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Cool your jets: Dave Johnson 1989 Go Getter Paper



Back in the days when MgAl was just a gleam in the parlon star makers eye Dave Johnson was fooling around with magnesium based jetting stars with some 9/16" tubes he had lying around.

In case you were wondering what to do with that Mg you inherited from pyros who passed on without resorting to dichromate treatment this is a good way to go. The paper was recovered from the archives and appears in a couple places like it might have been written by Syd Barret from the psychedelic detox ward. You'll see what I mean, its mostly legible. Shine on you crazy diamond.

		Page
1.0	Purpose	1
2.0	What are Go Getters	1
3.0	The Development of Go Getters	1
4.0	The Go Getter Formula and Process	3
5.0	The Components of Go Getters	9
5.1	The Tube	9
5.2	The Endplug	11
5.3	Barium and Strontium Nitrate	12
5.4	Parlon	12
5.5	Magnesium (metal fuels)	13
5.6	Red Gum	14
5.7	Boric Acid	14
5.8	Acetone (solvents)	14
5.9	Match	16
5.10	Water	16
6.0	Suggested Future Research	18
7.0	Additional Thoughts for this Unique Composition	19
7.1	Non-propelling Compositions	20
7.2	Self-propelling Compositions	

[illegible] and treatment of the topic is excellent.

Troy Fish suggested that a self propelled star could be produced by taking a straight stick of soft composition, see figure 1, and inserting a piece of match. He also suggests that a spinner could be made with a curved piece of comp with match in one end or with a straight piece with two pieces of match opposing each other at opposite ends. This method of hand forming each star is very time consuming. In an attempt to speed production I tried to successively dip and dry pieces of match into a slurry of composition, as is done in the manufacturing of sparklers and candles. Due to the solvents used with each successive dipping the previous layer would soften and fall off, and I could not get a build-up larger than that achieved with the first dip.

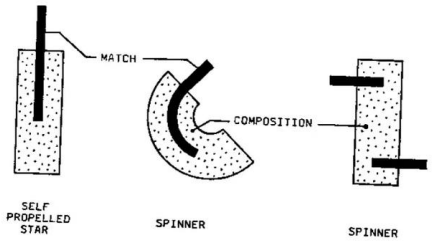
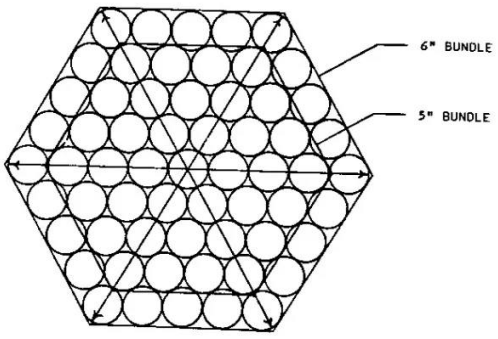


FIGURE #1
(SELF PROPELLED STAR TYPES)

likelihood of knocking the unsteady [illegible] eliminates the filling, and allows the "pour" once started to continue from one tube to the next uninterupted. Once dry the bundles of individual Go Getters can be used whole or broken apart depending on the individual's needs.



For use in shell [illegible]

conduct additional research and experiments to further refine and develop this effect. In their current state Go Getters are prone to several problems which limit their use in commercial production. These problems, and possible solutions, are detailed in this text.

This paper is not intended to be a how-to article, it is an up-to date accounting of the development of Go Getters. Do not attempt to make Go Getters by the methods I have employed in the past.

2.0 WHAT ARE GO GETTERS

Go Getters are best described as deep colored self propelled stars. Each star is capable of "swimming" through the air, with no external push, similar to a rocket without a stick. The flight path of an individual Go Getter may be a straight line up to several hundred feet in length, a slow lazy curve, a zig zag or they may spin wildly in place. To me the best Go Getter will spin for an instant then take off. This spinning, or hesitation, produces an interesting effect when used in a shell.

Go Getters are currently produced in three deep mag colors, red, green and yellow. Experimentation could produce other colors.

The thrust of a Go Getter is produced by a fierce burning composition rather than by a choked case as is necessary in most rocket motors.

3.0 THE DEVELOPMENT OF GO GETTERS

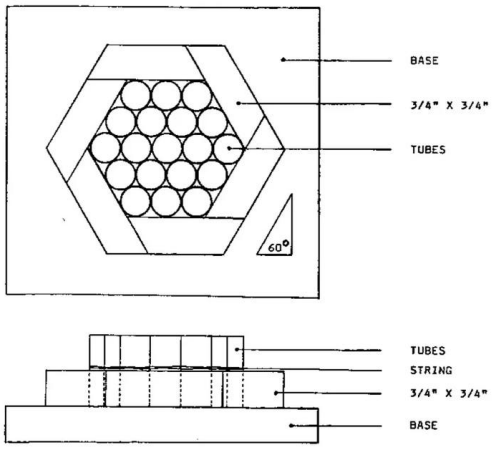
Before starting this section I would like to give credit to the person whose idea inspired the development of Go Getters and, who until the writing of this paper, has not received any credit, nor is he probably even aware of his influence. Troy Fish wrote an article entitled "Green and Other Colored Flame Metal Fuel Compositions Using Parlon" which was published in Pyrotechnica [illegible]. Since the years since their first development I have made many other attempts to produce a better Go Getter with only mediocre results at best. These further attempts have proven to me how lucky I was to come across the right combination early on in my research. Having worked with this goo for years now I can safely say that I would have become frustrated and given up long ago without my early success.

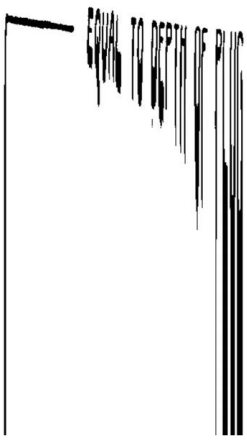
4.0 THE GO GETTER FORMULA AND PROCESS

The formulas for Go Getters are as follows, and are the same as those listed as Nitrate/Magnesium red and green on page #37 of Pyrotechnica VII:

	GREEN	RED	YELLOW
Barium Nitrate	63.0		37.8
Strontium Nitrate		58.0	23.2
Parlon	25.0	29.0	26.6
Magnesium	12.0	13.0	12.4
Red Gum	+3.0	+3.0	+3.0
Boric Acid	+3.0	+3.0	+3.0
Total parts	106.0	106.0	106.0

The yellow is produced by mixing approximately 60 parts green composition with 40 parts red. The color of the yellow can be adjusted by changing these percentages. It is not necessary to premix the red and green compositions. The correct formula can be calculated by the following method. Multiply 40% (0.40) times each of the Nitrate, Parlon and Magnesium in the red formula and 60% (0.60) times the Nitrate, Parlon and Magnesium in the green. When added together they yield the above formula. Since the Boric Acid and Red Gum are additional parts it is not necessary to adjust them, simply add them to the [illegible]





side of the tube, to the desired depth, then lay the match over to the opposite side, see figure 6. By inserting the match in this manner it is bound against the walls of the tube and will not settle deeper into the composition. If the match is inserted too deep, or settles deeper, the finished Go Getter may have a tendency to explode. This happens because the match burns quicker than the comp and lights the interior of the star.

The bundle of Go Getters should now be set aside and allowed to dry. Within 24-48 hours the stars will be hardened and can be used. The presence of remaining Acetone can be tested for by smelling the bottom (capped end) of the bundle. To speed the drying process allow 3-4 hours of drying then set the bundle of tubes on it's side. This exposes both ends of the tube to the air for faster drying.

5.0 THE COMPONENTS OF GO GETTERS

The individual componets of Go Getters, tube, chemicals, solvent and match all serve specific functions, and have a direct effect on the performance of the finished Go Getter. The type and quality of these materials will make a huge difference both in the workability of the composition slurry, and in the performance of the finished product.

I am neither a chemist nor scientist so the conclusions I have drawn from my own experiments may or may not be correct. I have included the results of my experiments, and my conclusions , as possible direction for further research.

5.1 THE TUBE

The tube is the one single component responsible for both the success and failure of Go Getters. The tube which acts as the mold or container and allowed the [illegible]

sealer such as paint, varnish, wax or even a solution of Parlon and Acetone. Again the possibilities for a sealer and method of sealing are almost limitless. I have only worked for a short time with pouring this comp into plastic molds. In my work I have noticed that the walls of the finished Go Getter, from plastic molds, are very smooth and shiny and hence may not need any sealing.

The paper tube has to be reduced, or eliminated, from Go Getters to reduce the possible fire risk. Experimentation is needed to find suitable molds, methods of sealing and even the possibility of a method to speed the drying time for molded Go Getters.

5.2 THE ENDPLUG

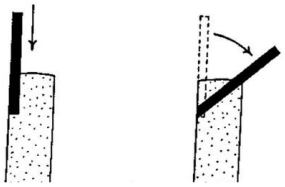
The endplug seals the one end of the tube to stop the liquid comp from running out and prevents ignition of the star on the plugged end. Unfortunately the plug increases the amount of flaming fallout from the star. When the comp burns up there is still about 3/8 - 1/2" of tube remaining which is still burning and left falling to the ground. If the plug was eliminated the comp would burn to the end of the tube and reduce or eliminate this fallout. If the plug was eliminated a shorter tube may be necessary so as not to increase the length of the star and hence it's burn time.

The plug could be eliminated by standing the unplugged bundle of tubes on kraft or wax paper for filling. Once the Go Getter was dry this paper could be peeled off. The ends may need to be sealed to prevent ignition, but this would probably not present a problem. The tubes could also be stood on a thin layer of nonburnable material, such as clay or sand, then filled. This layer of material would be picked-up by the comp and would seal the end of the tube from fire.

With either of these two methods it is necessary to place the empty bundle of tubes on small moveable boards or trays so that they can be moved about without picking up the [illegible]

are formed within the comp and cannot escape through the thicker liquid.

Just before filling the tubes restir the comp which has been sitting for several minutes, this is necessary so that the composition has a uniform consistency. The tubes are filled to the point of almost overflowing, so that there is actually a slight bulge of liquid composition above the top of the tube. It is not necessary to stop pouring between each tube, simply go to the next tube while still pouring. It is important to pour quickly, as a thickening of the composition remaining in the cup will occur after a number of tubes have been filled. This thickening is due to a combination of settling and evaporation, and will start to occur within several minutes. It is tough to avoid overfilling the tubes and a little overflow should not present a problem. If however a great number of tubes are overflowed in a bundle this can cement the entire bundle together making the Go Getters almost impossible to seperate.This cementing together is especially problemsome when the comp is thin as it will flow into the gaps between the tubes.



[illegible] on the surface of the Go Getter almost immediately after being poured. This film is due to the excellent film forming ability of the Parlon in the composition. This skin seals the exposed surface and prevents, or slows, the evaporation of the solvent. The paper walls of the tube interfere with this film forming ability and further, due to the absorbancy of paper, act as a wick to remove the Acetone. If the tube is peeled away from a dry Go Getter you will notice the rough porous surface where in contact with the paper as compared with the smooth sealed surface on the exposed end. Troy Fish discusses this film forming in Pyrotechnica VII, and the degree to which various solvents dissolve Parlon and further enhance it's film forming ability.

The tube protects the sides of the composition from taking fire and thus forces the comp to burn from one end like a cigarette. This end burning gives the star some directional thrust and prevents the stars from consuming themselves too rapidly which would happen if allowed to burn on all sides.

The tube which started out to be just a container to hold and shape the liquid comp has proven itself to be more than that. Two possibilities exist to eliminate or reduce the likelihood of starting ground fires due to the flaming fallout from the still burning, but spent, tube.

If very thin walled tubes, say two or three turns of 70 lb. kraft paper, were used they would probably be completely consumed by the burning composition. These thin walled tubes would still serve to stop side ignition and act as a wick for the solvent.

The second possibility would be to eliminate the tube completely which, would do away with the time and expense of purchasing bundling and plugging the tubes. If another mold could be found this could be accomplished. As this composition dries it shrinks slightly and if poured into a smooth mold, or left to harded in the plastic mixing cup, it will dry and pull away from the mold walls. This shrinking allows the finished formed star to be easily removed from the mold. The number of possible molds is only limited by the imagination

important that the Nitrates be dry before being used. In the more humid climates this may necessitate [illegible]

Parlon is softened or dissolved by the solvent(s) used and once the solvent evaporates the Parlon hardens and binds the star together. In it's liquid state Parlon coats the particles in the mix and since it is not effected by water effectively waterproofs the star. Troy Fish discusses at length the topic of waterproof and water resistant stars in his Pyrotechnica VII article.

5.5 MAGNESIUM (METAL FUELS)

The type and particle size of the Magnesium used to make Go Getters is very important to the proper functioning of this effect. I have always used Reade Manufacturing Companies Magnesium in the 100 mesh (RMC 100) and 200 mesh (RMC 200) grades. For green I use 100% RMC 200. In the red comp it is necessary to use 50% RMC 100 and 50% RMC 200 to prevent the stars from exploding. The yellow can be made with 100% RMC 200 Magnesium, but if trouble with popping or exploding is experienced it may become necessary to use a small percent of RMC 100 to tone it down a bit.

The granular forms of Magnesiun, such as manufactured by Reade, produce a Go Getter which burns with more thrust than one produced with atomized Magnesium. This may be due to a larger, more reactive, surface in the case of the granular materials.

I have experimented with both Magnesium/Aluminum alloy 50/50 and with American Dark Aluminum in Go Getters as a suitable substitute for Magnesium. 200 Mesh Magnalium was better than the Aluminum but still not as hot as the Magnesium. It may be possible to get a good Go Getter with a smaller particle size or by using a Mag/Al alloy with more than 50% Magnesium, such as 80/20 Mag/Al. Don't discount Aluminum either, the Go Getter produced with American dark Aluminum had some thrust and although it burned too long it produced a nice lazy effect. Numerous metals and alloys could be tested in various particle sizes. Most materials which I have tested produced thrust but burned too long for a 1 1/2" tube, maybe a shorter tube would work. I have

Amyl acetate	Methylene chloride
Benzene	Methyl ethyl ketone
Butyl Cellosolve	Methyl isobutyl ketone
Carbon tetrachloride	Methyl salicylate
Cellosolve	2-Nitropropane
Cellosolve acetate	Octyl acetate
Cosol No. 2	Solvesso 100 (KB 89)
Cyclohexanone	Solvesso 150 (KB 88)
Diacetone alcohol	Toluene
Diethyl carbonate	Xylene

Solvent Binary Mixtures, Weight, %
Acetone 50-80, hexane 20-50
Butyl acetate 30-100, mineral spirits 0-70
Cellosolve 50-100, mineral spirits 0-50
Cellosolve 20-100, turpentine 0-80
Ethyl acetate 50-100, hexane 0-50
Hi-flash naphtha (KB 77) 70-100, turpentine 0-30
Methyl acetate 60-100, hexane 0-40
Methyl isobutyl ketone 40-100, Troluoil 0-60

Solvent Mixtures Suitable for Brush Application, Weight, %[b]			
Amsco-Solv D	67	Solvesso 100	80
Solvesso 100	26	Turpentine or mineral spirits	20
Turpentine	7		

Solvent Mixtures Suitable for Spray Application, Weight, %[b]			
Xylene	55	Xylene	80
Hi-flash naphtha	35	VM&P naphtha	20
Turpentine	10		

Nonsolvents		
Acetone	Gasoline	Nitromethane
Amsco-Solv A-80 (KB 76)	Heptane	Shell TS-28 (KB 70)
Amsco-Solv D (KB 69)	Hexane	Troluoil
Butanol	Methyl Cellosolve	Turpentine
Ethanol	Mineral spirits	VM&P naphtha
Ethyl lactate	Nitroethane	

[a]The kauri-butanol value (KB) shown after some of the proprietary solvents represents the value obtained for the given lot of solvent used to obtain the above data

[b]For Rule 442-acceptable solvent blends, refer to Technical Bulletin CSL-106, Formulation of Coatings Based on Parlon* Chlorinated Rubber to Comply With Rule 442

TABLE 2

that the interior of the star is very porous, similar to the surface of a sponge. This network of tiny air pockets is probably due to gasses released when the Magnesium in the comp reacts with residual moisture present in either the Acetone and/or Nitrate. These tiny air bubbles are trapped as the comp thickens and hardens, and have a pronounced effect on the burning speed of this composition. If a pile of dry composition is ignited it will burn with the same vigor of most other star comps. Add Acetone and allow the comp to dry and you have a comp which burns on the edge of exploding. This increased burning rate I feel is a result of the increase in burning surface from the spongelike texture.

This "edge of exploding" is what causes Go Getters to work at times and fail at others. The edge is a very fine line between working and not working. Cross that line and the Go Getters explode, don't reach the line and they don't have any zip. The inconsistency of my results was probably due to the amount of water present and the resulting difference in the burning surface.

Boric Acid buffers the reaction between Water and Magnesium. If the Boric Acid is left out of the mix this reaction increases and the resulting stars explode. This is due to the increase in the reaction and consequently the increase in the number and size of the air pockets.

The curdling I experienced from time to time was not due to differences in chemicals but rather to the amount of moisture present. Water will interfere with the soluability of Parlon in Acetone. If a quantity of Acetone is added to some Parlon in a cup the Parlon will soften into a smooth flowing pearly liquid. Add a drop or two of water to this and the Parlon will clump together, the more water the worse it gets. If Xylene is added to this mixture of Acetone, Parlon and Water the Parlon will dissolve.

If this Water/Magnesium reaction could be controlled it may be

5.6 RED GUM

The Red Gum used in the formula is an additional percentage, meaning it is in addition to the already 100% Nitrate, Parlon and Magnesium. I have not tried altering or eliminating the additional Red Gum in the formula. Troy Fish, in Pyrotechnica VII says that Red Gum reduces the stickiness of this comp and that it alters the permeability of the Parlon skin which reduces drying times. As stated I have never changed this percentage, maybe someone should to see if the comp would flow any better and what the effect is on drying time. This may be a solution to increase drying time in metal or plastic molds if no sacrifice is made concerning moisture resistance of the finished star. I have always put Red Gum in the dry comp when mixing but it could be added to the solvent and dissolved before making the slurry. Then added to the dry composition.

5.7 BORIC ACID

Boric Acid is also an additional percentage, just as the Red Gum is. I have never increased the amount of Boric Acid but I did leave it out one time, the finished Go Getters all exploded when lit. Boric Acid acts as a buffer to reduce the reaction between the Magnesium and any water present. More will be said on this subject later, suffice it to say for now that Boric Acid is necessary, and should always be used.

5.8 ACETONE (SOLVENT)

The Acetone, or solvent, as mentioned earlier softens and/or dissolves the Parlon to bind and waterproof the star. Acetone does not actually dissolve Parlon it only softens it, Hercules lists Acetone as a nonsolvent of Parlon in their publication on Parlon. Table 2. is a

5.9 MATCH

The purpose of the piece of match is to insure ignition of the Go Getter. I have found the method of inserting a piece of match into each star to be very effective, similar to a pill box comet. In an effort to eliminate the lengthy process of matching each star I have experimented with alternate methods of priming the ends of the Go Getters with reasonable success. Black powder can be spread over the ends of just poured Go Getters and pressed into the still wet surface with a stick. The ends of dry stars can be dipped into a mixture of nitrocellulose lacquer and prime, then dipped into black powder. These two methods of priming have both produced decent ignition, although not as good as with pieces of match. Other methods of priming could be developed which may produce better results than those I have described.

Another method to increase the chances of lighting each Go Getter in a device is to leave the tubes bundled rather than breaking them apart. By doing this if one edge of the bundle lights fire will spread over the entire surface lighting each star. This of course assumes that the bundle is not broken apart by the blowing charge that expells, and lights the Go Getters.

5.10 WATER

DO NOT ADD WATER TO THIS MIX !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

I have included this section on water, not as a material which should be added, but in an effort to explain some of the problems I have encountered, and possible explanations for those problems. Over the years of working with this unusual composition I have had trouble with repeatability in the consistency of the slurry and the success of the finished Go Getters. There have been times when the composition slurry poured very smoothly, and times when it curdled. The green comp always gave the best results followed by yellow with red the most likely to curdle. Sometimes the finished Go Getters

willing to pay the price. Even if you start with dry materials unless you are working in a moisture free environment, they will pick up water as you work.

Acetone has a real affinity for water, and may be the biggest culprit. If another suitable solvent, or solvent mixture, was found which did not attract moisture this source of water could be eliminated completely.

The Magnesium can be treated with Bichromate to protect it from reacting with water. Although I have not done much testing with treated Magnesium the results to date have been excellent. This method of treating the Magnesium to control the reaction was suggested by Don Rowe, and holds much promise for the future.

6.0 SUGGESTED FUTURE RESEARCH

While Go Getters may have appeared to work perfectly, by now you know that that they do not. The following is a recap of the problems, and suggested research, which needs to be done to improve this effect.

* Reduce the tube wall thickness to reduce or eliminate the burning fallout, and potential to start fires.
* Find suitable removable mold to eliminate the tube and potentialfallout.
* Eliminate the endplug by sealing the end of the tube or by eliminating the tube.
* Find a method of fireproofing the sides of molded Go Getters.
* Identify other usable solvents, or solvent mixtures, which yield rapid drying, good waterproofing and excellent Go Getters.

* What causes some Go Getters to spin, and can this be reproduced if desired.

* Try using course Titanium and/or Aluminum to produce a nice silver tail.

* Try shorter tube, for slower burn times, with slow comps, such as produced with Aluminum, to see what other slow motion effect can be created.

* Increase the amount of Boric Acid slightly in the composition to see if additional buffering of the Magnesium/Water reaction can be obtained.

* Develop a pressurized dispenser which could be used to inject the composition into the tubes to speed production.

* Additional research could also be conducted in an effort to produce Go Getters of other colors. It may be very possible to produce a white Go Getter by using Potassium Nitrate in place of the Barium or Strontium Nitrates. This white could be used with Strontium to produce pink. Various mixtures of red and green could produce other shades of red, orange, yellow, chartreuse and green. It may even be possible to develop a pourable Charcoal, Flitter or Strobe which is capable of self propulsion. Color changing Go Getters can be made by pouring the tube half full of one color then filling the rest of the tube with another color.

7.0 ADDITIONAL THOUGHTS FOR THIS UNIQUE COMPOSITION

Troy Fish in his article in Pyrotechnica VII mentions briefly a couple of possible uses for this pourable, moldable composition

[illegible] mag color as the device swam through the air. The slower burning nonpropelling compositions could also be used for this purpose.

Comets could be poured with an internal cavity which could be filled with flash powder to produce a crossette like effect, or bursting comet. This could also be done by pouring a small amount of flash powder on a small piece of thin paper then bundling this over the end of a piece of match and tying it on. This flash bag and match could be inserted into the comet before or after filling. On a larger scale what about pouring this into 3" or 4" shell cans or casings around a large flash bag? This could produce the same results as a shell without the work of making stars. It may be necessary to evenly space some weakened areas around the shell or comp to produce a nice even pattern when the shell bursts.

Giant "fireball" comets may be possible by filling 3" and 4" shell cases with composition. After drying the case can be peeled away and the exposed surfaces primed. The finished comet could be shot from an appropriate sized gun just as a shell would be. It may be necessary to use less solvent to reduce or eliminate potential cracks which could form as a result of excessive shrinkage.

Many different devices may be possible by filling various sizes and shapes of tubes and containers with this composition. Try inserting match at different angles and/or at different points along the length of the tube wall. What about Troy Fish's idea of a spinner.

7.3 EXPLODING COMPOSITION

These compositions could produce some rather unique effects such as exploding comets and shells without the need for a bursting charge. Many of the preceding ideas could be tried with this composition which intentionally explodes.

[illegible] pyrotechnic devices, and should not be undertaken without adequate supervision, training and experience. The circumstances surrounding the manufacture, storage and discharge of such items is beyond my control. I assume no liability for any information contained herein. I cannot be held responsible for results, accidents or injuries occuring from the application of directions, formulae or ideas published herein. Nor can any guarantee be made that all information, hypotheses and theories published herein are correct or have been verified.

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produce enough heat to ignite the comp while you are working with it, or while it is drying.

7.1 NON-PROPELLING COMPOSITION

These compositions could be used to pour such things as comets, pillbox comets and other large stars, which would normally have to be pumped. It may be necessary to find appropriate reusable molds for each size comet, but this should not be difficult.

Falling leaves could be made by spreading a thin layer of composition on kraft paper then covering this with a second sheet of paper. This sandwich of paper and comp could be cut into strips which once dry could be primed on the edges and used as desired.

Pointed comets can be made by pouring a wafer of composition onto the end of a charcoal or flitter comet. It is necessary to roll the comet in 2-3 turns of pasted 30 lb. kraft paper extended about 1/4" past the end of the comet. The 1/4" deep tube produced on the end of the comet is then poured full of comp and allowed to dry. A disk is glued or pasted over the poured comp to prevent ignition on this end. This produces a comet which burns with a gold or flitter tail then changes color just before burning out.

Maybe this comp could be poured into rocket tubes while on a spindle to produce large mag colored rocket motors. How about adding coarse Titanium or Aluminum to produce a silver tail? What about using a long piece of match molded into the rocket motor in place if the spindle.

When working with the non-propelling compositions keep in mind that this is a slower burning comp. It may be necessary to reduce the amount of composition to reduce the length of burn time. This will help prevent still burning devices from reaching the ground and starting fires.

[illegible] throughout this text they are not beyond help. With a little work and research these problems can be overcome. By publishing this paper it is my hopes that we can open lines of communications and aid each other in this effort.

In the ancient art of pyrotechnics it is not very often that a new device or effect is created. Over the years pyrotechnicians have tried just about every conceivable method of producing new effects with the same materials. As times change and new materials and methods are developed the modern pyrotechnician has an opportunity to create something new and different.

Don't get me wrong I am a staunch believer in traditional methods of Pyrotechny. I do not advocate changing old for new, quality for speed nor that which works for ease of production. The art of pyrotechnics is an ancient art. We as pyrotechnists are the only ones capable of carrying on the traditional methods past on to us. While new methods and techniques will come along it is up to us to maintain the records of the past.

UNCATEGORIZED

Read it online

With the videos and comments: https://www.westernpyro.org/blog/dave-johnson-1989-go-getter-paper