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PESTICIDAL COMPOSITIONS COMPRISING N-SUBSTITUTED GAMMA HYDROXYCARBOXYLIC ACID AMIDES

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No Drawing. Continuation-in-part of application Ser. No. 143,040, Oct. 5, 1961. This application June 17, 1965, Ser. No. 464,847

Int. Cl. A01n *9/20;* C07c *103/44*

U.S. Cl. 424—320

14 Claims

This application is a continuation-in-part of application Ser. No. 143,040 filed Oct. 5, 1961, now abandoned.

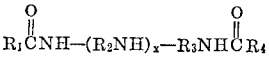
This invention relates to novel compounds and to compositions of said compounds which are useful as nematocides and insecticides. More specifically, this invention relates to compounds of N-substituted gamma hydroxycarboxylic acid amides and to the use of these compounds for pesticidal purposes.

It is an important object of this invention to provide novel compounds of N-substituted gamma hydroxycarboxylic acid amides which are useful as nematocides and insecticides.

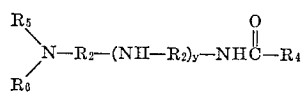
Another object of this invention is the provision of an improved composition comprising N-substituted gamma hydroxycarboxylic acid amides which is especially effective in killing the red spider mite (Tetranychus bimaculatus) and the Mexican bean bettle.

Other objects and advantages of this invention will appear from the following detailed description.

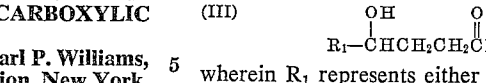
The compounds of the instant invention have the general formulae:

(I) 

wherein R_1 and R_4 represent hydroxyalkyl groups containing 3 or 4 atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, R_2 represents an alkylene group such as CH_2, C_2H_4 or C_3H_6, R_3 represents an alkylene group containing 2 to 6 carbon atoms, and x is an integer from 0 to 3.

(II) 

wherein R_4 represets a hydroxy alkyl group containing from 3 to 4 carbon atoms, i.e., hydroxy propyl, hydroxy butyl, etc., in which the hydroxyl group is situated in the gamma position to the carbonyl group, R_2 represents an alkyl group from 2 to 4 carbon atoms, e.g., ethyl, propyl, methyl propyl and butyl, R_5 represents an alkyl group of from 1 to 20 carbon atoms, e.g., methyl, ethyl, propyl, butyl, amyl, hexyl, nonyl, decyl, dodecyl tridecyl, tetradecyl, pentadecyl, heptadecyl, hexadecyl octadecyl, nondecyl, etc., and the corresponding hydroxy alkyls, i.e., hydroxymethyl, hydroxybutyl, hydroxytridecyl, hydroxyoctadecyl, etc.; aryl, e.g., phenyl, naphthyl, diphenyl, etc., containing not more than 20 carbon atoms; aralkyl, e.g., benzyl, methylbenzyl, ethylbenzyl, propylbenzyl, phenethyl, cuminyl, mesityl, menaphthyl, etc. of not more than 20 carbon atoms; alicyclic of not more than 20 carbon atoms, e.g., cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cyclooctyl, abieyl, cyclohexylmethyl, dicyclohexyl, propylcyclohexyl, cylononyl, bicyclohexyl, 1,2-dicyclohexylethyl, 3,3'-dimethylbicyclohexyl, etc.; neterocyclic containing not more than 20 carbon atoms, e.g., pyrrollidyl, piperidyl, morpholinyl, imidazolidyl, etc.; R_6 represents either hydrogen, alkyl and hydroxyalkyl containing from 1 to 20 carbon atoms and of the same value as in R_5; and y represents an integer of from 0 to 4.

(III) 

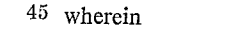
wherein R_1 represents either hydrogen or a methyl group and R_2 is an alkyl group of at least 8 to 23 carbon atoms, e.g., octyl, decyl, lauryl, myristyl, palmityl, stearyl, arachidyl, olekyl, linoeyl, elcostearyl linolenyl tetracosanyl.

The compounds indicated by Formulae I, II and III may be prepared by reacting a suitable amine, i.e., a primary amine, or mixture of amines, of the structure whose residue is desired in the final amide, with gamma-butyrolactone or gamma valerolactone. One molar proportion of the gamma-butyrolacetone is employed for each free amino group on the primary amine, e.g., two molar proportions of gamma-butyrolactone or gamma-valerolactone can be employed for each mole of amine having two primary amino groups, while in the case of amines having a single primary amine group, one mole of the lactone should be employed for each mole of the primary amine.

In preparing the compounds of the present invention the organic primary amine is heated to approximately 80–100° C. for a period up to about one hour. Thereafter, the gamma-butyrolactone or gamma-valerolactone is added slowly over a period of time ranging from 15 minutes to 3 hours while maintaining the same temperature range. At the end of this time, titration of the residual amine in the reaction mixture will indicate the extent of completion. Normally, within this time, the reaction is substantially complete. It is to be noted that the rate and time of addition of the lactone is not material or critical and will vary with the amount of the amine or mixture of amines employed. It is desirable that the temperature ranges be strictly maintained, otherwise, at higher temperatures, the reaction will be beset with side reactions resulting in the formation of an impure product. Holding the reaction at 80–100° C., after complete addition of the lactone, for over three hours will have no detrimental effect on the reaction itself or the resulting final product.

The organic amines employed in preparing the compounds of Formula I are characterized by the following general formula:

wherein



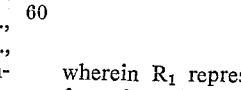
R_2 represents an alkylene group such as CH_2, C_2H_4 or C_3H_6;

R_3 represents an alkylene group containing 2 to 6 carbon atoms; and

x is an integer from 0 to 3.

Specific examples of suitable amines for preparing the compounds of Formula I are ethylene diamine, diethylene triamine, triethylene tetramine, tetraethylene pentamine, dipropylene triamine, 3,3'-iminobispropyl amine, etc.

The organic amines employed in preparing the compounds of Formula II are characterized by the following general formula:



wherein R_1 represents a hydroxyalkyl group containing from 3 to 4 carbon atoms, such as hydroxy propyl, hydroxy butyl, etc., R_2 and R_3 represent an alkyl group from 2 to 4 carbon atoms, such as ethyl, propyl, methyl propyl and butyl; and y represents an integer of from 0 to 4.

Specific examples of suitable amines for preparing the compounds of Formula II are aminoethylethanolamine, N,N-diethyl propylene diamine, N-aminopropylmorpholine, N-isopropyl-1-3-propane diamine, N-n-dodecyl diethylene triamine, N-n-hexadecyl triethylene tetramine,

N-n-octadecyl tetraethylene pentamine, N-abietyl-triethylene tetramine, N-aminoethylpyrrollidine, N-aminoethylpiperidine, N-ethyl, N-decyl propylene diamine, N-cyclopropyl-1-3-propane diamine, N-phenyl-1-3-propane diamine, N-benzyl diethylene triamine, N-dodecylbenzyl tetraethylene pentamine, and the like.

The organic amines employed in preparing the compounds of Formula III are characterized by the following general formula:

$$RNHCH_2CH_2CH_2NH_2$$

wherein R represents at least one alkyl group containing from 8 to 23 carbon atoms, e.g., octyl, decyl, lauryl, myristyl, palmityl, stearyl, arachidyl, behenyl, oleyl, linoleyl, eleostearyl, linolenyl, tetracosanyl, etc. and mixtures thereof derived from fatty acids, e.g., coconut fatty acid, tallow fatty acid, soya fatty acid, etc., all of which are commercially available (for example, under the brand name of "Duomeens").

As illustrative examples of the alkyl diamines characterized by the foregoing general formula and wherein R is a straight alkyl chain or a mixture of alkyl groups of from 8 to 23 carbon atoms, the following may be mentioned:

N-octylpropylene diamine
N-decylpropylene diamine
N-dodecylpropylene diamine
N-undecylenylpropylene diamine
N-tetradecylpropylene diamine
N-octadecylpropylene diamine
N-octadecadienylpropylene diamine
N-oleylpropylene diamine
N-elaidylpropylene diamine
N-tetracosanylpropylene diamine.

The following are illustrative examples of mixed alkyl diamines wherein R consists of a mixture of alkyl groups of from 8 to 23 carbon atoms:

Duomeen S wherein R is an amine residue derived from soybean acids containing the following components:

	Percent
Oleyl	35
Stearyl	10
Linoleyl	45
Palmityl	10

Duomeen C wherein R is an amine residue derived from coconut fatty acids:

	Percent
Octylamine	8
Decylamine	9
Dodecylamine	47
Myristyl	18
Palmityl	8
Stearyl	5
Linoleyl	5
Duomeen T:	
Tetradecylamine	2
Hexadecylamine	24
Octadecylamine	28
Octadecenylamine	46
Duomeen 12:	
Decylamine	2
Dodecylamine	95
Tetradecylamine	3

The straight chain alkyl diamines wherein R is an alkyl of from 8 to 23 carbon atoms are readily obtained by the reaction of a primary amine with acrylonitrile to give the corresponding cyanoethyl alkylamine. Hydrogenation of these products results in fatty diamines containing both primary and secondary amino groups. (See "Preparation of Various Complex Aliphatic Amines" (G. B. Bachman and R. L. Mayhew), The Journal of Organic Chemistry, vol. 10, No. 3, 1945.)

In accordance with this invention there is provided a method of eliminating nematodes from a material containing the same by treating said material with a composition of matter comprising N-substituted gamma hydroxycarboxylic acid amides. These compounds are employed in the form of dispersions in a liquid or a solid carrier. Thus the compounds can be employed in solution in a suitable solvent which does not have a deleterious effect on said compounds. Suitable solvents include water, selected isoparaffinic hydrocarbon fractions known commercially as Soltrols, straight chain hydrocarbons, naphthas, deodorized kerosene, and the like. The solvent being so selected that they will readily permeate the soil and carry toxic concentrations of our nematocides therethrough. Solutions prepared according to the manner of the present invention will contain nematocides of this invention on a weight basis of from .001 to 20 percent, preferably 1–15 percent.

Aqueous emulsions can be employed where it is desirable to drench soil such as in greenhouses benches and the like. The compound can also be employed in admixture with a solid carrier so that the compositions can be applied by the well-known dusting methods. Suitable solid carriers are pumice, talc and clay.

A very satisfactory method of use according to the present invention is to inject the nematocidal composition into a soil. This can be accomplished by directing the composition into holes or other openings in the soil in the amounts specified.

By way of further illustrating the invention, reference is made to the following examples:

Example 1

N-(coconut alkylaminopropyl) gamma hydroxybutyramide was prepared as follows:

263.6 grams (0.82 mole) Armour's Duomeen C was charged to a one liter flask and heated at 95° C. at 25 mm. for ½ hour. 71.4 grams (0.83 mole) gamma butyrolactone was then added with stirring at 96 to 100° C. at atmospheric pressure over a period of 15 minutes, then held at 96–100° C. for an additional 3 hours. On cooling the brown waxy solid was found to contain .00215 mole/gram amine.

Duplicate 100 gram samples of dry sand were mixed with a 5 gram sample of a brei of tomato roots infested with root-knot nematodes, meliodogyne incognito. The brei was prepared by cutting tomato roots of infested plants into quarter inch lengths, and then macerating the same in a Waring Blendor for one minute. The sand and the brei were mechanically mixed by shaking for one minute in a closed Mason jar. The mixture was transferred to 2¼ inch clay pots at which time 50 milligrams of the previously prepared N-(coconut alkylaminopropyl) gamma hydroxybutyramide was added to the mixture. Each loaded pot was wrapped in Saran and allowed to stand for 24 hours.

The mixture was then transferred to stainless steel cylindrical screens approximately 2½ inches high and 3½ inches in diameter. The screen material was 100-mesh stainless steel wire cloth. These screens were placed in the bottom half of a 9 centimeter petri-dish containing 25 millimeters water and covered with the petri-dish cover. Shortly thereafter an additional 10 millimeters of distilled water was added to each sample in order that free water will be available in the dish. After 24 hours microscopic counts were made of the living nematodes which migrated through the screen and into the petri-dish.

In the case of nonfumigant chemicals, nematodes may not make adequate contact with the chemical until after the water is added, therefore, such samples were read 48 hours after transferring to the screen. An effective water soluble nonfumigant chemical may let nematodes pass the screen but would immobilize the nematodes in the petri-dish.

Nematode counts were made by microscope. At least 10 fields were read or 150 nematodes counted per dish.

Result of test—No living nemas in 10 fields.

Example 2

Same procedure as set forth in Example 1 using 50 milligrams of iminobis (ethyl gamma hydroxybutyramide), e.g., $(HO(CH_2)_3CONHCH_2CH_2)_2NH$, which was prepared as follows:

412.8 grams (4.0 moles) diethylene triamine was charged to a 3 liter flask and heated to 85° C. 688.8 grams (8.0 moles) gamma butyrolactone was added at 85 to 95° C. over a period of 2½ hours, then held an additional 3 hours at 90 to 95° C. The final dark brown waxy solid was found to contain .00338 mole/gram amine.

Result of test—No living nemas in 10 fields.

Example 3

Same procedure as set forth in Example 1 using 50 milligrams of ethylenebis (gamma hydroxybutyramide), e.g., $(HO(CH_2)_3CONHCH_2)_2$, which was prepared as follows:

60.1 grams (1.0 mole) ethylene diamine and 100 mls. absolute ethanol were heated at 88° C. and 172.2 grams (2.0 moles) gamma butyrolactone added at 88 to 90° C. over a period of 1½ hours. Then held an additional 1¾ hours at 88° C.

The ethanol solvent was removed by heating in trays in a steam heated oven overnight.

230.5 grams of white solid product was recovered. The white solid product had a melting point of 137–140° C.

Result of test—No living nemas in 10 fields.

Example 4

N - (tallow-alkylaminopropyl)-gamma hydroxybutyramide was prepared as follows:

280 grams (0.7 mole) Armour's Duomeen T was charged to a one liter flask and heated at 95° C. at 25 mm. for ½ hour. 60.3 grams (0.7 mole) gamma butyrolactone was then added with stirring over a period of 15 minutes at 96 to 100° C. at atmospheric pressure. The heating was then continued for an additional 3 hours at 96 to 100° C. On cooling the brown waxy solid was found to contain .00225 mole/gram amine.

Red spider mites (*Tetranychus bimaculatus*).—Formulation: Concentrates of the chemicals were made to contain the following ingredients:

N - tallow-alkylaminopropyl)-gamma hydroxybutyramide	g	0.200
Acetone	mm	10
Triton X–155	mm	.020

Water to 100 millimeters.

Dilutions were prepared by diluting this concentrate with water to give the desired concentration of the candidate insecticide to be used in all screening methods.

An infested bean leaf, from a stock culture of mites, was placed on a bean leaf, 6–8 inches in height, growing in a 2½ inch clay pot. A sufficient number of mites for testing purposes (150–200) will transfer from the excised leaf to the plant in a period of 24 hours. The bean plants, two per test concentration, were placed on a revolving turntable and sprayed with a DeVilbia spray gun at 40 pounds pressure for 20 seconds.

Eighty millimeters of the test solution were applied. This amount was sufficient to wet the beans to run off. Eighty millimeters of a water solution containing acetone and Triton X–155, in the same concentration as used in the insecticidal solutions, but without the candidate insecticide solution, was also sprayed on the bean plants as a check control. Plants were held at room temperature for a period of 48 hours at which time microscopic examination of mortality is made.

Compounds were rated as follows:

	Kill, percent
Good	80–100
Fair	50–79
Not satisfactory	0–49

RESULTS OF TEST

Compound	Rating
N - (tallow - aminopropyl)-gamma hydroxybutyramide	Good (94% kill).
Check	Not satisfactory (18% dead).

Example 5

Mexican bean beetle leaf dip.—Formulation: The test materials are formulated as previously described in Example 4, the candidate insecticide being methylaminobis (propyl gamma hydroxybutyramide), e.g.,

$$CH_3N(CH_2CH_2CH_2NHCO(CH_2)_3OH)_2$$

which was prepared as follows:

117 grams (0.82 mole) methyliminobis propylamine and 128 ml. (1.64 moles) gamma butyrolactone were mixed together in a single neck flask. The exothermic reaction reached a temperature of 124° C. without external heating and then subsided to 35° C. within 2 hours.

Fourth instar larvae of the Mexican bean beetle (*Epilachna varivestis*) less than one day old within the instar and reared on tender green beans under greenhouse conditions, constitute the test insect for this method. The test larvae were removed from the colony and held without food, in a glass dish, for 4 hours prior to being placed on the treated foliage.

Paired seed leaves, excised from tender green bean plants, were dipped in the test formulation until they were thoroughly wetted. Excess liquid was removed by gentle shaking. While the leaves were drying in a ventilated hood, wilting was prevented by placing the stem in water. When dry, the paired leaves were separated and each was placed in a 9 centimeter petri-dish lined with filter paper. Ten random selected larvae were introduced before closing the dish.

The closed dishes were labeled and held at 75 to 85° F. for 3 days. Although the larvae can easily consume the whole leaf in 24 hours, no more food was added. Check larvae remained vigorous during the entire holding period and did not advance to the quiescent prepupal state. The holding time cannot be reduced to less than 3 days without sacrificing ease of reading the percentage mortality.

Larvae which cannot move the length of the body (translocate) even upon stimulation by prodding were considered dead. Possible repellent qualities of the test compounds were recorded as percentage feeding inhibition. While not excluding the possibility of contact insecticidal action, this test indicated chemicals which display repellent or stomach poison effects in the contact action.

The test compounds were formulated by a standard procedure of solution in acetone, addition of an emulsifier and dilution with water. Tests were run at 2000 p.p.m.

RESULTS OF TEST

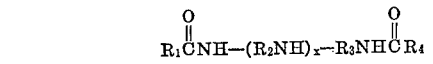
Compound	Conc.	Rating
Methylaminobis (propyl gamma hydroxybutyramide) $CH_3N(CH_2CH_2CH_2NHCO(CH_2)_3OH)_2$ (the reaction product of methyliminobis (propylenediamine) and 2 mols of gamma butyrolactone (p.p.m.)	2,000	Good.[1]
Check, percent kill	0	

[1] 80% kill.

While various embodiments of the invention have been described in detail it is to be understood that the same is not limited thereto but that further modifications are possible without departing from the spirit of the invention.

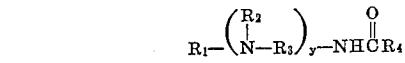
What is desired to be secured by Letters Patent is:

1. An insecticidal composition comprising a toxic concentration of a compound of the formula



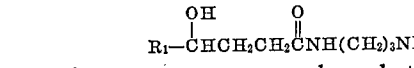
wherein R_1 and R_4 represent hydroxyalkyl groups containing 3 to 4 carbon atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, R_2 represents an alkylene group selected from the group consisting of CH_2, C_2H_4 and C_3H_6, R_3 represents an alkylene group containing 2 to 6 carbon atoms, and x is an integer from 0 to 3, and an inert insecticide adjuvant as carrier therefor.

2. An insecticidal composition comprising a toxic concentration of a compound of the formula



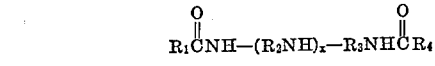
wherein R_1 represents a group selected from alkyl, hydroxyalkyl, aryl, alkylaryl, alicyclic and heterocyclic groups, R_2 represents a substituent selected from the group consisting of alkyl and hydroxyalkyl, R_3 represents an alkylene group selected from the group consisting of CH_2, C_2H_4 and C_3H_6, R_4 represents a hydroxyalkyl group containing 3 to 4 carbon atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, and y represents an integer from 1 to 4, and an inert insecticide adjuvant as carrier therefor.

3. An insecticidal composition comprising a toxic concentration of (1) a compound of the formula:



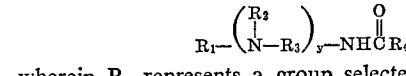
wherein R_1 represents a member selected selected from the group consisting of hydrogen and methyl, and R_2 is an alkyl group containing 8 to 23 carbon atoms; and (2) an inert insecticide adjuvant as carrier therefor.

4. A method of controlling red spider mites and Mexican bean beetle comprising contacting said mites and beetles with an effective concentration of a compound of the formula



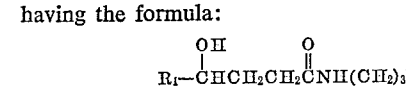
wherein R_1 and R_4 represent hydroxyalkyl groups containing 3 to 4 carbon atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, R_2 represents an alkylene group selected from the group consisting of CH_2, C_2H_4 and C_3H_6, R_3 represents an alkylene group containing 2 to 6 carbon atoms, and x is an integer from 0 to 3.

5. A method of controlling red spider mites and Mexican bean beetle comprising contacting said mites and beetles with an effective concentration of a compound of the formula



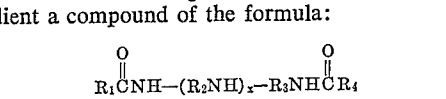
wherein R_1 represents a group selected from alkyl, hydroxyalkyl, aryl, alkylaryl, alicyclic and heterocyclic groups, R_2 represents a substituent selected from the group consisting of alkyl and hydroxyalkyl, R_3 represents an alkylene group selected from the group consisting of CH_2, C_2H_4 and C_3H_6, R_4 represents a hydroxyalkyl group containing 3 to 4 carbon atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, and y represents an integer from 1 to 4.

6. A method of controlling red spider mites and Mexican bean beetle which comprises contacting said mites and beetles with an effective concentration of a compound having the formula:



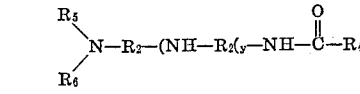
wherein R_1 represents a member selected from the group consisting of hydrogen and methyl, and R_2 is an alkyl group containing from 8 to 23 carbon atoms.

7. A nematocidal composition comprising as the active ingredient a compound of the formula:



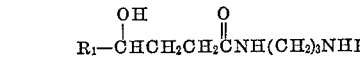
wherein R_1 and R_4 represent hydroxyalkyl groups containing 3 to 4 atoms in which the hydroxyl group is situated in the gamma position to the carbonyl group, R_2 represents an alkylene group selected from the group consisting of CH_2, C_2H and C_3H_6, R_3 represents an alkylene group containing 2 to 6 carbon atoms, and x is an integer from 0 to 3 and inert nematocidal adjuvant as carrier therefor, said active ingredient being from .001 to 20 percent by weight of the composition.

8. A nematocidal composition comprising as the active ingredient a compound of the formula:



wherein R_4 represents a hydroxyalkyl group containing from 1 to 20 carbon atoms and hydroxyalkyl groups containing from 2 to 4 carbon atoms; R_5 represents a member selected from the group consisting of alkyl groups containing from 1 to 20 carbon atoms, hydroxyalkyl groups containing from 1 to 20 carbon atoms, aralkyl groups containing not more than 20 carbon atoms, alicyclic groups containing not more than 20 carbon atoms and heterocyclic groups containing not more than 20 carbon atoms; R_6 represents a member selected from the group consisting of hydrogen, alkyl groups containing from 1 to 20 carbon atoms and hydroxylalkyl groups containing from 1 to 20 carbon atoms; y represents an integer from 0 to 4; and an inert nematocidal adjuvant as carrier thereof, said active ingredient being from .001 to 20 percent by weight of the composition.

9. A nematocidal composition comprising as the active ingredient a compound of the following formula:



wherein R_1 represents a member selected from the group consisting of hydrogen and methyl, and R_2 is an alkyl group containing 8 to 23 carbon atoms; and an inert nematocidal adjuvant as carrier thereof, said active ingredient being from .001 to 20 percent by weight of the composition.

10. A method of killing insects, which method comprises applying to the insects a toxic amount of N-(coconut alkylaminopropyl)-gamma hydroxy butyramide.

11. A method of killing insects, which method comprises applying to the insects a toxic amount of iminobis (ethyl gamma hydroxybutyramide).

12. A method of killing insects, which method comprises applying to the insects a toxic amount of ethylenebis (gamma hydroxybutyramide).

13. A method of killing insects, which method comprises applying to the insects a toxic amount of N-(tallow-alkylaminopropyl)-gamma hydroxybutyramide.

14. A method of killing insects, which method comprises applying to the insects a toxic amount of methylaminobis (propyl gamma hydroxybutyramide).

References Cited

FOREIGN PATENTS

612,320 1/1961 Canada.

ELBERT L. ROBERTS, *Primary Examiner.*

U.S. Cl. X.R.

260—561; 424—248, 274, 267, 273