UNDERSTANDING THE MARKUSH CLAIM IN CHEMICAL PATENTS*

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INTRODUCTION

Among Literature Chemists the following question is sometimes raised: "Why are chemical patent claims so difficult to understand?"

From studying chemical claims of every type in several different chemical fields it is apparent that similar problems of expression are encountered. Very often, such problems have centered around the so-called "Markush" claim. It was felt that perhaps an understanding of the philosophy behind the Markush expression in chemical claims might help to understand better the meaning of chemical claims themselves.

While legal opinion, e.g., on infringement and validity of chemical patent claims rightfully belongs to the province of the chemical patent attorney, nevertheless the chemist is often asked by the attorney for his valuable comments on, and explanation of, the chemistry which is the subject matter of chemical patent claims. A clear understanding of chemical claim language is, therefore, an asset to the chemist interested in the chemical patent literature.

Previous papers (1,2) have studied the language of chemical patents. Attention has been called to the "sometimes baffling" and seemingly "absurd" idiom in which are cast chemical patent claims. This obscurity in language has been explained as due to the dual nature of chemical claims, since they are at once both part of the patent-legal and scientific literature.

The hall-mark of the Markush claim is language such as: "a member selected from the group consisting of ...."[1] As will be seen from this study, a large number of chemical patents have Markush claims. Because of the frequency with which the chemist is confronted by Markush claim language, its importance should not have to be labored. The statistics which have been compiled speak clearly on this point.

A sample of 200 recently issued chemical patents, accordingly, was studied with special reference to Markush claims.[2] Representative claims[3] in the field of dyestuffs, industrial chemicals, agricultural chemicals and pharmaceuticals were studied in relationship to several subject-classes of chemical claims employing Markush language: the single ingredient composition, the multi-ingredient composition, the method of use, the process for making a composition and the article of manufacture as a chemical composition. The relative frequency of various Markush expressions also was tabulated and compared.

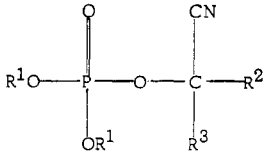
NATURE OF MARKUSH CLAIM

The purpose of the "Markush claim" is to create an expression for one class of individual compounds which have common characteristics or similar chemical and physical properties, or which have some other equivalent basis for classification in the same artificial group. In the beginning, the Patent Office required that a certain rigid formula be used to denote the fact that a Markush claim was being used. This formula took the form of the language: "a member selected from the group consisting of A, B and C", where A, B and C might be individual compounds, groups, radicals, etc.

For an excellent discussion of the origin and purpose of Markush claims, the reader might consult M. C. Rosa's instructive article in the Journal of the Patent Office Society (3). Mr. Rosa is presently Director, Patent Examining Operation, United States Patent Office.

An example of a claim[4] having such a Markush expression is:

An ester of phosphoric acid having the structure represented by the formula:



wherein R^1 represents an alkyl radical containing from 1 to 10 carbon atoms, R^2 represents a member of the group consisting of alkyl radicals containing from 1 to 10 carbon atoms, alkenyl radicals having less than 10 carbon atoms, and the perhaloalkyl radicals of from 1 to 6 carbon atoms, and R^3 represents a member of the group consisting of the hydrogen atom and the lower alkyl radicals. (Emphasis added.)

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It once was essential that formal language without structural formulae be adhered to in order that a Markush claim should be accepted by the Patent Office. However, it is now permitted to use the structural formula with suitable language such as "member of the group consisting of," as in U.S. Patent 2,965,533. The difference between the structural formula claim and the Markush claim without structural formula is merely a matter of form. Even when the structural formula is employed, the generic symbols which represent various atoms or radicals must be defined in approved Markush terminology.(3)

Moreover, it is not now permitted--although it once was permitted--to use the expression "or" when listing the various individuals within the larger Markush class.[5] Thus, we notice that the individual members, e.g., A, B and C are so connected in the model Markush claim above. In claim 6 of U.S. Patent 2,965,533 also, R^2 is defined by "... the group consisting of alkyl radicals .. and the perhaloalkyl radicals..." (emphasis added).

The philosophy behind this ruling might be interpreted thus: the class as a whole is being claimed and the claim is thus "generic" to all of the individuals within the class. Indeed, the claim is not directed alternatively to a plurality of individuals in the class. Therefore, it would be improper to claim "a member selected from the group consisting of A, B or C," since it would be alternative to so claim the class. The class is "A, B and C" and is an abstract concept.

The reason why the term "or" is not approved in chemical claim language--and hence, one no longer finds such term in U. S. Patent claims--is, perhaps, because the term "or" has been stigmatized as "alternative." There are those who believe such mechanical jurisprudence reaches an illogical result (4). Indeed, it would seem that the Canadian Patent Office has chosen not to follow the U.S. Patent Office in this regard (5).

RESULTS AND DISCUSSION

Out of 200 patents studied, at least one representative claim contained a Markush expression for approximately 47% of the claims studied. Thus, Table I shows that 93 patents out of the 200 studied contained at least one claim having a Markush expression therein.

TABLE I

Markush Terminology In 200 Chemical Patents Abstracted In O.G. 761, No. 3, December 20, 1960

Claim	Occurrences	Relative frequency
Composition	57	0.29
Method (Process)	36	0.18
Total	93	0.47

While it is true that a Markush claim is complete and proper even if it omits the words "group consisting of," it can be seen from Table II that this language "group consisting of" is still used in the majority of "true" Markush claims.[6] An alternative expression "class consisting of" is also used, but in a lesser number of cases. (Of course, proper Markush expression requires the phrase "consisting of"[7] whenever a Markush claim is used.)

TABLE II

Markush Terminology in Chemical Composition Claims of 200 Patents Abstracted in O.G., 761, No. 3, December 20, 1960

Language used	Occurrences in claims abstracted	Relative frequency	
		All pats.	Composition pats. only
"Selected from"	86	0.43	1.51
"Taken from"	1	0.005	0.0178
"Group consisting of"	95	0.475	1.68
"Class consisting of"	12	0.06	0.21

Thus, the language "selected from" is not, strictly speaking, required in order that a Markush claim should enjoy the benefits of such a form and be acceptable to the Patent Office. It is seen from Table II, however, that this language "selected from" is used in practically all of the cases where Markush language is employed.

The above percentage frequency is based upon the total number of 200 patents whose representative claims were studied. However, the frequency of such language was studied primarily in the composition claims. Perhaps a more meaningful measure of the frequency, therefore, is given by the other data in Table II. Thus, it is seen that the language "group consisting of" is used, not only in a majority of the composition claims studied, but also more than once in some composition claims, so that the percentage frequency is greater than 100 for the cases studied.

Another aspect of the Markush claim studied was the variation of single ingredient composition claims and of multi-ingredient composition claims which contain Markush expressions. By a "single ingredient" composition claim is meant a single composition or pure substance without admixture of other substances, for example, a pure chemical compound. A "multi-ingredient" composition, on the other hand, includes more than one substance, such as, for example, a mixture of two or more chemical compounds. Table III shows the results of this aspect of the study.

TABLE III

Markush Language in 200 Chemical Composition, etc., Patents Abstracted in O.G., 761, No. 3, December 20, 1960

Type	Occurrences in claims abstracted	Relative frequency All pats.	Relative frequency Composition pats. only
Single ingredient	23	0.12	0.40
Multi-ingredient	34	0.17	0.60

In a further aspect of this study it became apparent that other complicated situations arise in using Markush terminology for composition claims. The frequency of specific rather than generic members of the Markush group in both the single and the multi-ingredient composition claims was studied for those patents reviewed.

By a "specific" member of a Markush group is meant a term which represents one single substance or mixture of substances, which term may not be applied to any other single substance or definite mixture of substances. Thus, the term "specific" excludes any general language which could include more than one chemical compound, for example, or part of a chemical compound, such as radical, within its scope. On the other hand, "generic," when applied to a member of a Markush group in this study, is meant to represent a term which stands for more than one single individual chemical compound or substance, radical, etc.

In this study it was discovered that while some terms in a Markush group could be characterized as specific, nevertheless in the same group there might be also generic terms. This event was denominated as a "hybrid" occurrence and the Markush term containing such mixed terminology was also called a hybrid Markush term.

The following claim[8] illustrates these specific, generic and hybrid Markush terms:

A resinous composition of matter which comprises a polymer selected from the group consisting of polyvinyl chloride and copolymers of at least 70% of vinyl chloride and up to 30% of another monoethylenically unsaturated monomer, and a compound selected from the group consisting of butyl 9-carbobutoxystearate, butyl 10-carbobutoxystearate, and mixtures thereof. (Emphasis added.)

This claim is a multi-ingredient composition claim employing Markush expressions. The composition has at least two substances in it, namely, (i) a vinyl chloride polymer, and (ii) a stearate "compound." In the first Markush expression which describes the PVC polymer, it is seen that the members of this Markush group are (a) PVC and (b) certain copolymers of PVC and another monomer, not specifically defined. Therefore, this expression might be called a "hybrid" term since it contains a specific member (PVC) and a generic member (copolymer of PVC with an unspecified monomer). On the other hand, looking at the second Markush expression in the same claim, it is seen that the members of the group are specified as to identity, although certainly it is not obvious how many members are included since "mixtures" of the two specific stearates are included without any proportionality limitation. So, in one sense this Markush expression is specific and in another sense it is "hybrid," the latter being the case if the term "mixtures thereof" be considered generic.

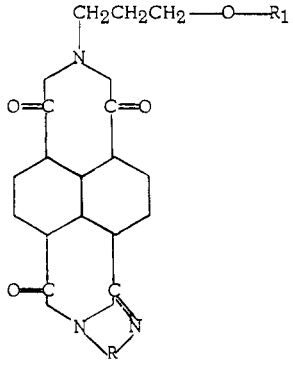
As an example of an article of manufacture claim having specific members in a Markush expression, the following claim[9] is illustrative:

Permanently tacky and pressure-sensitive tape adhesive composition comprising a blend of (1) 100 parts by weight of solid polymeric vinyl alkyl ether having side chains of at least two and up to about eight carbon atoms and (2) about 2-40 parts of compatible nonheat advancing terpene phenolic resin selected from the group consisting of wood rosin substituted phenol and pinene substituted phenol.

This claim represents a multi-ingredient composition which is in the form of a manufactured article, namely, a pressure-sensitive tape. The second component of the tape is a resin which is either (i) "wood rosin substituted phenol," or (ii) "pinene substituted phenol." Assuming these alternatives represent definite and specific substances, then it is true to say that the Markush expression defining the group is specific.

An illustration of a claim[10] taken from the dyestuff field is:

Dyestuffs which correspond to the following general formula:



wherein R represents a member selected from the group consisting of phenylene, chloro-phenylene, cyano-phenylene, methyl-phenylene, methoxy-phenylene and propoxyphenylene, and R_1 represents a lower alkyl group.

Here, again, is seen a "hybrid" Markush group. The term "phenylene" for R is specific, while "chlorophenylene," for example, is generic, there being several isomeric groups possible which are certainly distinct individuals.[11]

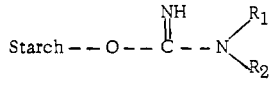
The following claim[12] illustrates a process for making a metal. In this claim Markush language is present in the phrase "a metal selected from the group consisting of calcium, barium, strontium and lithium":

A process for the production of a metal selected from the group consisting of calcium, barium, strontium, and lithium which comprises thermally decomposing an impure carbide of said selected metal to produce a gaseous mixture of elemental metal and carbon monoxide; passing said gaseous mixture to a purifying zone maintained at a temperature above the condensation temperature of said elemental metal, said purifying zone containing at least one active refractory metal selected from the group consisting of titanium and zirconium; reacting said carbon monoxide with said active refractory metal in said purifying zone to form at least one solid compound at the temperature of said purifying zone; and passing said gaseous elemental metal to a cooling zone maintained at a temperature below the condensation temperature of said metal to recover said elemental metal. (Emphasis added.)

This is an example of a claim employing a Markush expression with specific terms. The individual metals in the group are specifically named. It is also noteworthy that the metals are grouped in an artificial, not a natural group or class. This is a characteristic of the Markush claim.

As an example of a use or method claim, the following claim[13] is illustrative:

Process of sizing cellulosic substances which comprises contacting said substances with an aqueous slurry of a cationic starch imino disubstituted carbamate represented by the formula

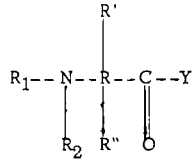


wherein R_1 and R_2 are a radical from the group consisting of alkyl, substituted alkyl, alkene, aryl and aralkyl.

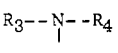
Here, use of the substituted starch compound for sizing cellulosic substances is claimed. What is claimed, thus, is the method of sizing cellulosic substances by the use of a cationic starch imino disubstituted carbamate, which is defined with a structural formula whose terms are further defined with a generic Markush expression.

From the field of agricultural chemicals, an illustration of the method or use claim[14] is the following:

The method of inhibiting the multiplication of plant viruses comprising applying to plants a virus growth-inhibiting quantity of a compound of the formula:



wherein R is a straight-chain alkyl hydrocarbon radical having 1 to 3 carbon atoms, R', R", R_1 and R_2 are selected from the class consisting of hydrogen and aliphatic hydrocarbon radicals having from 1 to 18 carbon atoms, Y is selected from the class consisting of hydroxyl, amino, $-OR_5$ where R_5 is an aliphatic hydrocarbon radical having from 1 to 18 carbon atoms, $-OX$ where X is an alkali metal and

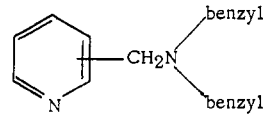


where R_3 and R_4 are selected from the class consisting of hydrogen and aliphatic hydrocarbon radicals having from 1 to 18 carbon atoms, provided at least one is an aliphatic hydrocarbon radical of from 1 to 18 carbon atoms but not more than one is an aliphatic hydrocarbon radical having from 7 to 18 carbon atoms of R, R', R", R_1, R_2, R_3, R_4 and R_5.

In this claim, a structural formula is also used, the terms of which formula are defined with both hybrid and generic Markush terms. For example, Y is defined as "selected from the class consisting of hydroxyl, amino, $-OR_5$ where R_5 is an aliphatic hydrocarbon radical having from 1 to 18 carbon atoms," etc. The foregoing is a "hybrid" Markush expression. As a purely generic expression, "R is a straight-chain alkyl radical having 1 to 3 carbon atoms" is observed.

A simple example of a pharmaceutical patent with Markush language in the claims is the following:

A compound selected from the group consisting of bases represented by the structural formula



and medicinally acceptable acid addition salts thereof.

This claim[15] illustrates the use of both a structural formula and the familiar Markush language as a means of representing a family of compounds. This Markush expression is certainly generic, since both members are represented by generic expressions, the first expression being the structural formula with the "floating" dibenzylaminomethyl substituent representing three distinct bases, the second expression, "medicinally acceptable acid addition salts thereof," being broad in scope and also generic.

Table IV is a summary of data relating to these various specific, generic and hybrid Markush expressions.

TABLE IV

Differentiation of Markush Language In Composition Claims Of 200 Patents Abstracted In O.G. 761, No. 3, December 20, 1960

Term representative of class or group within Markush	Number of occurrences		
	Total, all comp. pats. abstracted	Single ingred. comp. pats.	Multi-ingred. comp. pats.
Specific	44	13	31
Generic	48	17	31
Hybrid	22	15	7

In Table V, the data of Table IV are expressed as decimals to show the relative frequency of occurrence of the specific generic and hybrid expressions in the Markush claims studied.

TABLE V

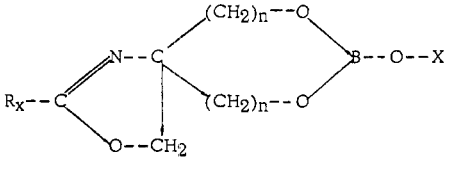
Frequency Of Various Markush Classes In Composition Claims Of 200 Chemical Patents Abstracted In O.G. 761, No. 3, December 20, 1960

Term representative of class or group within Markush	Relative frequency			
	Total, all com. pats. abstracted	Single ingred. comp. pats. only	Multi-ingred. comp. pats. only	Total, all pats. abstracted
Specific	0.77	0.57	0.91	0.22
Generic	0.84	0.74	0.91	0.24
Hybrid	0.39	0.65	0.21	0.11

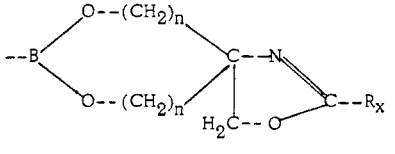
From Table V it is seen that the "hybrid" type of Markush expression is much less frequent than the simple generic or specific expression. It is also clear that some composition claims contain Markush groups which are defined by generic terms while in the same claim other Markush groups are defined by specific terms.

Another complication in the Markush claim is the presence of a "Markush group within a Markush group"[16] which occurs in some claims. An illustration[17] of this situation follows:

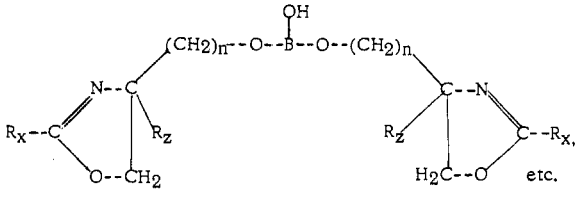
A motor fuel for internal combustion engines consisting essentially of a leaded gasoline and from 0.0025 to 0.05% by weight of a boron compound selected from the group consisting of (1)



where X is selected from the group consisting of hydrogen and



and (2)



In this claim the larger Markush group is made up of two smaller groups of compounds, each represented by a structural formula which is defined in terms of still further Markush language. Thus, here is a case of a "Markush within a Markush."

Technically, of course, the whole group of compounds defined by the claim as a unit is the true Markush group. But the form of the expression is otherwise. This causes some confusion; however, there are times when it appears difficult to find a better way of expressing what is claimed.

It can be observed from Table VI that such complicated expressions are relatively infrequent, even when considering the smaller number of composition patents only.

TABLE VI

Complex Markush Expressions In Composition Claims of 200 Chemical Patents Abstracted In O.G. 761, No. 3, December 20, 1960

Composition claim	Number of claims containing Markush within Markush	Relative frequency composition pats. only
Single ingredient	3	0.053
Multi-ingredient	4	0.070
All composition claims	7	0.123

Finally, for comparison purposes, the variation in the type of chemical claim in the 200 patents studied was tabulated and is set forth in Table VII.

TABLE VII

Variation Of Subject Matter In 200 Chemical Patents Abstracted In O.G., 761, No. 3, December 20, 1960

Patent	Occurrence	Relative frequency
Composition	89	0.44
Method (Process)	101	0.51
Apparatus	10	0.05

In Table VII, the term "composition" embraces patents having at least a single and/or multi-ingredient composition claim. The term "method (process)" includes method of use claims as well as process of manufacture claims. And the term "apparatus," of course, includes structures and devices useful in the chemical arts. The apparatus claim[18] does not usually contain Markush expressions since these are reserved for representation of chemical compounds.

CONCLUSION

A word of caution must be added as a guide to an interpretation of the data discussed above. The mere fact that something appears in the claims of one chemical patent does not mean that the same thing would be proper in other subsequent chemical patents. The views and policy of the Patent Office are seen to evolve and develop like all dynamic enterprises. What is permitted today, as we have seen, may be forbidden or restricted tomorrow. But this fact only underscores the need for continuing study of chemical patents by the chemist.

From the foregoing limited data, moreover, it does not seem valid to draw broad generalizations as to the relative frequency of the

various Markush expressions studied. However, the apparently trivial statistics represent a valid point of departure for learning more about the language and semantic structure of chemical claims which are being published at the present time.

BIBLIOGRAPHIES

(1) H. T. Stowell, "The Language Of Chemical Patents," September 16, 1955, paper presented to the Division of Chemical Literature at the ACS Meeting, Minneapolis.

(2) A. J. Nydick, "How To Read A Patent," September 16, 1955, Paper Presented to the Division of Chemical Literature at the ACS Meeting, Minneapolis.

(3) M. C. Rosa, "Outline of Practice Relative to 'Markush' Claims," Journal of the Patent Office Society, Vol. 34, pp. 324 ff. (1952).

(4) R. I. Coulter, "Comments on 'Alternativeness' in Claims," Journal of the Patent Office Society, Vol. 33, pp. 819 ff. (1951).

(5) M. J. Markus, "Chemical Patents," Chemistry In Canada, August, 1959, p. 33

REFERENCES

(1) Ex parte Markush, 340 O.G. 839. While this Markush patent was not the first to employ this language, this seems to be the first Patent Office case deciding the propriety of such language (cf. U.S. Patent No. 1,472,048, e.g., Claim 2).

(2) Official Gazette of U.S. Patent Office, Vol. 761, pages 77 and following (cited herein as 761 O.G. 77).

(3) See U.S. Patents 2,965,450; 2,965,452-2,965,650, inclusive.

(4) U.S. Patent 2,965,533, Claim 6.

(5) An early U.S. Patent (No. 901,675) has an R described as standing for a "methyl or carboxyl" group (emphasis added).

(6) While the structural formula claims are really Markush claims also (cf. U.S. Patent 2,131,206; Ex parte Moll and Britton, 81 USPQ 447), this paper excludes such claims from the designation "true" Markush claim, unless such claims also contain some Markush language, e.g., "group consisting of . . .," etc.

(7) The expression "consisting of" is always allowed in Markush claims, while "comprising" is prohibited. This policy is based on the special meaning given to these terms whereby "consisting of" implies no more than the specific individuals listed in a class, whereas "comprising" signifies that the class is certainly made up of the individuals listed and may be made up of other unlisted or unspecified individuals.

(8) U.S. Patent 2,965,598, Claim 3.

(9) U.S. Patent 2,965,592, Claim 1.

(10) U.S. Patent 2,965,644, Claim 1.

(11) It is important to distinguish between language and effective group. The Markush claim embraces a group of compounds or individual compositions, although the term "Markush" is loosely applied to various parts of a structural formula, which parts may be defined using Markush expressions. See Ex parte Moll et al., 81 USPQ 447.

(12) U.S. Patent 2,965,475, Claim 1.

(13) U.S. Patent 2,965,518, Claim 1.

(14) U.S. Patent 2,965,534, Claim 1.

(15) U.S. Patent 2,965,646, Claim 4.

(16) The U.S. Patent Office restricts the use of the "Markush group within a Markush group" to those cases wherein so many possibilities are not generated as to extend the general concept beyond what is fairly disclosed. See Ex parte Dotter, 12 U.S.P.Q. 382 and In re Archbold 1946 C.D. 63.

(17) U.S. Patent 2,965,459, Claim 1.

(18) Ex parte Clark and Malm, 11 USPQ 52; In Ex parte Spafford, 66 USPQ 361, 362 it is said that: ". . . The Markush type of claim was devised to meet particularly the situation presented by chemical cases for conveniently expressing a broad claim involving certain actions of several chemical compounds, which, in general, were not associated as a recognized group but yet had a common property that rendered them equivalent in the particular situation involved. It does not seem that this reason applies in mechanical elements since they can be fairly defined as to structure by ordinary language and since their simple mechanical action is considered obvious beforehand."