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SPACE ADMINISTRATION

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POWER FACTOR CONTROLLER

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PRESS CONFERENCE

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INDEX

PROCEEDINGS

INTRODUCTORY REMARKS OF DICK MCCORMACK

PUBLIC AFFAIRS OFFICER

OFFICE OF APPLICATIONS

MR. MCCORMACK: Good morning. I am Dick McCormack I am the Public Affairs Officer of the Office of Applications. I would like to welcome you here this morning for a Press Briefing and demonstration of the Power Factor Controller which is a NASA spin-off.

We are lucky enough -- fortunate to have the inventor, Mr. Frank NOLA who is from Marshall Space Flight Center. Frank will give you a rundown on the invention, when it was invented, how it was invented, the history of it. And he has some charts here and we will answer any questions from the members of the Press when he is finished. Frank?

PRESENTATION OF FRANK KNOWLER

MARSHALL SPACE FLIGHT CENTER

MR. NOLA: Thank you.

MR. MCCORMACK: Would you dim the lights please.

MR. NOLA: In the presentation I will give you some background on how we got into this since this applies to the -- this is an energy saving device for electric motors. And it applies to the type of motors that you have in your home as well as used in industry and not necessarily the type we use in space, although there are similarities.

So I will tell you how we got into it and what the significance is in saving energy in electric motors and then I will go into what the applications are for the device and a little bit on how it works, what testing has been done and what you can expect out of it in the way of savings and some of the other benefits that we see besides direct energy savings, what has been done for the commercialization of the device. And then I have a chart -- I have taken some examples of what it will do on a nationwide basis if applied to various types of motors and appliances, and, finally, what I would like to see done, if we were going to pursue this further.

Okay, this is a device that attaches to the leads or to the wires going to the electric motor and it senses if the motor is wasting power. And if it senses that, then it reduces the amount of power being wasted within the motor as well as within the utility company's lines that is delivering the power to the motor.

Studies by the Arthur D. Little Corporation of Cambridge, Massachusetts, indicate that there are about 50 million electric motors built each year in the United States -- and when I say "50 million" I am talking about the type that are for major home appliances and larger, not little motors like those used in hand drills and automobile car windows.

There are several billion of these motors presently in use. They use about 2/3's of all of the electrical energy

that is generated in the United States and they use 1/3 more energy than automobiles. And the amount they use is equivalent to about 6 million barrels of oil each day -- or in terms of coal, it is about 1-1/2 million tons of coal a day.

So if you could achieve just a four percent reduction on the average then you would save about a quarter of a million barrels of oil a day. And at $14.00 a barrel, that would amount to an annual savings of about 1.2 billion dollars.

The way we got into this was through our solar heating and cooling program. The Marshall Center has a research program for solar heating and cooling in which they have a demonstration house which is both heated and cooled by the sun. And this house required several motors for turning the fans and the pump.

And the engineers were concerned about the amount of power that they were having to buy from the utility company to run these motors. As you know, a solar heating system -- a solar heating and cooling system costs more initially to install than does a conventional system. But the way you justify it is that you are getting most of your power free and that will pay it back, over the years.

But they were concerned about the amount of power these motors were taking. We were doing some other work for them in the controls area so they asked us if we could do something to make those motors take less power.

Now, our normal mainstream of activities is to design electronic control systems for guiding missiles, for controlling earth orbiting spacecraft, particularly now for controlling experiments that fly in space.

And it was in the programs like the Lunar Roving Vehicle and the Skylab Space Station that is still in orbit -- you recently read that they had to turn on these large gyroscopes to get the thing reoriented so it would last -- to reduce the drag so it would stay up longer.

And it was in doing research on the motors that were used in those programs that we gained or got the technology that resulted in this invention.

So when the engineers asked us if we could do something to reduce the energy, we just applied some of the principles and techniques that we had learned from some of these other programs to this. And we came up with this device.

All of the initial work on the invention was done in April of 1975. And at that time, after I saw that it worked on one motor, I went out and rounded up three other motors to make sure that it worked on them. And then I immediately wrote the invention disclosure and turned that in. And then I essentially didn't do any more with it until we were notified in the summer of 1977 that a patent would be issued.

And at that time, that was the first time that I really became aware of how important it would be to save energy. That

is pretty far out of our mainstream and it was the result of the Arthur B. Little study and there were reports coming through the newspapers about other motor related inventions that would save, you know, a lot of oil. And that was the first time that I was aware that a one percent savings meant 50,000 or 60,000 barrels of oil a day.

So at that time, we cranked it back up again, and in the meantime the patent search was being done. And also, immediately -- when we turn in an invention disclosure, it automatically goes to our technology utilization office. They take it from there and have it evaluated by a contractor -- I think it is Illinois Institute of Technology. And I did talk to them, I think, in 1976. And they did go around the country talking to people about it. So there were several paths that brought it all together.

The patent was issued. At the time that we were notified that the patent would be issued, we thought that we might get some publicity. We wanted independent verification that the concept was sound before we did at least any publicity on it.

So we gave Auburn University a small contract and we furnished them a controller and they did test five industrial type motors and did verify that the concept is sound.

The patent was issued in October of 1977. The patents are applied for in eight foreign countries. NASA owns all of the patents rights. All of the information is public domain.

And it is available for licensing free of charge.

The invention applies to the AC induction motor. I believe, of the 50 million motors that are built each year -- of the motors that are out there -- 90 percent of them are of this type. So it applies to 90 percent of the motors that are in use. And it applies to both single phase motor systems that you have in all of your major home appliances. And that is the type used in light industry. It also applies to three phase motors which is the type used in heavy industry.

And it can be used with most -- I hesitate to say "all" because there are several billion and I am not sure of all of them. But it can be used with most existing motors without any modification to the motor. It just attaches to the wires of the motors and it can sense whether the motor is loaded or unloaded by looking at the phase relationship between the voltage and the current.

When it recognizes that the motor is unloaded and is wasting power, then it will reduce the applied voltage. And when it recognizes that the motor is being loaded, it automatically increases the voltage to whatever is required to keep the load turning.

And there is no sacrifice in performance. If the motor was capable of producing a 200 percent overload before you put this device on, it will still produce a 200 percent overload after you put this device on.

Now, in this chart -- it is a schematic and I am not going to discuss details-- I am going to talk about cost so you get an idea.

There are a lot of ways to make motors take less power, but they are not economical. They won't pay back soon enough. In this device -- you notice that this is where you would plug it into the wall and you would plug the motor into this device. And then this is the main solid state power switch that controls the current flow.

And the price of that will vary with the size of the motor. The size of it and the price will vary. The remainder of the circuit remains essentially the same.

And this circuit that you see here is the same -- should we pass this around?

MR. MCCORMACK: Sure, sure.

MR. NOLA: This is -- the same is on here and this is for the single phase motor which is the type you have in your major home appliances. And I believe of the 50 million motors, 40 million of them are of that type and 10 million, I think, are the industrial type.

So this circuit would apply to 40 million motors that are built each year. And this device right here, for a motor the size of a home appliance would be in the range of $1.00 to $2.00. And then as the motor got bigger, it would go up by about $1.00 a horsepower.

The remainder of the circuit would remain essentially the same. And this, that is in dotted lines, is a monolithic integrated circuit and it would sell for about 35¢ in mass quantities and, unfortunately, if you buy two of them it is still 35¢. If you bought one it is 35¢ which kind of implies that this could kind of be integrated for maybe 50¢ to $1.00.

But these little resistor components are one to two pennies. And the remainder of the components are 10¢ to 20¢ -- 30¢ -- so that the total price of the components is in the range of $3.00 to $5.00.

And usually, I have been told by manufacturers that they could market the device for three times the price of the raw components. And as you will see later on that is what it is being advertized for.

And, remember, that since this solid state switch is in the circuit line, as well as controlling the motor, it can also be used to turn the motor off and on. And I will mention that again later on.

Now, with respect to the testing, I have tested the device on every motor that I could get my hands on, including -- I took it home and tried it on eight home appliances. And I guess we have tested it on close to 50 motors now -- everything from a 1/12th horsepower typewriter motor on up to a five horsepower industrial type motor.

And most motors if they are completely unloaded will

show from 40 to 60 and even as much as a 70 percent savings in the power that they are taking.

Small motors like used in home appliances will normally show a two to five, two to six percent savings even at rated load. And that depends a lot -- the amount of savings depends a lot on what the voltage is coming into your home or into the plant.

If you are right near the power station or near the substation and the voltage happens to be high, this device will save much more than it will if you are a long way and the voltage happens to be low.

You know up in the east and the power begins to get short, the first thing that the utility company does is to lower the voltage five percent. That is to save energy.

Well, that is essentially the same thing that this thing does. It lowers the voltage to whatever the optimum value is to run the motor efficiently.

In larger and more expensively built motors, if you build the motor efficiently to begin with, then it is fully loaded and you are not going to do any better than that. You can't save any power if the motor is built efficiently to begin with if it is running at rated load.

If it is unloaded or partially loaded, you still can save power. And to show that the thing would work, we have assembled 15 units and tested them on everything from type-

writers and vacuum pumps and drill presses and grinders and tube flaring machines. And we were typically seeing a 30 to 40 percent savings in power when the motor -- like on a drill press when it is sitting there and just turning there is a 30 to 40 percent savings and when it is drilling a hole, it may even save 10 to 15 percent.

And I've got a statement -- one vacuum pump ran about 25 degrees cooler with the device. That is these two units right here than I will show you later.

When we gave Auburn the contract to study this, we also furnished them an engineering model -- what we call a "breadboard." And they had an open house for their alumnae and they had this device on display. And it created a lot of interest.

And one of the people who saw it was the General Manager of Russell Mills in Alexander City, Alabama. They had 3,700 industrial sewing machines in this plant. And he asked if he could borrow this device to test it.

So they took the device and they instrumented two machines in the research department. They put this device on one of the machines and then to make sure that both the machines got the same treatment, they simulated the most typical sewing cycle or the most typical duty cycle in the plant which was sewing a sleeve on a garment.

And they ran the test for 21 days for 24 hours a day.

And the device equipped with the machine took 33 percent -- actually 35 percent -- less energy. And they did not have to touch the motor in any way.

And at the present time, in the last few months now, we are starting to get reports from other companies who have tested it and are finding results very similar to ours.

MR. NOLA: Now, to give you an idea of what the savings will look like. What I have plotted here is the percent of power that a motor is taking as a function of the percent load. And the top curve is what a motor would look like without the device attached to it.

At 100 percent load, it would take 100 percent power. If you unload the motor, the power will come down. And when the motor is completely unloaded, it will -- and this top line is the average of the first four motors that I tested. The power came down to about 35 percent of what it was taking at full load. And then when you apply this device, it will reduce that by about a third.

So the savings, then, is the area under this curve. At full load, you may pick up a four to five percent savings. And at half load, you may pick up a 15 percent savings. And at a no load, a 60 percent savings.

Now, the slope of this line is fixed by how much money was put into the motor to begin with. More efficient motors --

the more efficiently, the more money, the more iron that is put into a motor, this curve will have a steeper slope. It will come down more towards zero. And this curve will be up closer to it and the less power there is to be saved.

You may remember, before the war, when you went to buy a half horsepower motor, it was about as big as your head and weighed 30 pounds. And when you go to Sears now, there is a motor on the shelf about that big and it is a half horsepower.

And the reason is that in the olden days, insulations weren't very good. They couldn't stand the heat so they had to build the motors larger so they could run cooler so that the insulations would take it.

Then after the war, fantastic strides were made in insulating materials and power was cheap and plentiful and competition was fierce so they started making the motors smaller and running them hotter.

So many of the motors that are in use, today, are of that type. They waste power.

Then I have one more curve where I have plotted the savings directly as a function of the load. This is the percent of the load on the motor and this is the percent of savings that you will see.

The top line, here, is the average of the first four motors that I tested. And it shows that at full load you will get about a five percent savings and at half load about an 18

or 19 percent savings and at no load, a 60 percent savings.

The other two curves are from the Auburn study and they are industrial type motors. The top one is a three horsepower, three phase, motor. And at no load, that one actually saves 75 percent. The second one at no load saves 46 percent and then you notice, at full load, there was no savings.

But it is our understanding that very few motors that are continuously loaded -- that run all of the time -- are fully loaded. Generally, in blowers or air conditioners where they are trying to get a constant speed, they will run them fully loaded. But in most other applications where motors run continuously, they normally don't load them to over 70 percent.

If you need a seven horsepower motor, they will buy a ten horsepower motor which indicates that there may be a few percent savings in most motors. And, then, of course, if you have cyclic duty out of it which is loaded part of the time and unloaded part of the time, which is the case quite often, then you will be picking 15 and 20 and even 30 percent.

Then I have one more curve on energy savings. And this is the curve that Russell Mills furnished us on the test that they did on the industrial sewing machines. And what they have plotted here is the actual energy in kilowatt hours taken by the motor as a function of the days that they ran it. And this is the days in April -- I can't -- this is the days in April of 1978, and May. And there is 21 days.

So they came in at 8:00 each morning and the read the watt meters. And the motor without the device plotted this line. At this point, they came in and swapped the meters to make sure that there was no error in the meters. And the motor with the device plotted this line. And the difference in the two is the 35 percent savings.

Now, in addition to direct power savings in the motor itself, generally, the power that is being delivered into the plant or into the home has to come from 10 or 15 or 20 miles away. And the power comes out of the generator. It has to be stepped up through a transformer to keep the losses down. Then it is transmitted into the city and it is stepped down again, two or three times. It goes over a lot of transmission -- many miles of transmission lines.

So generally, there is a loss of efficiency to that system or a seven to ten percent loss in the utility company's distribution system.

So what this amounts to -- if you are seeing a savings in -- let's say you are seeing a 100 watt savings in a motor. That same amount of power will be saved also for the utility company.

And that has other benefits to the utility company other than direct power savings. The capacity of their system is governed or fixed by those losses in their system. So what that means -- if they are looking into a load and they are

wasting 10 percent -- 10 percent of the power is being wasted, then they can reduce that power by 10 percent.

What that means to them is that they can go over here and add 10 percent more customers without any increase in capital equipment or capital investment. They only have to string new wires to them and they can start collecting 10 percent more revenue.

Now, there is nothing new about that. The utility companies have known that probably since the turn of the century and they don't like it. And they do penalize large users of motors for it.

For small users like homes and small factories, they either correct for it themselves or they don't do anything at all.

But for a large -- I think the break point right now is if your load is 200 kilowatts. And I understand that that might drop down to 20 kilowatts because they are becomming more conscious of it.

If a factory uses more than 200 kilowatts of power the utility company will hang another meter right along side their power meter that measures what is called the "power factor" of a motor.

Now, technically, the power factor is the co-sine of the phase angle between the voltage and the current, but practically, what it is -- it is a measure of how well the motor is

using the voltage and current being applied to it.

A large, fully loaded motor will be using it 90 percent well. And when it is unloaded, it will only be using it 10 percent well.

So the utility company measures that and if it ever drops below 80 percent, they will hit that company with a surcharge on top of their power bill. And to keep from paying that this company will go out and invest in maybe throusands of dollars in capacitors and they will hang them right across the motor line. And the motors make the current shift one way and the capacitors make it shift the other way. And the net result to the utility company is a reduction of the current in their lines which reduces the losses in their lines. And that allows them to use that same generating station to supply more homes.

So with this device in there, we believe it would reduce the cost that the plant would have to pay for these capacitors as well as help the utility company. Because there is a lot of places where they just live with that loss. And this would help that loss.

One of the licensee's product, before he got into this, was to build a device where he goes right out in the neighborhood and he hangs a device on the power lines that senses the motor voltage. And since they know that most of the loads are motor -- are motor loads -- when the voltage drops, they

automatically start switching in these banks to the capacitors right on the utility pole. It raises the voltage and saves this wasted power.

In addition to that, when you apply this device to the motor it usually runs quieter, but that is not too big an advantage. But it will always run cooler. Since it is heat that eventually breaks down the insulation over the years and makes the motor fail, this device ought to make the motor last longer.

Now, if you have got the motor sitting in a room -- an airconditioned room -- and it is putting out heat into the room. It is wasting power putting out heat into the room, the air conditioner has to overcome the heat that is being put out if it is an airconditioned plant.

To give you an example, the plant at Russell in Alexander City is air conditioned. They did have 3,700 of these machines so this device has been able to save 60 watts on each machine.

So the evidence that the motor is wasting 60 watts is multiplied 60 times 3,700 of power being put into the room because of the heat from the motors. The wasted heat is 222,000 watts.

And that is the equivalent of just opening the oven door and letting the heat pour out. The air conditioner has to be designed to overcome that load.

So if this device were on each motor then you would be able to save. And to overcome that heat in that plant would take 60 to 70 tons of airconditioning which would be the equivalent of 25 central home units.

So that power would be saved in addition to saving on the direct wasting power.

And this one, I covered already. And then the payback time for the device can be enhanced in a lot of cases by the device serving as a double duty.

Most motors, like in your refrigerator or your heat pump or your air conditioner, you need a switch to turn the motor off and on. Remember, I showed you that that device is right in the motor line so that device could serve double duty in the sense of being used also to control the motor. It could also be used to turn the motor off and on.

And since that is one of the principal cost items and if this device were installed in original equipment, it could be built a lot cheaper if it were serving a double duty.

Also, in larger motors, you notice in your home air conditioner, when your compressor kicks on, the lights will flicker in your house. And the reason for that is that the motor takes a large in-rush current to get it started.

Now, in a plant that has very large motors, the utility company doesn't like that and you either have to get special service from them to start that motor or you have to put a

special starting box on that motor that limits that in-rush current.

Well, the same device that it takes to limit that in-rush current is the same device that this thing uses to control the current. So if you had a 100 horsepower motor that you had to put one of these starting limiters on, you may have to pay $100 or $200 for that thing. This could be added for just a few more dollars so that even if you were saving a half a percent, you would essentially be getting a free ride.

And let me point out one thing here. You remember I said that a utility company hangs on -- they go into the plant of a large user and they hang a device called a "power factor meter." And you notice that the technical name of this device that appears on the patent is a "power factor controller."

They measure the power factor and charge for it. This device measures the power factor and controls it.

Now, for what has been done towards commercialization. The device has been publicized worldwide. And in this country it has been publicized in about 35 trade journals and trade magazines. And because of that we have received at Marshall Space Flight Center -- we have received and answered close to 5000 inquiries.

Ten companies are now licensed to manufacture the device. This chart is a little bit old. One company is selling the device right now, but to other motor companies and to motor

users and appliance manufacturers, not to go into production in the use with it, but just to test it and see what it can do for them at this time.

And he has installed about 35 units in the Chicago area and is getting good results. He has it advertized for $13.60 for a one horsepower motor and that is in quantities of 1000. I believe in single quantities it is about -- and in quantities of one, it is about $20.00.

And the Marshall Center is presently evaluating proposals -- four proposals to commercialize the device. And the reason you might ask, you know, why are you having to spend money to commercialize it if ten companies are already building it. And the reason is that our interest is in what it can do for the nation as a whole. Whereas, we are not sure what their interest is.

As I have said, there are 40 million small motors. They may be just interested, you know, in finding a certain piece of that business, and building just for that. Whereas, our interest is nationwide -- the potential.

Now, in this chart here, what I have done is to take some actual test data from tests that I have run in all cases except the industrial sewing machine. And I have estimated -- I have taken the power savings that I saw and I have estimated the number of units in operation in the United States and the length of time that they operate. And I have given an indication

of what it amounts to in fuel savings.

And, once again, this in the case of home appliances is based on tests of just one type of appliance. You may test another type and get less savings. You may test another type and get more savings. So, you know, treat this as just an indication of what you would get if it was applied not as absolute data.

I checked with the Department of Labor and they estimate -- they said that there are close to five million secretaries in the United States. And there are a lot of insurance companies -- this is on typewriters -- a lot of insurance companies have typewriters that run for 24 hours a day.

A lot of high schools have typewriters. So I estimated the number of electric typewriters at five million. And on the first typewriter that I tested the power savings was 30 watts and I estimated that it runs eight hours a day. And the savings for that would amount to about 2000 barrels of oil each day.

I have since tested other typewriters that use more efficient motors or smaller motors, but they don't take as much power. But I also understand that one of the licensees has tested typewriters that take more power. So the numbers may be 1000 to 2000 barrels of oil a day.

On the industrial sewing machine, I checked around and tried to get an estimate. I checked with "Bobbin Magazine."

And the editor estimated that there were about one million industrial sewing machines. And it saves 60 watts per machine. Now, the plant in Alexander City runs two shifts a day. So I estimated that the total savings for that would be about 1000 barrels of oil equivalent each day.

And when I say "barrels of oil," that is generally the way they talk in power savings. Some power plants use gas -- natural gas and some use coal. And it is nice to put everything in terms of barrels of oil.

On my washing machine, it saved -- in washing a load of clothes it saved 36 watt hours. And I believe that there are 75 million households, but I estimated 50 million washing machines washing one load a day would save 3000 barrels of oil. On the dryer it would save -- I estimated it would be 35 million dryers and it would save 55 watts and at one hour a day, it is 3200 barrels of oil each day.

Now, on a refrigerator, it would only save five percent. The power was 13 watts out of 260. That is only about five percent savings. But if there are 50 million refrigerators and they run 10 hours a day. And I understand some of -- this was an old type that frosts up. I understand that some of the frost free run more than that.

But because of the large number and the large length of time that they run, the savings amounts to about 1100 barrels of oil a day.

On a freezer it was about the same. I estimated 25 million freezers and it saved about six percent which was about 7000 barrels a day.

And, finally, this was my blower fan for my air conditioner, it saved about six percent which was about 25 watts. And I estimated 10 million. And the savings was 4000 barrels a day and at $14.00 a barrel, that was about $445,000 a day and I did not take into account any savings to the utility companies or savings for airconditioning.

And then, finally, this last chart is things that I think should be done. I would like to see a study by somebody that is capable of performing the study. And I think it would almost have to be a large motor company who knows motors and who knows their efficiencies -- just to see what it can do on a nationwide basis for saving power, for saving energy.

And I would like to see some of the things -- I would like to tell what the benefits are to plant owners in reducing the costs for these capacitors and what the benefits are to the utility company and cost comparisons of correcting their power factor either by this device or by conventional means.

And I would like to demonstrate the ability of this device to save energy, to limit that in-rush current and to be used as the off-on switch for a motor.

And on this thing about developing a free phase controller that does not requiring attaching to a "Y," the way I

initially built the device for industrial type motors, there is one connection internal to the motor that I had to open the motor to bring out that connection.

Now, in the case of the Russell Mills application, that point was brought out of the motor. In some of them it is brought out and some of them it is not brought out. But I have always thought that that was not necessary and now I understand that Auburn University and one of the licensees does have it working where they do not have to bring that point out. So it essentially now can be attached to all existing motors without bothering the motor.

And then the stability -- it is a closed loop and does sense and feed back to correct so I think it needs to be analyzed and studied to make sure that it will work on all motors. If you are going into production I think that you would want to do that before you start mass producing the device.

I don't know what effects this -- this thing actually chops the voltage, part of each cycle to control and I don't know what effect that will have on the utility companies.

I have talked to them. They don't see any problems. One of the licensees has talked to Chicago Edison and they said, "Just hang all you want on there." They don't see any problem with it, but I think it does need to be determined.

And then, finally, there is a potential noise problem.

What I mean by "noise" is when you turn on a hair dryer or a drill, you may see the ripple in the TV set. This device could possibly effect that and that needs to be studied. I didn't see any effects from it, but one of the licensees has built that protection into the device.

And that, essentially, is all that I have unless there are any questions.

MR. MCCORMACK: Before we ask the questions, there will be a transcript of this press conference available in a matter of days, and if anyone wants one, they can address an envelope on the back table to themselves and we will mail it to you.

The second thing is that we have Mr. Al Hayes from the Department of Energy with us who may feel that there are questions that he could answer.

We have recently concluded an agreement with the Department of Energy to test this power factor controller on three phases of industrial type motors.

Now do we have questions for Frank?

QUESTIONS AND REMARKS

MR. MCCORMACK: Mr. DeLong from UPI.

MR. DELONG: I was looking at your little breadboard model. It looks like it is a fairly simple construction process. Of course, we have the country littered with electronic parts places and with people who like to do their own construc-

tion.

If a body wanted to build this, how would he go about doing it? Where would he get plans and so forth?

MR. NOLA: You mean an individual, if he wanted to construct it?

MR. DELONG: If I wanted to build it?

MR. NOLA: Just write to Marshall Space Flight Center's Technology Utilization office, I guess. If you want -- you know for licensing, you should go to the patent council, but just to build the device or test it, you know, just to test it on your own, just write the Technology Utilization Office and ask them.

And there is a standard package that they send out and it does have detailed schematics in it. Or you can call me if you have any problems.

MR. WILFORD : How long long would it take an individual to build one -- a fairly capable electronics hobbiest?

MR. NOLA: I can put it together in a few hours. I guess, you know, that is hard to say. If you had the parts sitting there. It all depends on the type of construction you use. This type right here -- this type of construction which is not permanent, it is just what we call --

MR. WILFORD : Something more permanent that that.

MR. NOLA Well, you know, I can put that together in -- if I had the parts I could put it together in an hour

and do all the wiring. But if you had a printed circuit and did the solder type construction, you know, several hours probably.

MR. MCCORMACK: Mr. Howard Benedict of Associated Press.

MR. BENEDICT: Can you point out what the device is here on the table -- which one is it? And how big it is?

MR. NOLA: Well, unfortunately, you can't demonstrate this device unless you have a watt meter to go along with it.

What you are seeing on the table -- this right here -- and I can take the back off of this and show you. This right here does have that in it plus a watt meter and the watt meter is more complicated than the device itself. But I had to build a wattmeter into the device to demonstrate it. You couldn't tell what it was doing. Just to have it sitting there doesn't mean anything unless I put is on an oscilloscope and show you.

MR. BENEDICT: I have seen a picture of the one that is manufactured and it looks like it is the size of a cigarette package. If that will help you.

MR. NOLA: I think that the one that is the size of the package of cigarettes is good for about a one horsepower motor. But you need to check with the person who is building that. I haven't seen one of the devices.

MR. BENEDICT: Did Russell Mills after testing this decide that it was worthwhile to go ahead and maybe buy a whole bunch of them?

MR. NOLA: The engineers that tested it are textile engineers. And also the model that I built was much more complicated than the model that you see here.

I knew what I wanted to do. Those types of solid state switches are what is called a triac. And in the space program we used transistors, generally. We don't use that. And I wasn't real familiar with it.

But I did know a way to do it. I knew what I wanted to do and I didn't spend a lot of time. I just got whatever it took to do it and I did it. So the original model had more piece parts in it than this model that you see here.

And the textile engineers that ran the test are not electronics people. They are not people who would know about mass production. They estimated how much it would cost to build it and they were only paying 2¢ a kilowatt down there at the time. So they said, you know, "It is really nice, but we couldn't build it for less than $100 and some dollars." And they said that it would take several years to pay back.

They were definitely interested, but they just didn't see the payback. But now, I think that they could probably buy that device -- I don't know if I mentioned it, but the schematic that I put on the board was for single phase motors. It would

take essentially three times that much for an industrial type motor. Since there are three phases, it is two to three times depending on how you want to build it.

I think that one of the licensees is just building one standard unit that you can put on a single phase motor or he takes three of those same units and he puts them on a three phase motor.

So I would estimate for like about $30 or $35, they could put it on there and I believe that it would pay back -- even at 2¢ a kilowatt hour, it would pay back probably in one to two years. I haven't figured it out, but some time.

I do know that they are interested in it and I have heard that one of the licensees has contracted with a major motor control manufacturer to -- they are going to apply this device, I guess, to what they call the after market -- to the ones that are in industry right now.

So they are planning on going after the textile mills to put this device in.

Incidentally, I didn't mention, there is -- you got one of the handouts, there is a list of the licensees in there.

MR. BENEDICT: Of that, yes, but there is --

MR. NOLA: And it is the first one on the list that has it. And the reason -- I don't mean to single anybody out here, but that is the only advertizement that I have seen for the device. I think there are five on there that have called

us and said, "We are now ready to sell this device." As inquiries come in, we send them all five names. We just generally send them that paper that you have there and tell that we understand that the first five companies -- but that particular individual keeps in touch with me more than the others do so I am just more aware of what he is doing.

The other companies may be doing more with it or, you know, they have it for sale also. He is the only individual that I have seen an advertizement for. And that is why I mentioned him.

MR. MCCORMACK: There is a copy of the vu-graphs on the back table by the door for those of you who may --

MR. NOLA : I have been told by one plant -- the Adelet-PLM Corporation, which is close to a billion dollar corporation, that they plan to build a new building just to manufacture the device.

But I do communicate more with Electronic Relays than the other and I am more familiar with what he is doing and that is why I mentioned his name.

MR. MCCORMACK: Frank, we have another question over here.

MR. WILFORD : You mentioned that there were 35 trade magazines that had been running press releases?

MR. NOLA: Well, the Marshall Space Flight Center releases, you know, puts out a press release and these magazines

pick it up and print it.

MR. WILFORD: Could you just tell me some of the names of these publications?

MR. NOLA: It has appeared two times in "IEEE Spectrum." January, 1979, was the last time in the "Forum" section. It appeared once in "Popular Science" and they are now gathering information. When they printed the first article it was just little and I said "We will bring you more on this later." So I have just mailed them a lot of information and I think they are planning on doing another story on it.

One of the licensees has just written an article for "Appliance Magazine." I haven't seen it yet, but I understand that it is out right now. I can tell you all of them -- just one second.

MR. MCCORMACK: I think that is in the packet by the door if you want --

MR. NOLA: "Paul Harvey News," Wall Street Journal," "Kipplinger," "Washington News Letter." UPI Press interviewed me on the radio -- UPI radio. Louisville TV Productions which is syndicated, did a little story on it. "IEEE Spectrum," "Popular Science," "Industry Week," "Chemical Engineering News," "Quality Reports for View of the News," "National Science Institute Newsletters," "Bobbin Magazine," "Phasa," which is an Iranian magazine.

We have gotten requests from all over the world on it,

South Africa.

MR. WILFORD: Is there a list that I can pick up on those publications?

MR. MCCORMACK: Yes, there is.

MR. NOLA: You can have this one. I don't know if anybody else wants one, I will have to see if I can get some run off.

MR. MCCORMACK: I can have one run off.

MR. NOLA: I believe that is the only copy that I brought for some reason. Do you want to have this run off?

MR. NOLA: And keep this then.

MR. DELONG: Ed. Since we've got a DOE man here, I am just curious on what DOE's position on this is and whether they are going to attempt to do anything to commercialize it since that really is the area that they are in?

MR. NOLA: All I can tell you is that we presented it to DOE and it was addressed, I guess, to the extent that they agreed to give us some money for those requests for proposals that I told you about. And I will let Mr. Hayes answer that.

MR. MCCORMACK: This is Al Hayes from DOE.

MR. HAYES: I thought that you would never ask. I wanted to get up here to speak to you just for a minute. I am an engineer with the Department of Energy. I am with the Conservation and Solar Applications Office, the Industrial Programs Area.

My principle responsibility is the industrial equipment in the Deficiency Office. Our basic concern is with industrial equipment, motors, compressors, ovens, kilns, furnaces, electrolytic devices, a whole range of things.

We have a program currently which involves the commercialization of high efficiency motors. And as Frank has said, he has given us his presentation at the Department of Energy and we looked at it and we determined that there are some opportunities for mutual interest in this device.

Presently, our efforts have been aimed at commercializing high efficiency motors. In a high efficiency motor the power factors are generally very close to one. There are basically given certain specific duty cycles and use patterns, industrial situations -- power factors that need no correction.

We recognize that. There are instances where a high efficiency motor or something less than a high efficiency motor when run under varying circumstances and varying loads, power correction is significant and can be used and employed in energy savings.

As Frank said, as a result of our discussions, we have decided to enter into an agreement with NASA and we are co-sponsoring an effort at the level of $75,000 presently to take a look at the device, to further understand that applications and the actual savings, where the savings are, what the savings are, the utilities, what the savings are to the user. And just to define the characteristics of the device and how we can better define what the savings are.

I must also mention at this point that Frank's device is what I term a "dynamic power factor controller." There are people who have also invented things that I have called a "static power factor controller." You may have heard of the "Wadless Device."

The Department of Energy tested that device and that essentially is a static power factor controller. What it does is basically find tools or motor to the load. The only problem there is if the load changes on that motor then the power factor goes askew, again.

What Frank has is a device that dynamically controlls the power factor and keeps it within certain limits and allows you to realize savings with the full operation of the motor.

Just so I won't run on too far, there are a couple of items that I have a responsibility for in the Department of Energy.

There is a legislative mandate requiring that the

Department of Energy take a look at classifying and evaluating electric motors and pumps. They are big energy users. The Arthur D. Little study that Frank mentioned was a study sponsored by the Department of Energy. I was the project officer for that effort when it was conducted.

In that effort we were able to characterize the use of motors across the country and industrial applications and then some commercial applications. We know where some of the problems are.

As a result of hearing the concept invented by Frank and other concepts such as the (inaudible) concept, we have evaluated some things. We are interested in this and we are entering into the (inaudible) agreement as I just mentioned to help, look at this, and see how it can be commercialized and integrated into the commercialization program for high efficiency motors.

MR. MCCORMACK: We have a question beside you, Al. What is your name, sir?

MR. WILFORD: Tom Wilford. I am with"Energy Management" publication. Are there any manufacturersof high efficiency electric motors that would be able to conduct these studies?

MR. HAYES: Oh, sure. There is a principal motor manufacturing association. It is called National Electrical Manufacturers Association -- NEMA. There are about 33 motor manufacturers in this association. They are the major industrial

motor manufacturers.

Now, there are some major motor manufacturers outside of this association. There are about eight to ten. So, in all, let's say that there are about 40 industrial motor manufacturers in the country.

MR. WILFORD: How many of those motor manufacturers produce high efficiency electric motors?

MR. HAYES: Okay. My source of information is the "Energy Users News." I don't know whether you have seen that publication or not, but they claim that to date there are only about eight to nine motor manufacturers who are producing high efficiency industrial motors.

MR. MCCORMACK: Ed?

MR. DELONG: I wonder if either of you gentlemen have a more precise estimate than several billion on the total number of motors in use today.

MR. NOLA : I think that the study said "10 billion," but I hated to use that number. That sounds like a -- but our Public Affairs writer had something that she got from somewhere. I don't know where she got it, but it said "10 billion." That sounds like a high number.

MR. HAYES: I really don't have anything better than that. Our most reliable source of information was the Arthur D. Little study that we had conducted and a report came out on it in 1976. If you need a copy of that, you can contact me.

And I can get -- we have plenty of copies of those things.

We will probably get new information which perhaps will confirm that data. We do have to conduct this classification and evaluation study to give a report to Congress in 18 months which means by May of 1980 we should have a report to Congress on where the usage is and what the opportunities are in electric motors and pumps.

But I don't see that any new data would basically refute what has been said essentially already.

MR. NOLA: We have received a lot of letters from companies that say that they have 8000 motors in the plant, 2000 motors in the plant. U. S. Tobacco in Nashville says that they have 2000 three horsepower motors that make pipecleaners and the motors run half of the time loaded and half of the time unloaded.

And in that type of application you would see a significant savings.

MR. : (Inaudible) that when you make statements like "motorists consume 2/3's of all electrical energy generated, use 1/3 more energy than automobiles, etc.," there must be some more precise data base than several billion on which to base statements like that.

MR. NOLA: That came out of the A. D. Little study. It is a book this thick. They can tell you that 34 percent is in compressors. It is a pretty detailed study.

MR. HAYES: I don't have a copy with me. If you are asking if there is more precise information, I would say at this point that there basically isn't.

You know, before the energy crunch -- this study was published in 1976 -- there was basically no real interest in saving energy at this level. I mean, the electric motor, the electric power sources of energy were relatively cheap. Savings of 20 to 30 percent in the electrical motor wasn't of interest to most people.

Now, as it is cost effective and as energy costs increase then it will be even more significant and you will have more people interested in using power factor controls and using high efficiency motors and in doing various things to correct the real opportunities for conversation than savings, economic things.

But it has got to be cost effective, otherwise, you won't get a manufacturer to interrupt his production to try to modify motors with power factor controls or anything else.

MR. WILFORD: Just to point that out, this was data that was compiled by the Labor Department for HVAC Statistics. Electrical energy used in the industrial sector as of the oil embargo from 1974 and 1975, the energy price index has gone up 127 percent. And that is in four years. So there definitely is an increase in the cost of that energy.

MR. HAYES: And that makes the device and high

efficiency systems a lot more attractive at this point in time. This hopefully will be revealed in the document that has to be published by the Department of Energy in the so-called report to Congress on industrial motors and pumps.

MR. MCCORMACK: I have a little story that I thought was interesting. I asked Frank how long it took him to -- how does an inventor make an invention? How do you do it? And he said, "Oh, it was mostly luck." And then I probed further and I found out that he worked his way through college rewinding electric motors and the problem had been with him for a number of years.

So it probably was something that was percolating in the back of his head for 20 or 25 years before that dumb luck came and happened.

MR. MCCORMACK: Any more questions?

MR. HAYES: By that time, it was educated luck.

MR. MCCORMACK: Yes.

(Laughter.)

MR. MCCORMACK: Okay, thank you very much, gentlemen. Thank you, Frank. And thank you, Al.

(End of the portion requested.)