

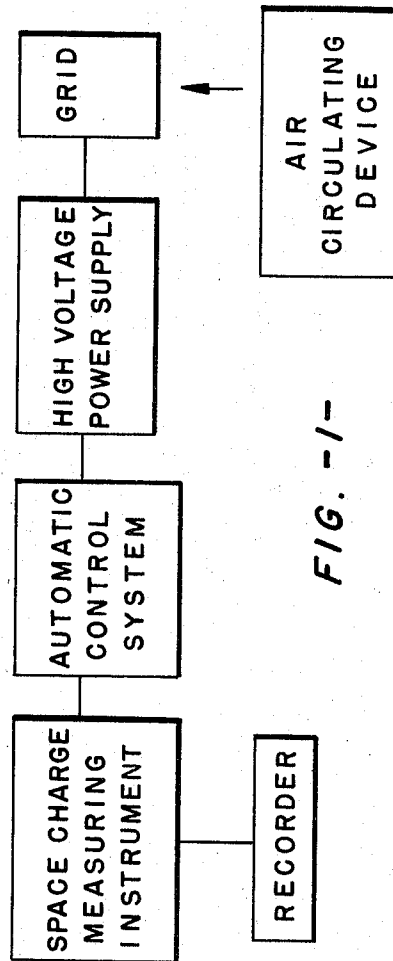
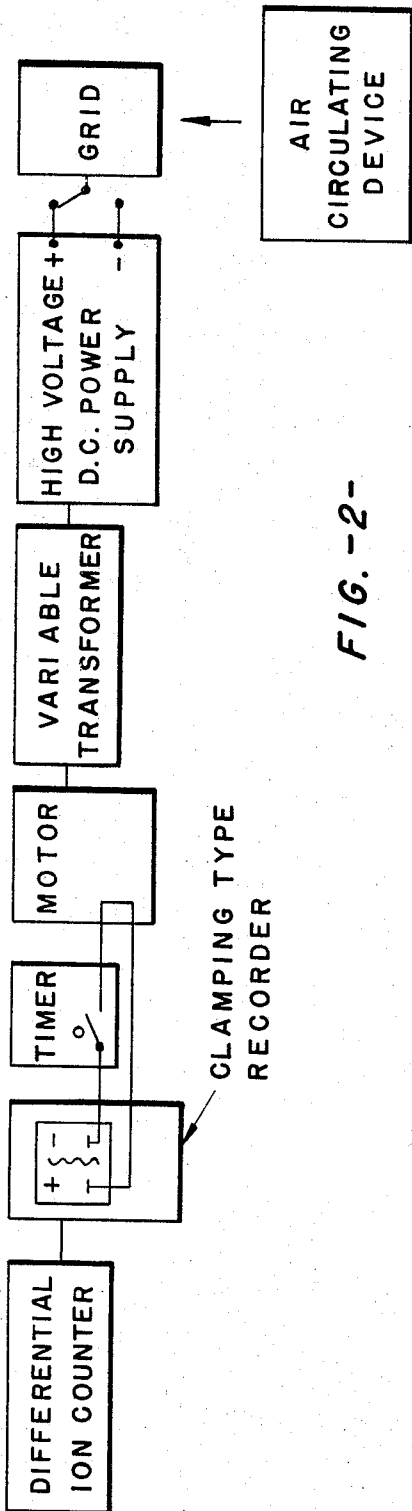
Dec. 13, 1966

J. W. MICHENER ETAL
PROCESS AND APPARATUS FOR PRODUCING A SUBSTANTIALLY
NEUTRAL ELECTRIC ATMOSPHERE

3,292,042

Filed June 10, 1963

3 Sheets-Sheet 1



INVENTORS
JOHN W. MICHENER
JIMMY L. QUINN
BY *Robert J. Blanke*
ATTORNEY

Dec. 13, 1966

J. W. MICHENER ETAL
PROCESS AND APPARATUS FOR PRODUCING A SUBSTANTIALLY
NEUTRAL ELECTRIC ATMOSPHERE

3,292,042

Filed June 10, 1963

3 Sheets-Sheet 2

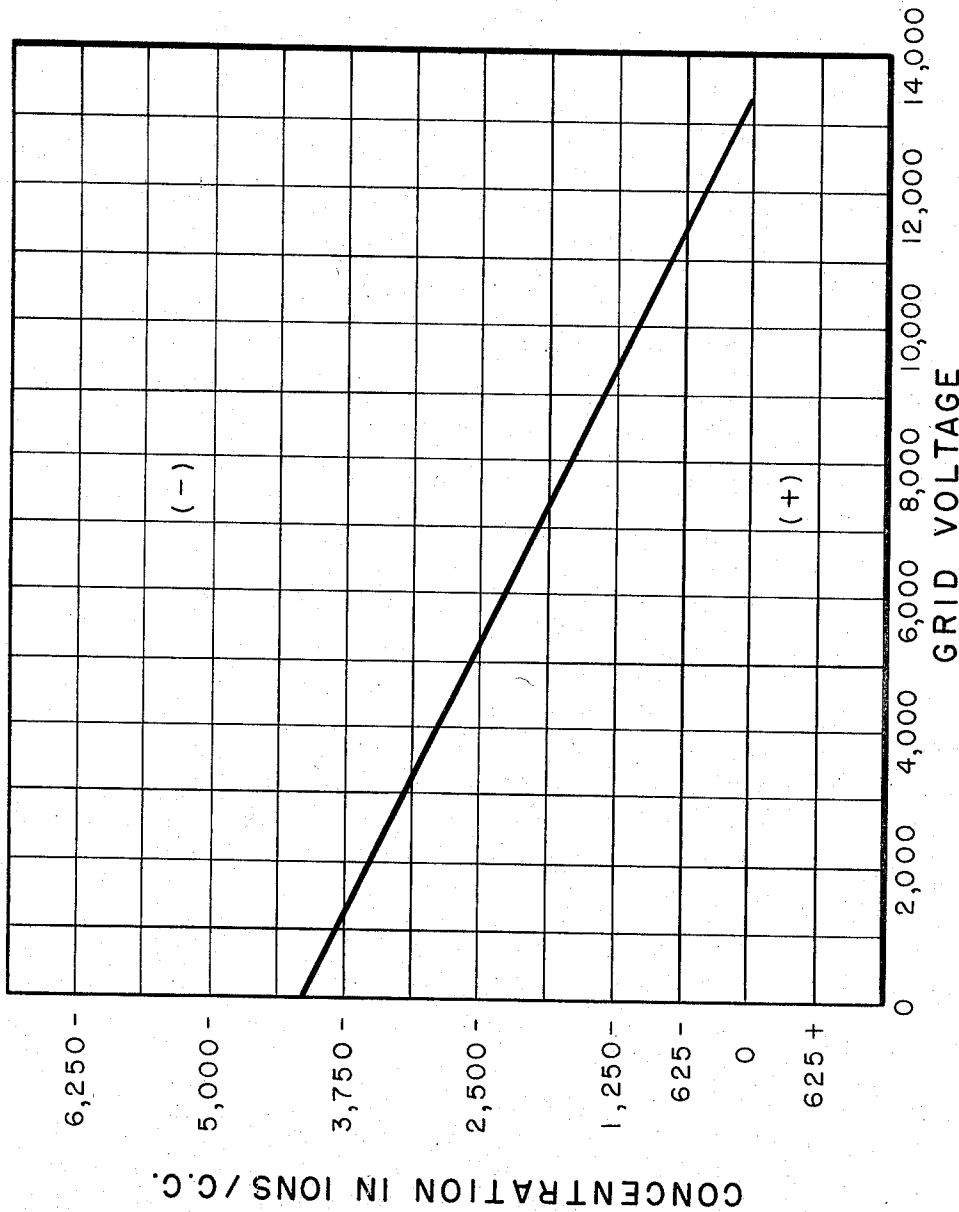


FIG. -3-

INVENTORS
JOHN W. MICHENER
JIMMY L. QUINN
BY
Robert J. Blake
ATTORNEY

Dec. 13, 1966

J. W. MICHENER ETAL
PROCESS AND APPARATUS FOR PRODUCING A SUBSTANTIALLY
NEUTRAL ELECTRIC ATMOSPHERE

3,292,042

Filed June 10, 1963

3 Sheets-Sheet 3

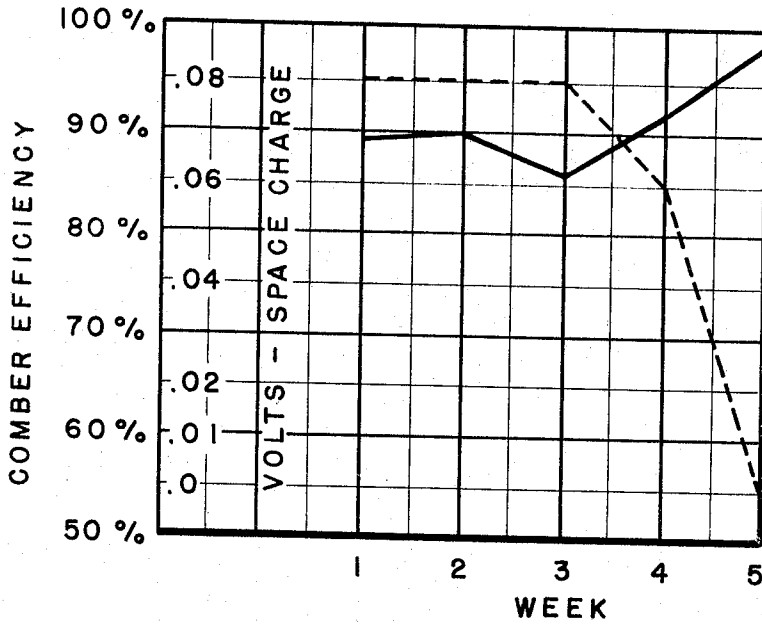


FIG. -5-

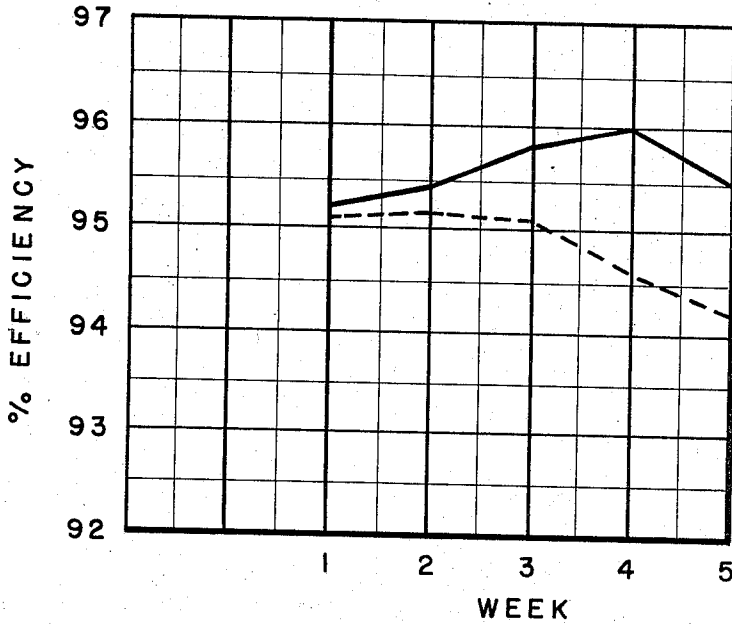


FIG. -4-

INVENTORS
JOHN W. MICHENER
BY JIMMY L. QUINN

Jimmy L. Quinn
ATTORNEY

1

2

3,292,042

PROCESS AND APPARATUS FOR PRODUCING A SUBSTANTIALLY NEUTRAL ELECTRIC ATMOSPHERE

John W. Michener and Jimmy L. Quinn, Spartanburg, S.C., assignors to Deering Milliken Research Corporation, Spartanburg, S.C., a corporation of Delaware
 Filed June 10, 1963, Ser. No. 286,633
 12 Claims. (Cl. 317-2)

This invention relates to method and apparatus for improving the performing of operations on materials which are influenced by electrically charged bodies. More specifically this invention relates to a method and apparatus for producing a substantially neutral electric atmosphere or an atmosphere of reduced electric charge whereby materials which are influenced by electrically charged bodies may be processed with a minimum of interference.

In the handling of materials which are subject to influence by electrically charged bodies such as textile fibers, fine powders, thin films or, in general, objects which have relatively small mass, various efforts have been made to overcome the effects of electrically charged bodies, these efforts being concentrated for the most part in increasing the humidity of the atmosphere and in ionic emissive static eliminators. Increasing the humidity of the atmosphere has the effect of increasing the amount of moisture on the low mass objects, that is to say fibers, particles or films being treated. The high moisture content will increase the electrical conductivity of the low mass objects and thereby serve to eliminate some of the electrostatic effects. High moisture may, however, produce a tackiness in the objects being processed and will thereby interfere with processing. The increase in the moisture in the atmosphere also has the effect of decreasing atmospheric conductivity by reducing ionic mobility and may also produce an increase in the net space charge. An increase in the net space charge will, of course, produce more charging in low mass objects exposed to such an atmosphere. The ion emissive static eliminators are of two general types which are the radioactive source type and the high voltage discharge type. Both of these types of ion emitting static eliminators function by being placed in close proximity with an object having a static charge. The static eliminator neutralizes this static charge by emitting large numbers of ions so that ions of proper polarity are attracted to the charged object and thereby neutralize it. Static eliminators, however, while effective in eliminating static effects which are due to surface friction are not satisfactory in the elimination of space charges which give rise to static troubles in low mass objects which are being processed.

It is therefore an object of this invention to provide a method and apparatus for overcoming space charges in the vicinity of low mass articles which are being processed.

It is another object of this invention to provide a method for improving the handling of fibrous materials subject to the influence of electrically charged bodies.

It is still another object of this invention to provide an apparatus for the annihilation or reduction of space charges in the atmospheres surrounding low mass articles which are being processed.

In accordance with this invention, it has now been discovered that atmospheric ionization in production areas may be controlled by placing a charged grid in the main air stream of an air circulating system whereby charged particles contained in the air stream are annihilated upon approaching and being deflected to the grid carrying an opposite charge. It should be understood that the grid is any device which is capable of carrying a high voltage charge and that the circulating air system is any system which has the ability to provide a significant air exchange in the atmosphere surrounding a production area. The

charge placed on the grid may be an alternating current charge or a direct current charge. Whether alternating current or direct current is employed, the charge should be great enough to annihilate atmospheric ions, but not so great as to generate ions, that is to say not so great as to become an ion discharge device. The alternating current charged grid will always remove those charged ions which are present in a preponderance as the grid will function as a positive grid for one time interval and/or a negative grid for another time interval. The preferred current for purposes of this invention is direct current of a polarity which is determined by an ion measuring device. A typical installation consists of a charged grid placed in the air conditioning duct of a production area, the grid comprising a row of parallel copper wires with about a one-inch spacing between wires. The wires are mounted on an insulated support and are usually operated with direct current of preselected polarity and preselected voltage in the range of from about 2,000 volts to about 30,000 volts, the voltage being set so that the return air contains a very low space charge. The charged grid will attract and annihilate ions with a charge opposite to that of the wire grid. It is generally not necessary or even desirable to annihilate all of the negative ions, should these be the type of ions being removed, since a small excess of positive ions is usually produced in the production areas which are then neutralized by the negative ions coming into the room. In this way, the space charge in the room is made quite low. Due to normal variations in the rate of ion production and in the air circulation, the voltage required on the grid in order to maintain a minimum space charge may vary considerably. Where the air circulation system is something other than an air conditioning unit such as for instance a window fan circulation system, the space charge of the air being circulated may be positive rather than negatively charged as is usually the case in a water washed air conditioning unit. For these reasons a control system is desirable, the control system being employed to govern the voltage as well as the polarity employed on the grid. A better understanding of the invention may be had from the drawings which are as follows:

FIGURE 1 is a circuit diagram of one form of ion annihilation system of this invention.

FIGURE 2 is a circuit diagram of another form of ion annihilation system of this invention.

FIGURE 3 is a chart plotting ion concentration against grid voltage.

FIGURE 4 is a chart illustrating weaving efficiency.

FIGURE 5 is a chart illustrating comber efficiency.

In FIGURE 1, a grid which is in the air flow of an air circulating device is placed in circuit with a high voltage power supply which may be either a direct current power supply or an alternating current power supply. The voltage is regulated by an automatic control system which functions in response to a space charge measuring instrument. If so desired, a recorder may be placed in circuit with the space charge measuring instrument.

A somewhat more complex ion annihilation system is set forth in FIGURE 2, wherein a grid which is in the air flow of an air circulating device is placed in circuit with a high voltage direct current power supply. The high voltage power supply is regulated by a signal from a space charge measuring instrument. The space charge measuring instrument is a differential ion counter which functions by drawing a metered volume of ionized air through a collector tube by a suction blower. The ions are then trapped by a collecting electrode wherein the charges are transferred to a highly sensitive electrometer. The measured space charge from the differential ion counter is then recorded by a clamping type recorder. When the recorder which is periodically actuated by a timing

3

mechanism reaches an instantaneous preselected ion count value, it places a motor in circuit which turns a variable transformer which is in circuit with the high voltage power supply, thereby increasing or decreasing the voltage supplied to the grid. When the recorder reaches a preselected minimum ion value it will also reverse the polarity of the high voltage power supply, thus permitting the annihilation of ions of another charge.

FIGURE 3 of the drawings is a chart plotting negative ion concentrations against direct current grid voltage of positive polarity. The grid is a straight wire grid spaced $\frac{1}{2}$ inch and employing a wire diameter of .1055 inch. While the chart plots negative ion concentration, it should be understood that the same relationship exists between positive ion concentration and direct current voltage of negative polarity. It is noticeable from the diagram that while even low grid voltages will provide a significant reduction in ion concentration that the efficiency of the system increases as the voltage is raised to maximum values. It is difficult, however, to define optimum voltages for operation of the apparatus and process of this invention as optimum conditions will vary with the type of grid being employed, the air velocity, and the mass or physical dimensions of the ionic material present in the atmosphere. Examples of optimum voltages for certain specific conditions are as follows:

Straight wire grid spaced $\frac{1}{2}$ "
Wire diameter, .1055 in.
Air velocity over grid, 690 ft./min.
Voltage, 14 kv.

Screen wire grid spaced $\frac{1}{2}$ "
Wire diameter, $\frac{3}{64}$ "
Air velocity over grid, 2,000 ft./min.
Voltage, 18,000 volts

It is important to understand the distinction existing between a space charge due to atmospheric ionization and a static charge existing on an object. The atmosphere normally contains at least a small number of ionized particles. These particles may be ionized atoms or they may be bits of dust or droplets of water which are charged or ionized. Any of these charges are produced naturally by interaction with cosmic rays, the breakup of water droplets into fine particles some with a positive charge and some with a negative charge, electrical discharge by friction against a surface and by air turbulence. These naturally produced ionized particles along with certain artificially produced ionized particles in the atmosphere constitute atmospheric ionization. External atmospheric air normally has a few ionized particles that is to say a number in the range of from 0 to about 1000 ions per cubic centimeter of air. When this average number of ions is greatly increased there is usually a great excess of either positive or negative ions since, if there is a large number of both, the positive and negative ions will be attracted to each other resulting in uncharged particles. The net excess of positive or negative ions is sometimes referred to as net space charge.

Atmospheric ionization has a detrimental influence on the processing of low mass objects such as textile fibers, films, fine powders and the like, by bombarding these low mass articles with ions and thereby causing the articles to become charged. As certain of these articles become charged they will repel one another since most will have the same charge polarity while at the same time some of these charged articles will become attracted to uncharged surfaces. In textile processing of fibers, those fibers which have become charged with like charges will exhibit repulsive forces between themselves and at the same time exhibit an attraction toward uncharged surfaces. Such repulsive and attractive forces will cause a fibrous strand to become wild, that is to say, to become uncontrollable and of nonuniform density and thereby increase the probability of a process interruption.

4

The process and apparatus set forth herein will effectively control atmospheric ionization and correspondingly greatly facilitate the processing of low mass articles.

While improvements may be obtained in the processing of a wide variety of low mass articles, the process and apparatus of this invention are especially suitable for improving the processing of textile fibers. An illustration of the improvement obtained in the processing of textile fibers is given in the following table.

Week	Percent ends down ¹ / _{total spindles}	Space charge	Excess concentration of negative ions per cc.
1-----	1.51	-.53	6,625
2-----	.89	-.35	4,370
3-----	.70	-.18	2,250
4-----	.52	-.11	1,375
5-----	.33	-.12	1,500

¹ Yarn Breakage.

The data of the table was obtained from the spinning of a 65% polyester, 35% cotton blend yarn in a spinning room employing a water washed air conditioning system. The voltage on the grid was raised with each succeeding week, thereby reducing the space charge and correspondingly the concentration of ions per cubic centimeter, and resulting in a reduction of percent ends down/total spindles. The space charge is an arbitrary meter reading which may be correlated to concentration of ions per cc. A 1.0 reading in space charge is equal to 12,500 ions per cc.

An illustration of the improvement obtained in the weaving of textiles is given in the chart set forth in FIGURE 4. The chart plots percent weaving efficiency which is

$$\frac{\text{number of actual picks}}{\text{number of possible picks}} \times 100$$

against periodic time interval of efficiency measurement for a weaving zone having the ion annihilation system of this invention illustrated with a solid line and for a weaving zone without an ion annihilation system illustrated by a broken line. Both weaving zones were weaving substantially the same type of cotton cloth with substantially the same type of weaving equipment. It can readily be seen that a marked improvement in weaving efficiency is obtained when the ion annihilation system of this invention is employed in a weaving zone.

An illustration of the improvement obtained in the combing of textiles is given in the chart set forth in FIGURE 5. The chart plots comber efficiency and space charge (1 unit space charge being equal to 12,500 ions/cc.) against periodic time intervals of measurement. The space charge is illustrated by means of a broken line, while comber efficiency is illustrated by means of a solid line. It may be readily seen that comber efficiency increases as space charge decreases.

What is claimed is:

1. The method of improving the processing of low mass articles which are subject to attraction and displacement by electrically charged bodies comprising circulating ion containing atmosphere in the vicinity of said low mass articles in a manner so as to contact an oppositely charged member which carries a charge sufficient to annihilate atmospheric ions but insufficient to generate ions thereby annihilating those ions which were previously contained within said atmosphere whereby bodies will not acquire an electrical charge such as to subject low mass articles to attraction and displacement by said electrically charged bodies.

2. The method of claim 1 wherein said member is charged with a direct current charge.

3. The method of claim 1 wherein said low mass articles are textile fibers.

5

4. The method of improving the processing of low mass articles in an area having an air supply system for recirculation of air throughout the area, said method comprising generating in the air for recirculation an electric field sufficient to attract ions of a given polarity said electric field being produced by a voltage of sufficient intensity to annihilate atmospheric ions but insufficient to generate ions and passing air through said electric field thereby permitting ions of said given polarity to be attracted to and be annihilated in the presence of said electric field and thereafter passing the thus treated air through said area.

5. The method of claim 4 wherein said electric field is a field generated by direct current.

6. The method of claim 4 wherein said low mass articles are textile fibers.

7. The method of aiding in the processing of textile fiber materials in a textile processing room comprising generating an electric field in the ion containing air for said room of sufficient strength to attract and annihilate ions in substantial numbers but insufficient to generate ions and circulating said air through said electric field.

8. The method of claim 7 wherein said electric field is an electric field generated by direct current.

9. An apparatus for the annihilation of atmospheric ions comprising a grid member, a high voltage source in circuit with said grid member, the polarity and voltage of said high voltage source being controlled by a polarity and voltage regulator which functions in response to a differential ion counter by causing a polarity opposite that indicated by said differential ion counter to be applied to said grid member at a voltage insufficient to generate ionic material and an air circulating system suitable for continuously passing air over said grid members.

6

10. The apparatus of claim 9 wherein said air circulating system is an air conditioning unit.

11. An apparatus for the annihilation of atmospheric ions comprising a grid member, an air circulating system suitable for continuously passing air over said grid member, a high voltage source in circuit with said grid member, the polarity and voltage of said high voltage source being controlled by a polarity and voltage regulator which functions in response to a differential ion counter by causing a polarity opposite that indicated by said differential ion counter to be applied to said grid member at a voltage insufficient to generate ionic material, said differential ion counter being in circuit with a clamping type recording unit.

12. The apparatus of claim 11 wherein said air circulating system is an air conditioning unit.

References Cited by the Examiner

UNITED STATES PATENTS

844,300	2/1907	Chapman	317—2	X
1,992,974	3/1935	Thompson	315—111	X
2,462,890	3/1949	Newman	250—45	X
3,035,208	5/1962	Clark	317—2	X

OTHER REFERENCES

376,930, Peycelon et al.: (Alien Property Custodian) (published May 1943 application filed January 1941).

McKay, H. B.: Air Ionizers, Radio-Electronics, July 1960 (pp. 32-33).

MILTON O. HIRSHFIELD, *Primary Examiner.*

SAMUEL BERNSTEIN, *Examiner.*

J. A. SILVERMAN, *Assistant Examiner.*

35