

PATENT SPECIFICATION

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(54) COLLARS FOR ANIMALS

(71) We, A. H. ROBINS COMPANY, INCORPORATED, a Corporation organised and existing under the laws of the State of Virginia, United States of America, of 1407 Cummings Drive, Richmond, Virginia 23220, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to collars for the control of fleas and ticks on warm-blooded animals, such as cats and dogs, and to a method of treating such animals for fleas and ticks.

Heretofore, phosphate insecticides such as dimethyl 2,2-dichlorovinyl phosphate commonly known as dichlorvos (DDVP) or by the trademark "Vapona", and dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate commonly known as naled, have been widely used for controlling insects. The incorporation of naled and a surface porosity control component in a flexible synthetic resin pet collar to control fleas is disclosed in our British Patent Specification No. 1444038.

According to one aspect of the invention a flea and tick control collar for a warm-blooded animal comprises a strip of porous flexible synthetic resin material containing from 5 to 20 weight % naled and from 2 to 12 weight % of a substantially non-volatile carbamate insecticide.

The strip may be formed from a dispersion of a heat-curable synthetic resin, naled, the carbamate and a surface porosity control component that is non-reactive in the dispersion and has a boiling point at or below the curing temperature of the resin. The dispersion is heated to its curing temperature to produce surface openings in communication with pores in the strip by vaporization of the porosity control component. These openings provide for release of naled vapour and the carbamate at a rate effective to control fleas and ticks on the animal throughout a period of at least 90 days, e.g. up to 120 days.

According to the another aspect of the invention a method of treating a warm-blooded animal for fleas and ticks comprises providing a strip having a width and thickness and length suitable for use as a collar for the animal, the strip comprising a mixture of a synthetic resin, from 5 to 20 weight % naled and from 2 to 12 weight % of a substantially non-volatile carbamate insecticide; the strip having been formed from a dispersion (as herein defined) of a heat-curable synthetic resin, naled and the carbamate, and a surface porosity control agent that is non-reactive in the dispersion and has a boiling point at or below the curing temperature, which dispersion has been formed into the strip at the curing temperature thereby vaporizing the control agent and producing surface porosity in the strip which permits release of naled as vapour and the carbamate as powder at a rate effective to control ticks and fleas on the animal throughout a period of at least 90 days but insufficient to be toxic to the animal; and the strip having been provided near one end with a clamping means for engaging a spaced portion of the strip to form a collar to encircle the neck of the animal; and placing and maintaining the collar on the animal.

The invention is based on the discovery that when naled insecticide, a substantially non-volatile carbamate insecticide and a surface porosity control component are incorporated in a resin matrix and the surface porosity control component is volatilized during curing to produce porosity in the resin matrix, then

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the naled insecticide is released from the cured collar at a greater rate than from a cured collar containing only naled, thereby resulting in a more effective collar for the control of fleas and ticks on warm-blooded animals, particularly dogs and cats. The invention is also based on the discovery that naled is emitted from the collar as a vapour and the carbamate migrates from the collar as a powder without affecting the release of each other. Moreover, the carbamate which migrates as a powder onto the surface of the collar is substantially dry and free of liquid naled.

Cured resinous compositions for cats will generally contain from 5 to 12 weight % naled and from 2 to 5 weight % carbamate, preferably from 7 to 10 weight % naled and from 2 to 3.5 weight % carbamate. Cured resinous compositions for dogs will generally contain from 8 to 20 weight % naled and from 2 to 12 weight % carbamate, preferably from 12 to 17 weight % naled and from 3.5 to 8 weight % carbamate.

The invention may be performed in various ways, and will be described in more detail with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a representative pet collar embodying the invention;

Figure 2 is a view of the collar in cross-section taken along the line 2—2 of Figure 1; and

Figure 3 is a graph showing the comparative rates of naled release in collars employing naled with "Sendran" (2 - isopropoxyphenyl - N - methyl carbamate) and with a surface porosity control component or additive in accordance with the present invention, naled with a surface porosity control component or additive, and naled without the additive.

Figures 1 and 2 show a typical collar suitable for pets such as dogs or cats. The components making up a satisfactory naled carbamate-containing pet collar include a synthetic resin that is sufficiently flexible to be placed around the animal's neck and has a strength sufficient to remain on the animal throughout a period of at least 4½ months or the period during which naled-carbamate is released in amounts effective to control fleas.

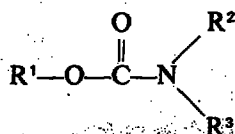
The collar is constituted by a band or strip of a PVC-naled-carbamate combination with the concentration of PVC sufficiently large to give the collar physical properties such as strength, flexibility and freedom from tackiness to make it suitable for use as a collar for the animal. Normally, the cross-sectional dimensions of the collar vary from about one-fourth to five-eighths of an inch (about 6 to 16 mm) in width, and from about three thirty-seconds to three-sixteenths of an inch (about 2 to 5 mm) in thickness. For collars of the present invention employing the PVC-naled-carbamate combination, the preferred dimensions are three-eighths of an inch (about 10 mm) in width and one-eighth of an inch (about 3 mm) in thickness, and the cross section is as illustrated in Figure 2.

The collars are made of sufficient length to encircle the neck of the largest dog or cat for which the collar is intended; for smaller animals, the end of the collar may be cut off to reduce the size of the collar to correspond with the size of the animal. With the PVC-naled-carbamate combination and dimensions as given above, the lateral perimeter of the collar is about one inch (about 25 mm) and the mass of the collar is about one gram per lineal inch (about 0.04 g/mm). By use of a clasp having a friction grip, the collar can be adjustable without the need for holes.

In making the collar strips, naled insecticide, a substantially non-volatile carbamate insecticide and a surface porosity control component are incorporated into resin compositions prior to curing.

The strip may be formed from plastisol dispersions or dry blend mixtures of a synthetic resin, naled insecticide, carbamate insecticide and a surface porosity control component. Plastisol dispersions may be cured by heating in open faced moulds. Dry blend mixtures may be extruded with heating to curing temperatures to provide flexible strips. The compositions are characterized by their provision of the benefits of naled insecticide and a substantially non-volatile carbamate insecticide for control of fleas and ticks on animals. The naled penetrates the atmosphere surrounding the animals as a vapour and the carbamate as it migrates onto the collar surface as a powder is displaced therefrom by rubbing or dusting onto the hair of the animal. The compositions serve as a reservoir providing continuous replenishment of naled insecticide and carbamate insecticide.

The preferred carbamates which can be used in combination with naled in the present invention may be represented by the formula:



Formula I

wherein;

R¹ represents phenyl, substituted phenyl, naphthyl, substituted naphthyl, heterocyclic or substituted heterocyclic,

R² represents hydrogen or lower alkyl, and

R³ represents lower alkyl.

The term "lower alkyl" as used herein refers to an alkyl radical having one to six carbon atoms. The carbon chains can be straight or branched.

The term "lower alkoxy" has the formula —O—lower alkyl.

The substituted phenyl radical or the substituted naphthyl radical can have one or more substituents selected from radicals such as lower alkyl, chloro, bromo, fluoro, lower alkoxy, lower alkylamino, lower dialkylamino or lower alkylthio. The preferred numbers of substituents are one and two.

The term "heterocyclic" as used herein refers to a heterocyclic group having an oxygen atom, a sulphur atom or one or two nitrogen atoms in the nucleus thereof. The term "substituted heterocyclic" as used herein refers to a heterocyclic group substituted with one or more groups such as lower alkyl, lower alkoxy, lower alkylthio, lower alkylamino, lower dialkylamino, carbamoyl, alkyl substituted carbamoyl or halogen. The preferred numbers of substituents are one and two.

Carbamates which can be used in practicing the present invention include:

2-isopropylphenyl-N-methyl carbamate,

2-isopropoxyphenyl-N-methyl carbamate,

3-(1-methylbutyl)phenyl-N-methyl carbamate,

3-(1-ethylpropyl)phenyl-N-methyl carbamate,

6-chloro-3,4-xylenyl-N-methyl carbamate,

4-methylthio-3,5-xylenyl-N-methyl carbamate,

N-methyl-1-naphthylcarbamate,

N-ethyl-1-naphthylcarbamate,

N-isopropyl-1-naphthylcarbamate,

N-butyl-1-naphthylcarbamate,

N-hexyl-1-naphthylcarbamate,

1-(4-chloronaphthyl)-N-methyl carbamate,

1-(5,6-dihydronaphthyl)-N-methyl carbamate,

1-(5,8-dihydronaphthyl)-N-methyl carbamate,

4-benzothienyl-N-methyl carbamate,

1-phenyl-3-methylpyrazol-5-yl-N,N-dimethyl carbamate,

2 - (N,N - dimethylcarbamyl) - 3 - methylpyrazol - 5 - yl - N,N - dimethyl carbamate,

3,4-xylyl-N-methylcarbamate,

3-methyl-5-isopropyl-N-methylcarbamate,

2-chlorophenyl-N-methylcarbamate, and

2,2-dimethyl-1,3-benzodioxol-4-yl-N-methylcarbamate.

The preferred carbamates are 2 - isopropoxyphenyl - N - methylcarbamate commonly known as propoxur or "Sendran" and N - methyl - 1 - naphthylcarbamate, commonly known as carbaryl or "Sevin" (Registered Trade Mark).

The carbamates of Formula I and methods for their preparation have been described in U.S. Patents 2,903,478; 3,111,539 and 3,203,853.

The thermoplastic resin is preferably plasticized and in the preparation of the plasticized thermoplastic component of the present invention, there can be employed any suitable thermoplastic resin which is satisfactorily compatible with the plasticizer employed, named and the carbamates. The various known synthetic resins which can be used for a pet collar containing the combination of insecticides of this invention include materials such as polyethylene, polypropylene, copolymers of ethylene and propylene, nylon, Cellophane (Registered Trade Mark), poly - acrylates such as polymers and copolymers of methylacrylate, ethylacrylate, methylmethacrylate and ethylmethacrylate, polymers of vinyl compounds such as polystyrene, polymerized divinylbenzene, polyvinylhalogenides, such as polyvinylchloride; polyvinylacetals, such as polyvinylbutyral; polyvinylidene compounds such as polyvinylidenechloride,

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polyvinylacetate, ethylvinylacetate - vinylacetate copolymers; copolymers of vinylchloride and vinylacetate, polyurethanes, polyaldehydes, and thermoplastics.

Polyvinylchloride (PVC) homopolymers and copolymers with other polymers such as polyvinyl acetate (PVA) are preferred synthetic resin materials. Suitable PVC resins are commercially available and include, for example, PVC homopolymer dispersion resin "Firestone FPC-6337" available from Firestone Plastics Co., U.S.A., and PVC homopolymer extender resin "Borden 260S" available from the Broden Co., U.S.A., and mixtures thereof. Other suitable, commercially available PVC resins are known in the art. Suitable PVC-PVA copolymers are also commercially available and include, for example, Geon (registered Trade Mark), 135 (Goodrich Corp., U.S.A.), PVC-74 (Diamond Alkali Co., U.S.A.) and XR-6333 (Exxon-Firestone, U.S.A.). Other suitable PVC-PVA copolymers are also known in the art.

The preparation of synthetic resin-insecticide combinations is achieved by conventional methods. Because of the compatibility of naled and the carbamates in the resin dispersions, the compositions may be prepared merely by mechanically mixing of the insecticides with powdered resin. Fluid pastes, or plastisol dispersions, can be made which, as is known, can be moulded, extruded, cast, or otherwise formed into the shape of a band or strip. Where the prepolymerized resin exists in liquid form, as in the case of such monomers as styrene or methyl methacrylate, the insecticides may be incorporated in the liquid before it is polymerized or cured. The term "dispersion" as used herein is intended to include mixtures of a solid with a liquid, a liquid with a liquid and a solid with a solid.

In the embodiments where polyvinyl resins are used, plasticizers and other additives commonly used for providing the flexibility, strength and surface characteristics desired for a pet collar are well known to those skilled in this art, and no further discussion is deemed necessary here. In addition, colouring and odour control agents may be employed in the collars of the present invention to enhance consumer acceptance.

Plasticizers suitable for preparing the plasticized thermoplastic resin component of the compositions of the present invention are those conventionally employed in plasticizing solid thermoplastic resins. The particular plasticizer or plasticizers employed will depend upon the resin and its compatibility therewith. Suitable plasticizers include esters of phosphoric acid such as tricresyl phosphate and esters of phthalic acid such as dioctyl phthalate. Other esters such as those of adipic acid, azelaic acid, maleic acid, ricinoleic acid, myristic acid, and trimellitic acid as well as complex linear polyesters, polymeric plasticizers and epoxidized soybean oils.

Other ingredients such as stabilizers, lubricants, fillers and colouring materials can be included in the compositions of the present invention without changing fundamental properties thereof. Suitable stabilizers are the antioxidants and agents which protect the resin from ultraviolet radiation, undue degradation during processing such as casting and extrusion, a wide variety of which are commercially available.

Some stabilizers such as epoxidized soybean oils or epoxidized octyl tallate serve also as a secondary plasticizer. Stearates including stearic acid and low molecular weight polyethylene are examples of lubricants which can be used.

Because of the low vapor pressure of naled, which is believed responsible for a relatively low release rate, the naled release rate from PVC-naled-carbamate collars is enhanced by the use of an additive in the dispersion. This makes possible effective flea control at lower initial naled concentrations and a collar having an increased effective life.

The additive, also referred to as a surface porosity control component, is present in the final plastisol dispersion or mix used in forming the collar, and hence must be non-reactive with the other components of the dispersion or mix. The main function of the additive is to provide a surface porosity which preferably includes pores extending part way into the body of the collar. The desired surface characteristics are obtained by the vaporization of the additive during the curing period. Hence the additive should comprise one or more compounds having a boiling point at or below the curing temperature of the resin.

Compounds which are suitable as the surface porosity control component in PVC resins which are cured at a temperature in the range of between 300° and 375°F (149° and 191°C) preferably are aldehydes and their lower alkyl acetals containing bromine or chlorine, though other materials can be used. The porosity

control component may thus include one or more of the following which have approximate boiling point temperature as set forth:

	Name	B.P. °F.	°C	
5	chloroacetaldehyde	185	85	
	dichloroacetaldehyde	192	89	5
	chloral	218	103	
	bromoacetaldehyde	176—221	80—105	
	dibromoacetaldehyde	288	153	
	bromal	346	174	
10	bromodichloroacetaldehyde	258	125	10
	chlorodibromoacetaldehyde	299	148	
	bromochloroacetaldehyde	233	112	
	2-bromopropanol	229	109	

15 The surface porosity control component is included in the synthetic resin-
naled-carbamate combination in an amount sufficient to produce surface porosity
by its vaporization during curing of the dispersion whereby said cured strip releases
naled gas at a rate effective to control fleas throughout a period of at least about 90
days without forming droplets on the strip. While the amount of the porosity
control component to be used depends on the density of surface openings desired
and somewhat on the particular procedure used for curing the resin, it is generally
20 from about 0.8 to 4, preferably from about 1 to 3 wt. percent of the dispersion.

The invention is illustrated by the following Examples.

EXAMPLE 1

A mixture in parts by weight of

25	35.82	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337")	25
	17.32	PVC homopolymer extender Resin Type B ("Borden 260S")	
	16.36	di-2-ethylhexylphthalate	
	2.36	epoxidized octyl tallate	
	0.94	calcium and zinc stearate powders	
30	19.90	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate	30
	2.30	surface porosity control component (e.g. bromodichloroacetaldehyde)	
	5.00	2 - isopropoxyphenyl N - methylcarbamate (90%) and amorphous silica (10%) in dust form	

100.00 total

35 was thoroughly triturated to form a plastisol. A portion of the plastisol was metered
to a machined aluminium open-faced cast mould having a cavity 3/8" (10 mm) in
width×21" (532 mm) in length×1/8" (3 mm) in depth. Temperature of the mould at
filling time was approximately 200°F (93°C). The mould was immediately placed in
an oven and heated to 310—335°F (154—168°C) by means of hot air and radiant
40 heat. The mould containing the dispersion was moved through the oven over a 6
minute period. Thus, the dispersion was maintained at or above the curing
temperature of 310—335°F (154—168°C) for about 6 minutes. Cooling was then
started, the temperature being lowered rapidly to 305°F (152°C) within 30 seconds.
The cured strip was immediately thereafter removed from the mould and cooled
45 rapidly to room temperature. The top side of the collar was rounded due to the
meniscus formed on filling the mould, the shape being retained during curing.

Analysis of the collar after curing and cooling showed the naled (dimethyl
1,2 - dibromo - 2,2 - dichloroethyl phosphate) content of the collar to be 17.9
weight % and the 2 - isopropoxyphenyl - N - methyl carbamate content to be 4.4
50 weight %.

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EXAMPLE 2

A mixture in parts by weight of

34.19	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337")	
16.54	PVC homopolymer extender Resin Type B ("Borden 260S")	
15.62	di-2-ethylhexylphthalate	5
2.25	epoxidized octyl tallate	
0.90	calcium and zinc stearate powders (50—50 by wt.)	
19.90	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)	
2.30	surface porosity control component (e.g. bromodichloroacetaldehyde)	
8.30	2 - isopropoxyphenyl N - methylcarbamate (90%) and amorphous silica (10%) in dust form	10
100.00	total	

15 was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar 3/8"×21"×1/8" (10×532×3 mm) as in Example 1. Analyses of the collar after curing and cooling showed the content of dimethyl 1,2 - dibromo - 2,2 - dichloro - ethyl phosphate to be 18.3 weight % and the 2 - isopropoxyphenyl N - methyl carbamate content to be 7.4 weight %.

EXAMPLE 3

A mixture in parts by weight of

37.00	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337")	20
17.90	PVC homopolymer extender Resin Type B ("Diamond 7-44L")	
17.58	di-2-ethylhexylphthalate	
2.44	epoxidized octyl tallate	
0.98	calcium and zinc stearate powders (50—50 by wt.)	
17.55	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)	25
1.95	surface porosity control component	
4.60	N-methyl-1-naphthylcarbamate	
100.00	total	

30 was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar 3/8"×21"×1/8" (10×532×3 mm) as in Example 1. Analysis of the collar after curing and cooling showed the content of dimethyl 1,2 - dibromo - 2,2 - dichloro - ethyl phosphate to be 15.0 weight % and the content of 1 - naphthyl - N - methyl carbamate to be 4.2 weight %.

COMPARATIVE EXAMPLE 1

35 Following the procedure of Example 1 and using a plastisol dispersion consisting in parts by weight of

35.62	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337") (a)	
17.23	PVC homopolymer extender Resin Type B ("Borden 260S") (b)	
16.27	di-2-ethylhexylphthalate (DOP)	
2.34	epoxidized octyl tallate (EPO)	40
0.94	calcium and zinc stearate powders (50—50 by wt.)	
27.60	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)	
100.00	total	

45 was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar 3/8"×21"×1/8" (10×532×3 mm). Analysis of the collar after curing and cooling showed the content of the dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate to be 22 weight %.

COMPARATIVE EXAMPLE 2

Following the procedure of Example 1, a mixture in parts by weight of

38.3	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337")	50
18.5	PVC homopolymer extender Resin Type B ("Diamond PVC-7-44L")	
18.7	di-2-ethylhexylphthalate	
2.5	epoxidized octyl tallate	
1.0	calcium and zinc stearate powders (50—50 by wt.)	
21.0	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)	55
100.0	total	

was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar $3/8" \times 21" \times 1/8"$ ($10 \times 532 \times 3$ mm) as in Example 1. Analysis of the collar after curing and cooling showed the content of dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate to be 16 weight %.

EXAMPLE 4

A mixture in parts by weight of

36.05	PVC homopolymer dispersion Resin Type A ("Firestone FPC-6337")
17.44	PVC homopolymer extender Resin Type B ("Borden 260S")
16.88	di-2-ethylhexylphthalate
2.36	epoxidized octyl tallate
0.88	calcium and zinc stearate powders (50—50 by weight)
19.25	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)
2.14	surface porosity control component (e.g., bromo - dichloroacetaldehyde)
5.00	2 - isopropoxyphenyl - N - methyl carbamate 90% and amorphous silica 10%

100.00 total

was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar $3/8" \times 21" \times 1/8"$ ($10 \times 532 \times 3$ mm) as in Example 1. Analysis of the collar after moulding and curing showed the dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate content to be 16.2 weight % and the 2 - isopropoxyphenyl - N - methyl carbamate content to be 4.2 weight %.

EXAMPLE 5

A mixture in parts by weight of

42.33	PVC homopolymer dispersion Resin Type A ("Firestone FPC 6337")
20.47	PVC homopolymer extender Resin Type B ("Borden 260S")
19.81	di-2-ethylhexylphthalate
2.77	epoxidized octyl tallate
1.04	calcium and zinc stearate powders (50—50 by weight)
9.70	naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate)
1.08	surface porosity content component (e.g., dibromo - acetaldehyde)
2.80	2 - isopropoxyphenyl - N - methyl carbamate 90% and amorphous silica 10%

100.00 total

was thoroughly trituated to form a plastisol. A portion of the plastisol was moulded into a collar $3/8" \times 21" \times 1/8"$ ($10 \times 532 \times 3$ mm) as in Example 1. Analysis of the collar after moulding and curing showed the dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate content to be 7.0 weight % and the 2 - isopropoxyphenyl - N - methyl carbamate content to be 2.4 weight %.

Insecticidal Efficacy of Collars

The insecticidal efficacy of the animal collars of the present invention was determined using animals confined to cages wearing various collars. The animals were infested with fleas or ticks on the same day the collar was applied to the animal and periodically thereafter. The number of surviving fleas were counted after each infestation. Control animals wore collars containing only naled (dimethyl 1,2 - dibromo - 2,2 - dichloroethyl phosphate).

Three groups of dogs (6 dogs per group) were provided with collars from Example 1, Example 2 and Comparative Example 1. Each dog was infested with 50 fleas (*Ctenocephalides felis*) biweekly for a total of nine infestations. Flea counts were made at days 1, 3 and 5 post infestation. The data in Table 1 shows a 63—66% greater reduction in flea content on animals wearing the collars of the present invention during the first nineteen days of the test period. The number of fleas present each day was counted.

The data in Table 2 shows the results of the entire test period with a 26—57% greater reduction in flea content on animals wearing the collars of the present invention. The dead fleas were counted in the pans beneath the cage of each dog on days 1—5 after each infestation.

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TABLE 1
Average No. of Residual Fleas/Dog

	Day	Example 1	Example 2	Comparative Example 1	
5	0	—	—	—	5
	1	1.17	0.83	6.83	
	3	0.83	1.00	2.17	
	5	0.33	0.0	3.17	
	14	—	—	—	
10	15	1.83	3.67	3.50	10
	17	1.83	1.17	3.50	
	19	1.00	1.17	1.83	
		6.99 total	7.84 total	21.00 total	

¹Dogs infested at day 0 and day 14.

TABLE 2
Average No. of Dead Fleas/Dog

	Infestation	Day	Count	Example 1	Example 2	Comparative Example 1	
	0		1—5	22	22.3	16.7	
20	14		15—19	24.3	17.7	20.2	20
	28		29—33	22.0	20.5	17.0	
	42		43—47	19.7	9.8	14.3	
	56		57—61	17.0	16.2	10.7	
	70		71—75	16.5	15.2	6.2	
25	84		85—89	16.3	16.3	11.2	25
	98		99—103	19.2	14.5	8.5	
	112		113—117	20.0	9.3	8.0	
				177.0 total	141.3 total	112.8 total	

¹Estimated; pans cleaned inadvertently.

In another comparative test, 9 individual dogs were fitted with collars from Example 4, and 3 individually caged dogs were fitted with collars from Comparative Example 2. The dogs were infested at days 0, 14 and 29 with 50 fleas per dog (*Ctenocephalides felis*). The number of residual fleas per dog was determined on various days post infestation. The data are shown in Table 3.

TABLE 3
Average No. of Residual Fleas/Dog

	Day	Example 4	Comparative Example 2	
	0	—	—	
40	2	2.89	4.67	40
	4	0.56	2.0	
	6	0.0	0.0	
	10	0.44	2.0	
	14	—	—	
45	16	0.67	1.0	45
	18	0.22	0.67	
	21	0.11	0.0	
	24	0.11	0.67	
	28	0.0	0.33	
50	29	—	—	50
	30	1.89	1.0	
	32	1.11	2.0	
	35	1.0	2.0	
	38	0.67	1.0	
55	42	0.11	1.0	55
		9.89 Total	18.34 Total	

The efficacy of the collars of the present invention were tested on dogs infested with brown dog ticks (*Rhipicephalus sanguineus*). The number of residual live ticks and the number of live attached ticks per individual dog was determined per post infestation days. Each dog was infested with 50 ticks at day 0, 14, 28 and 42. The tick counts were made on days 1, 3, 5 and 14 post infestation. The data are shown in Table 4.

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TABLE 4

No. Live Residual Ticks			No. Live Attached Ticks	
Days	Example 4	Comparative Example 2	Example 4	Comparative Example 2
0-14	43.8	63.9	33.9	47.2
16-28	36.6	59.3	24.8	47.3
30-42	28.5	43.8	22.5	36.8
44-56	33.4	27.0	23.4	6.9
	142.3	194.0	94.6	138.2

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Summary of Advantages

The pet collars of the present invention have the advantage of the release of both a vaporous insecticide and a substantially non-volatile powdery insecticide. The naled vapour releases to the atmosphere surrounding the pet and the carbamate powder migrates onto the surface of the collar and then onto the coat of the animal.

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The resin-naled-carbamate pet collars of the present invention have improved naled release over pet collars containing only naled. The net effect of increased naled release and the migration of the carbamate onto the collar and from the collar surface onto the coat of the animal is a more effective collar against the infestations of fleas and ticks.

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The pet collars containing the combination of naled and carbamate provide greater protection against ticks than naled alone, particularly on free running animals where the naled vapour is released to unconfined space. The carbamate as a powder is distributed on the animal coat and more effectively controls the ticks and results in a larger percentage kill.

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WHAT WE CLAIM IS:-

1. A flea and tick control collar for a warm-blooded animal, comprising a strip of porous flexible synthetic resin material containing from 5 to 20 weight % naled and from 2 to 12 weight % of a substantially non-volatile carbamate insecticide.

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2. A flea and tick control collar as claimed in Claim 1, the strip having been formed from a dispersion (as herein defined) of a heat-curable synthetic resin, naled, the carbamate and a surface porosity control component that is non-reactive in the dispersion and has a boiling point at or below the curing temperature of the resin, which dispersion has been heated to its curing temperature to produce surface openings in communication with pores in the strip by vaporization of the porosity control component to provide for release of naled vapour and the carbamate at a rate effective to control fleas and ticks on the animal throughout a period of at least 90 days.

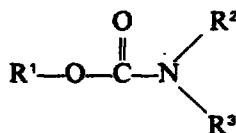
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3. A flea and tick control collar as claimed in Claim 1 or Claim 2 wherein the carbamate is selected from those having the formula:

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wherein;

R¹ represents phenyl, substituted phenyl, naphthyl, substituted naphthyl, heterocyclic or substituted heterocyclic,

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R² represents hydrogen or lower alkyl, and

R³ represents lower alkyl.

4. A flea and tick control collar as claimed in Claim 3 wherein the carbamate is 2 - isopropoxyphenyl - N - methyl carbamate.



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The efficacy of the collars of the present invention were tested on dogs infested with brown dog ticks (*Rhipicephalus sanguineus*). The number of residual live ticks and the number of live attached ticks per individual dog was determined per post infestation days. Each dog was infested with 50 ticks at day 0, 14, 28 and 42. The tick counts were made on days 1, 3, 5 and 14 post infestation. The data are shown in Table 4.

TABLE 4
No. Live Residual Ticks

No. Live Attached Ticks

Days	Example 4	Comparative Example 2	Example 4	Comparative Example 2
0-14	43.8	63.9	33.9	47.2
16-28	36.6	59.3	24.8	47.3
30-42	28.5	43.8	22.5	36.8
44-56	33.4	27.0	23.4	6.9
	142.3	194.0	94.6	138.2

Summary of Advantages

The pet collars of the present invention have the advantage of the release of both a vaporous insecticide and a substantially non-volatile powdery insecticide. The naled vapour releases to the atmosphere surrounding the pet and the carbamate powder migrates onto the surface of the collar and then onto the coat of the animal.

The resin-naled-carbamate pet collars of the present invention have improved naled release over pet collars containing only naled. The net effect of increased naled release and the migration of the carbamate onto the collar and from the collar surface onto the coat of the animal is a more effective collar against the infestations of fleas and ticks.

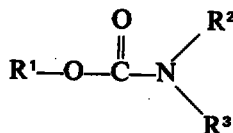
The pet collars containing the combination of naled and carbamate provide greater protection against ticks than naled alone, particularly on free running animals where the naled vapour is released to unconfined space. The carbamate as a powder is distributed on the animal coat and more effectively controls the ticks and results in a larger percentage kill.

WHAT WE CLAIM IS:—

1. A flea and tick control collar for a warm-blooded animal, comprising a strip of porous flexible synthetic resin material containing from 5 to 20 weight % naled and from 2 to 12 weight % of a substantially non-volatile carbamate insecticide.

2. A flea and tick control collar as claimed in Claim 1, the strip having been formed from a dispersion (as herein defined) of a heat-curable synthetic resin, naled, the carbamate and a surface porosity control component that is non-reactive in the dispersion and has a boiling point at or below the curing temperature of the resin, which dispersion has been heated to its curing temperature to produce surface openings in communication with pores in the strip by vaporization of the porosity control component to provide for release of naled vapour and the carbamate at a rate effective to control fleas and ticks on the animal throughout a period of at least 90 days.

3. A flea and tick control collar as claimed in Claim 1 or Claim 2 wherein the carbamate is selected from those having the formula:



wherein;

R¹ represents phenyl, substituted phenyl, naphthyl, substituted naphthyl, heterocyclic or substituted heterocyclic,

R² represents hydrogen or lower alkyl, and

R³ represents lower alkyl.

4. A flea and tick control collar as claimed in Claim 3 wherein the carbamate is 2 - isopropoxyphenyl - N - methyl carbamate.



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5. A flea and tick control collar as claimed in Claim 3 wherein the carbamate is 1 - naphthyl - N - methyl carbamate.

6. A method of treating a warm-blooded animal for fleas and ticks which comprises providing a strip having a width and thickness and length suitable for use as a collar for the animal, the strip comprising a mixture of a synthetic resin, from 5 to 20 weight % naled and from 2 to 12 weight % of a substantially non-volatile carbamate insecticide; the strip having been formed from a dispersion (as herein defined) of a heat-curable synthetic resin, naled and the carbamate, and a surface porosity control agent that is non-reactive in the dispersion and has a boiling point at or below the curing temperature, which dispersion has been formed into the strip at the curing temperature to vaporize the control agent and produce surface porosity in the strip to provide for release of naled as vapour and the carbamate as powder at a rate effective to control ticks and fleas on the animal throughout a period of at least 90 days but insufficient to be toxic to the animal; and the strip having been provided near one end with a clamping means for engaging a spaced portion of the strip to form a collar to encircle the neck of the animal; and placing and maintaining the collar on the animal.

7. A method as claimed in Claim 6 wherein the collar is as claimed in any of Claims 3 to 5.

8. A flea and tick control collar substantially as described in any of Examples 1 to 6.

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