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**From:** PAS

**Project:** Plasma Arc Speaker

**Subject:** TRIZ Insights and Patent Search

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A review of the TRIZ “Feature to Improve” categories for the plasma arc speaker resulted in several relevant relationships to the project.  
  
Force is a feature to improve due to the input force possibly creating an undesired result of high speed in the movement of electrodes.  Suggested design principles for solving the problem are equipotentiality, inversion, dynamicity, and replacement of a mechanical system. Equipotentiality is not a viable option since it requires the electrodes to not be raised or lowered, and inversion is not an option because it requires other objects to move instead of the electrodes.  Replacing the mechanical system is not likely since other alternatives, such as electromagnetic devices, have already been considered and cannot be used.  Dynamicity requires more parts to move which is not likely, so the solution will most likely be an increase in friction within the mechanical device to slow the speed of the electrodes.  
  
Improving the stability of the object resulted in a potential undesired result of energy spent by the mechanical device.  A higher input force will be required due to more friction for maintaining the electrodes in a fixed position and slowing their speed.  Potential solutions to the problem were inversion and periodic action.  Inversion is not useful, as previously stated, as well as periodic action being an unlikely solution, since electrodes must be maintained in a fixed position following movement.  
  
Strength improvements could result in an increase the amount of substance used.  Solutions include prior action, using inexpensive, short-lived objects instead of expensive, durable ones, and using a pneumatic or hydraulic construction.  Prior action cannot be considered since the only stress involved is caused by movement of the electrodes at the time of operation.  The parts requiring the most strength are already limited to the material used and cannot be replaced.  A pneumatic or hydraulic construction is overkill for this project.  The project will move forward with allowing an increase in the amount of substance for a stronger design.  
  
Durability improvements of the mechanical device may cause an increase in the amount of substance also because an increase in material can create a more durable part when dealing with small parts.  Solutions include local quality, prior action, transformation of the physical and chemical states of an object, and using composite materials.  Prior action has been ruled out of consideration.  Changing the states of the parts is also not possible since the objects used cannot change states.  Using composite materials would also be overkill for the scale of this project.  Local quality solves this issue, which places parts in conditions, which favor their use, such as using the prototyped parts for a prototype only, but not as a long-term product solution.  
To improve the waste of substance in the product, the strength and durability of the mechanical device could be compromised.  Solutions include local quality, mechanical vibration, copying, using inexpensive, short-lived parts instead of expensive, durable ones, replacement of a mechanical system, use of porous material, transformation of the physical and chemical states of an object, and using composite material.  Composite material, changing states of the parts, replacing the mechanical system, and using inexpensive, short-lived parts have all been eliminated.  Mechanical vibration is not useful since oscillation is not used.  Copying has been used in several parts which are commercially available.  Porous parts are an option to use for the mechanical device parts and the entire electrode housing.  Local quality will continue to be used as a solution, as previously stated.  
  
Reliability improvements may affect the complexity of the device because simple products are more reliable than complex products.  Potential solutions are segmentation, inversion, and transformation of the physical and chemical states of an object.  Inversion and changing states have been eliminated, while segmentation has been implemented by dividing the mechanical device into independent parts, which can relied on individually.  
  
Improving the accuracy of manufacturing results in a waste of time since more time is spent for better manufacturing.  Solutions include mechanical vibration, copying, replacement of the mechanical system, and changing the color.  Mechanical vibration and replacing the mechanical system have been eliminated.  Copying is already in use, as stated previously.  Changing the color is not likely since the parts are only available in one color.  
  
Manufacturability is an important feature to improve but it can negatively affect the complexity of the device.  Solutions include segmentation, copying, and inexpensive, short-lived parts instead of expensive, durable ones.  Segmentation and copying are in use as stated previously, while inexpensive, short-lived parts are not an option.  
  
Reparability improvements can result in undesired problems with the level of automation.  The level of automation allowed is limited when the focus is on future repairs of the product.  Solutions include nesting, inversion, rejecting and regenerating parts, and transformation of the physical and chemical states of parts.  Inversion and changing states have been considered and eliminated.  Nesting is in place already by including electrical and mechanical parts inside of the electrode housing.  Rejecting and regenerating parts cannot be utilized because parts are securely in place until changed by a person.  
  
Improvements to the complexity of the device will negatively affect the convenience of use of the device.  Solutions include prior-counter action, mediators, copying, and replacing inexpensive, short-lived parts for expensive, durable ones.  Replacing parts has been eliminated, while copying is in use.  Prior counter-action can be implemented using friction to counter forces that will be encountered in using the mechanical device to lower and raise electrodes.  Mediators are in use for the mechanical device, which is composed of various parts connected to others, which allow for easy removal and interchangeability.  
  
A patent search was conducted to find any patents relevant to a plasma arc speaker.  The term plasma was used at first but was too broad.  Searching for plasma arc ended with no results. Plasma arc speaker and plasma loudspeaker found information on distortion and noise caused by a plasma arc sparking in electrical equipment.  Ways to block noise and distortion created are also a focus of those searches, which are not relevant to the speaker.  Results for plasma speaker included irrelevant patents on plasma displays.  A search for tweeters found nothing plasma related.  The final term searched was speakers which found nothing relating to plasma.  The patent search did not bring forth any new information to the project.