court of competent jurisdiction for an order restraining any further such disclosure and for such other relief as it may deem appropriate. Aerojet shall at Megabar's request initiate and diligently prosecute, at its own expense, legal proceedings against persons with whom it is in privity to restrain such disclosure or to obtain other relief, unless such proceedings are likely to be futile. However, disclosure by an employee or other person which is neither procured nor counseled by Aerojet shall not give Megabar a right to seek injunctive or other relief under this Agreement if Aerojet shall have taken all reasonable and required steps, including the obtaining of written agreements under Section 9.1, to protect the interests of Megabar.

9.4. Aerojet may from time to time disclose to Megabar technical information in the nature of proprietary information and trade secrets of Aerojet. Megabar will (a) protect and keep confidential all such technical information, (b) take all reasonable precautions to avoid disclosure of such information by agents, employees, sub-licensees and independent contractors of Megabar and (c) will obtain or cause to be obtained from such agents, employees, sub-licensees and independent contractors their written agreement to such effect; provided, however, that the obligations of this section shall not apply to information which Megabar can demonstrate was in its possession prior to disclosure by Aerojet, which enters the public domain by the act of a person or persons other than Megabar or with respect to which Megabar acquires from a third party a valid right of disclosure.

9.5. The obligation of Megabar to hold technical information of Aerojet confidential and not to disclose the same to third parties shall survive any such termination and any such return.

9.6. In the event of any disclosure of technical information of Aerojet in violation of this Agreement, Aerojet may apply to a court of competent jurisdiction for an order restraining any further such disclosure and for such other relief as it may deem appropriate. Megabar shall at Aerojet's request

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initiate and diligently prosecute, at its own expense, legal proceedings against persons with whom it is in privity to restrain such disclosure or to obtain other relief, unless such proceedings are likely to be futile. However, disclosure by an employee or other person which is neither procured nor counseled by Megabar shall not give Aerojet a right to seek injunctive or other relief under this Agreement if Megabar shall have taken all reasonable and required steps, including the obtaining of written agreements under Section 9.4, to protect the interests of Aerojet.

9.7. The parties will consult with regard to disclosures required by government agencies prior to such disclosure or agreement to disclose.

10. TERM AND TERMINATION

10.1. Unless terminated as otherwise provided in this Article 10, this Agreement shall remain in effect for an initial term of fifteen years commencing on the effective date hereof and continuing thereafter until terminated by Aerojet upon one year's prior notice.

10.2. Megabar shall have the right to terminate this Agreement by 60 days prior notice in writing upon the occurrence of any of the following if Aerojet has not corrected such breach or default within such 60 days:

(a) Failure of Aerojet to make any report required by this Agreement or the making of any willfully false report;

(b) Failure of Aerojet to make any payment due hereunder within 30 days of the due date of such payment;

(c) Insolvency, bankruptcy, receivership or any other like event or proceeding, whether voluntary or involuntary, affecting Aerojet; or

(d) Any other substantial breach or default of licensee in performing its obligations under this Agreement.

10.3. Aerojet shall have the right to terminate this Agreement by 60 days prior notice in writing in the event of substantial breach or default of Megabar in performing its obligations under this Agreement.

10.4. Termination of this Agreement shall not affect the right of Megabar to receive royalties or other payments accrued as of the date of termination, nor shall it affect or prejudice Megabar's right to seek damages or other remedies for breach or default by Aerojet.

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10.5. Upon termination of this Agreement, Aerojet shall have no further license or right to use any of the Subject Technical Information or Subject Patents and any sublicenses which Aerojet has granted and which are still in force shall at Megabar's request be assigned directly to Megabar by Aerojet, and the sublicensee shall upon such assignment attorn to Megabar therefor.

11. MISCELLANEOUS

11.1. All notices provided for in this Agreement shall be given in writing, and shall be considered duly served and given, by mailing the same, postage prepaid, by registered or certified mail to the parties at the following addresses or such other addresses as may be designated in writing by the party whose address is changed:

Megabar Explosives Corporation
P.O. Box 2385
Ogden, Utah 84404

Aerojet-General Corporation
c/o Vice President-Contracts
Aerojet Strategic Propulsion Company
P.O. Box 15699C
Sacramento, California 95813

11.2. This Agreement shall be binding upon and inure to the benefit of each of the parties hereto and their successors in interest, but neither this Agreement nor the licenses contained herein may be assigned by either party hereto upon the prior written consent of the other party.

11.3. This Agreement shall be governed by and interpreted according to the laws of the State of Utah, and in relation to any dispute arising out of the construction, interpretation or implementation of this Agreement the parties agree to submit themselves to the jurisdiction of the courts of the State of Utah or the Federal District Court for the District of Utah, as the plaintiff may elect.

11.4. This writing constitutes and contains the entire agreement between the parties hereto with respect to the matters treated herein, and may be changed only by an instrument in writing executed by both parties.

11.5. This Agreement may be executed in one or more counterparts and each such counterpart shall be deemed to be an original.

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Executed this ____ day of _____, 1984.
AEROJET-GENERAL CORPORATION
By _____
R.W. Warden
Group Vice President
MEGABAR
PROPRIETARY
MEGABAR EXPLOSIVES CORPORATION
DISTRIBUTE TO AUTHORIZED
PERSONS ONLY
President

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21 August 1984

Dear Shareholder:

I am pleased to inform you that Megabar Explosives Corporation and Aerojet-General Corporation have entered into agreements for the acquisition by Aerojet of a significant shareholding in Megabar and for a comprehensive technical cooperation in the development of energetic materials.

By the terms of a Stock Purchase Agreement dated August 17, 1984, Aerojet has purchased 500,000 shares of the common stock of Megabar for the price of \$1.00 per share. This purchase reflects the confidence of Aerojet in Megabar as a continuing source of state of the art technology in energetic materials.

On the same date, Megabar licensed to Aerojet its patents and trade secret information relating to energetic materials. The license calls for the payment of running royalties equal to 1.5% of net sales of all Aerojet products containing energetic materials embodying Megabar technology. The minimum payments which Megabar will receive during the first five years of the License Agreement will aggregate \$1.25 Million and thereafter will be not less than \$400,000 per year. The Agreement is exclusive for military and aerospace markets in the United States and covers a broad range of products including military explosives, solid fuel rocket propellants and gun propellants. The License Agreement contemplates joint licensing of the technology to other manufacturers in North America for products of interest to the U.S. Military.

Reflecting the broadened interest of the company in propellants as well as explosives, the Board of Directors has voted to change the name of Megabar Explosives Corporation to Megabar Corporation, a change which will become effective immediately.

Construction of the company's new executive office and laboratory facility north of Ogden, Utah is nearing completion. The company expects to occupy the facility not later than September 15, 1984. Following that date the mailing address and telephone number of the company will be as follows:

2200 West 4100 North
P.O. Box 2385
Ogden, Utah 84404
(801) 782-2970

PLAINTIFF'S
EXHIBIT

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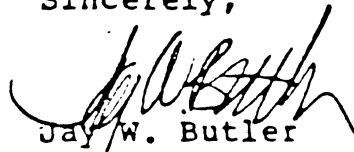
MEGABAR EXPLOSIVES CORPORATION

Suite 480 American Plaza 3147 West Second South Salt Lake City Utah 84107

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Shareholder letter
21 August 1984

On July 13, 1984, Ireco Corporation filed an action against the company in the District Court for Salt Lake County alleging misappropriation by Megabar of Ireco trade secrets. In the opinion of management the claims filed by Ireco are utterly without merit, and this litigation has been commenced by Ireco solely for purposes of interfering with the business of Megabar. We intend to vigorously resist and have filed an answer denying the Ireco claims and alleging attempted interference by Ireco with Megabar's business activities. It is the position of the company that the alleged trade secrets which Ireco claims have been public since at least 1981. The technology of Megabar consists of genuine advances over the prior art which are the subject of numerous patent applications now pending in the U.S. Patent Office. We are confident that this matter will be disposed of on terms favorable to Megabar.

Sincerely,



Jay W. Butler
President

JWB:scp