Parts Reduction Design by TRIZ II

– To break down conventional designs and stay one step ahead –

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Purpose and Theme of Presentation

Purpose

Main Theme of the symposium this year

"Change Risk to Chance with TRIZ!"

Purpose

Technology should evolve to avoid the risk of goods commoditization and to maintain domination in the market. To achieve this, conventional designs have to be broken down, but there are cases where it is difficult to find contradictions in conventionally followed structures. Therefore, it will be shown that there is a chance to tie to a good design by an expert's view or a new invention by applying trimming.

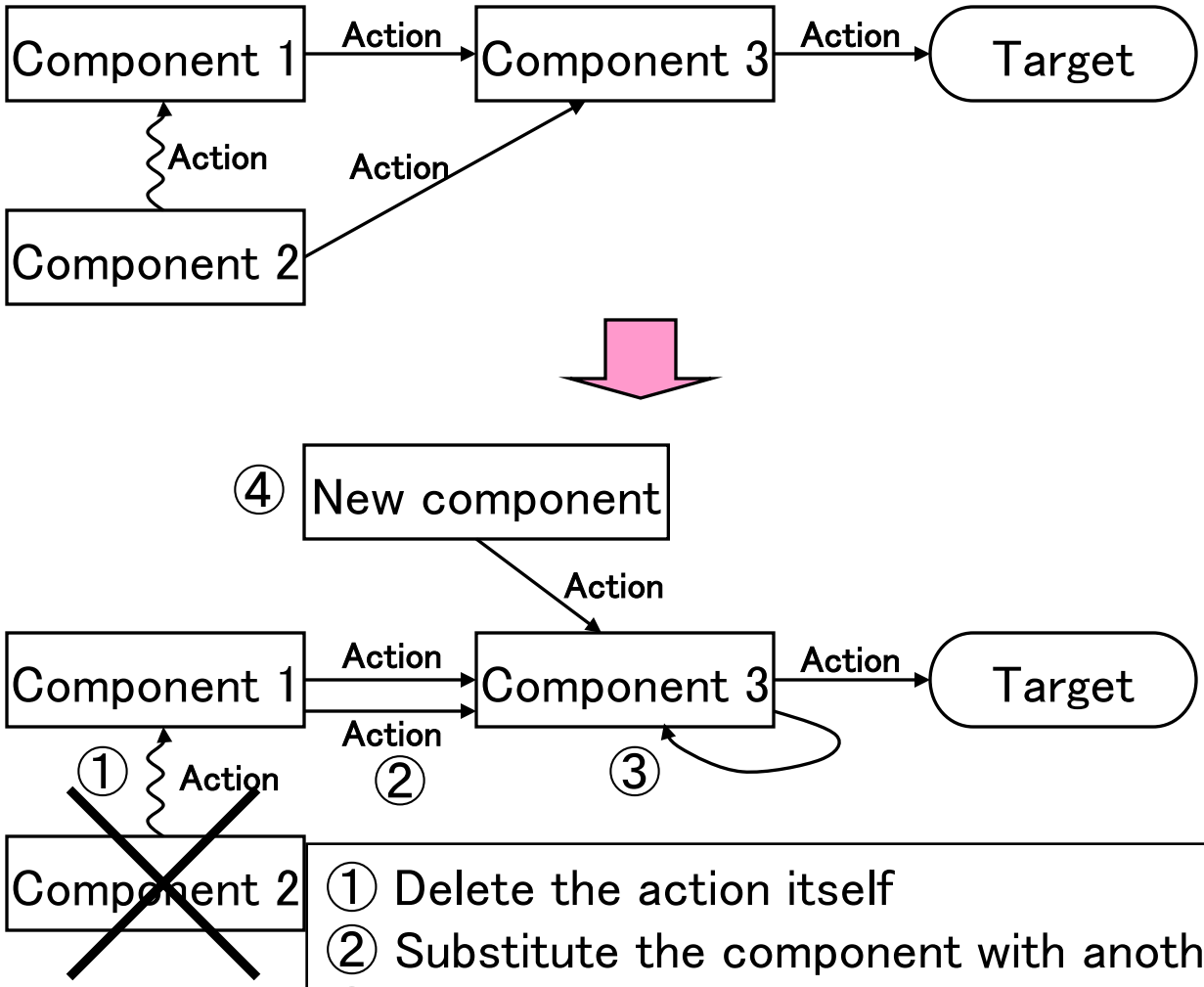
Theme

Proposal of a view that breaks down conventional designs by trimming

Good Designs can Be Made by Trimming!

- It has always been said that a simple design decreasing the number of components is a ″Good design,“ a design of experts.
- If so, how can such a design be made? This seems to be dependent on individual skills, something that cannot be taught, and something that is not taught even if one asks for it.
- Besides, the most effective method for circumventing a patent right is to develop a new invention that decreases the composition requirements from the former patent, but it seems that little information exist that shows a concrete way how to achieve this.
- As trimming shows a view to decrease the number of components, it is a method which has the possibility for a simple design or an idea that exceeds the prior invention. Therefore, I will introduce cases which can serve as a trigger to break down the conventional design.

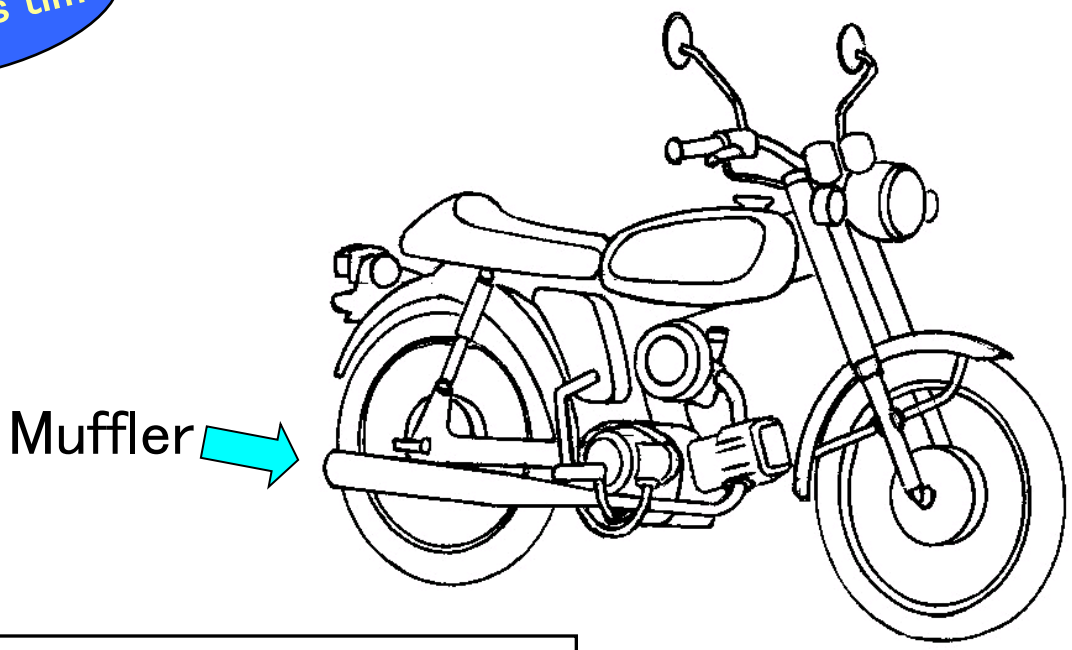
Way of Thinking in Trimming



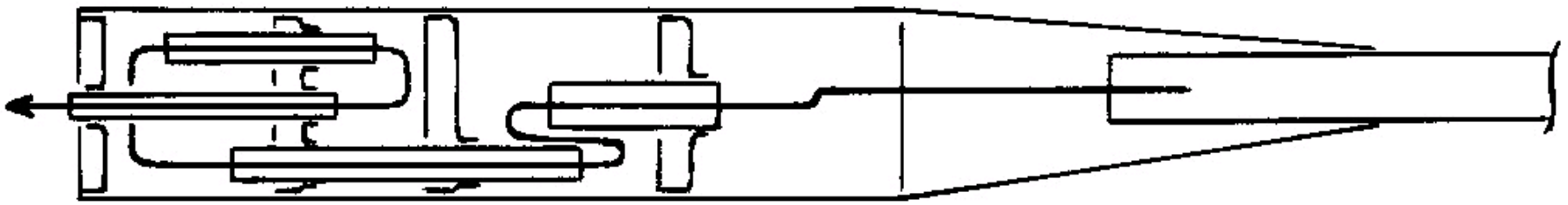
① Delete the action itself
② Substitute the component with another
③ Provide the action by the component itself
④ Substitute with another new cheap component
⑤ Delete the component

Composition of the Muffler for a Motorcycle

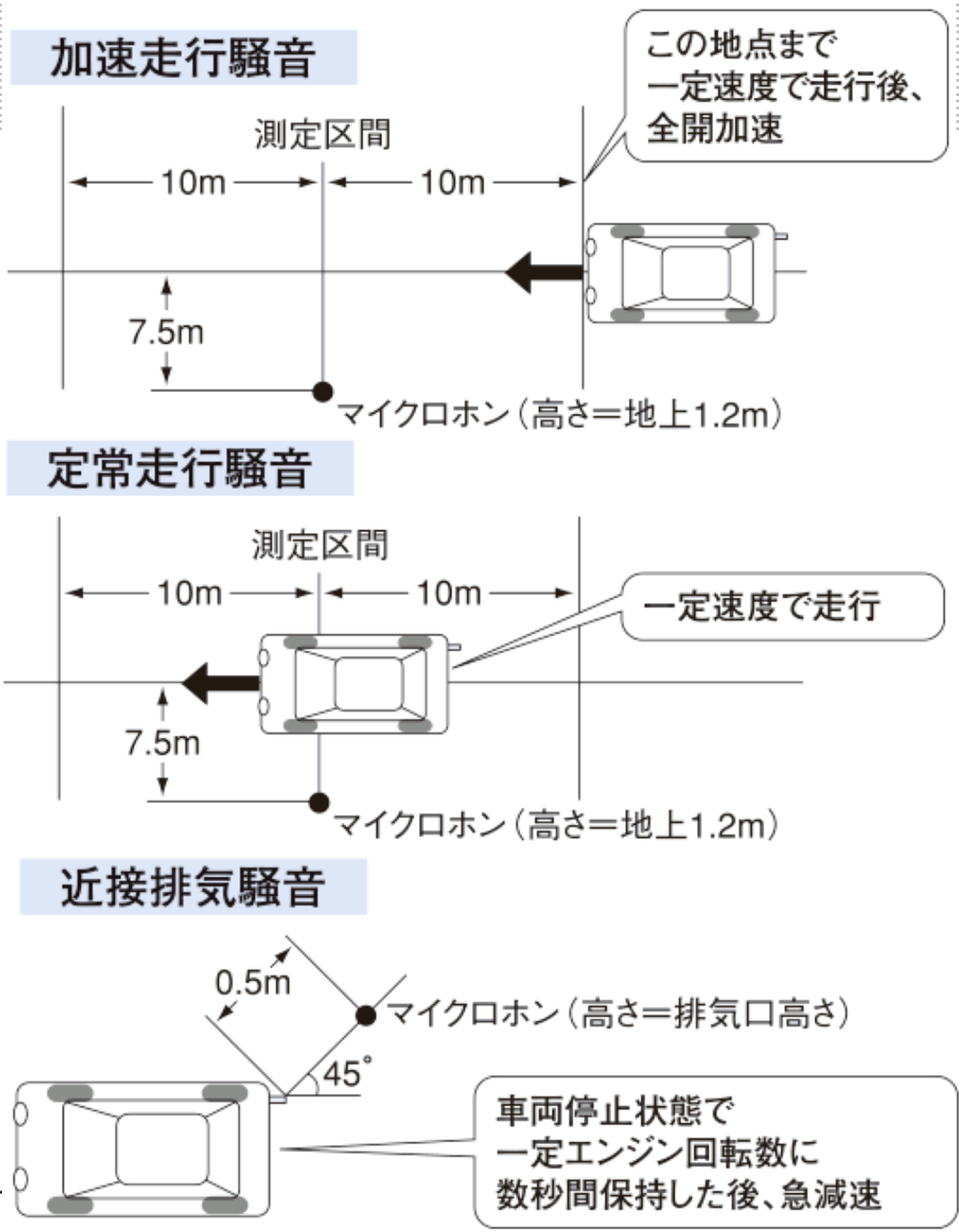
Previous time



Structure of an expansion type muffler



Automobile Noise Test Method



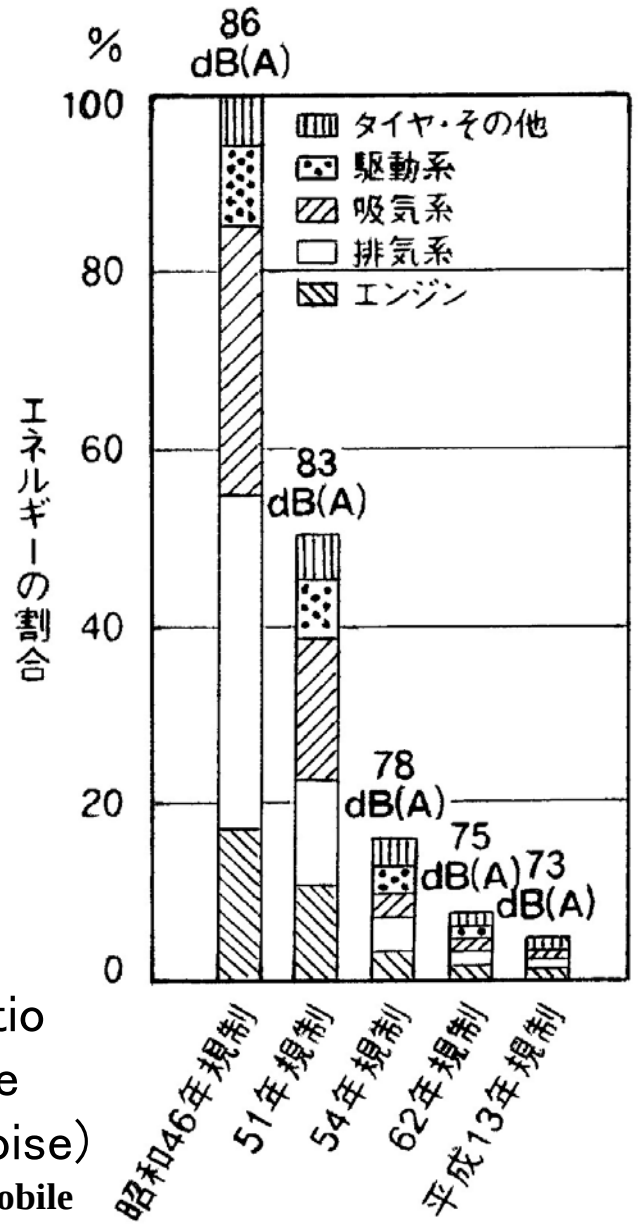
Source: Japan Automobile Manufacturers Association HP

Noise Regulation Value

（単位：dB）

		定常走行騒音	近接排気騒音	加速走行騒音
乗用車		72	96	76
二輪自動車	小型	72	94	73
	軽自動車	71		
原付自転車	第二種	68	90	71
	第一種	65	84	

The regulation values for the motorcycles are severer than those for the cars. Application to the imported cars …



Composition ratio by sound source (acceleration noise)

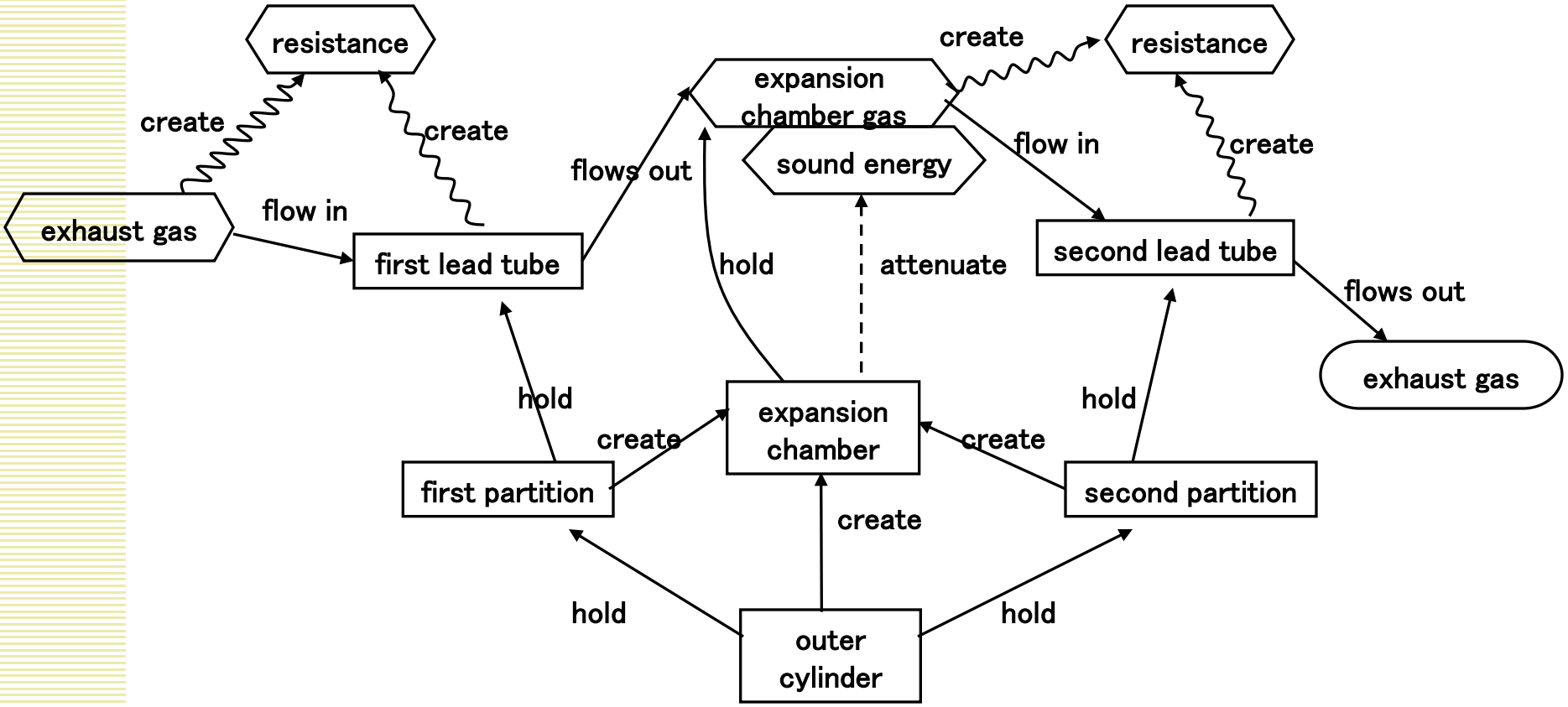
Source: Japan Automobile Manufacturers Association HP

Adoption Reason for Expansion Type Muffler

1. The resonance type is not effective for single cylinders
2. No durable and practicable noise absorbing material found
3. The active type is not practicable for lowering the exhaust sound because of the wide frequency
   Therefore, the communication path area was narrowed down for noise reduction, and it was tried to recover the resulting power reduction by expanding the muffler volume
4. Even if cost is put on the muffler, it doesn't become an immediate charm quality.
5. As specification can be decided by simulation, and development in a short term is possible, a new method is not tried to be examined.

- Though there are needs for downsizing, the conventional method is followed because of development efficiency etc., and the muffling method hasn't changed
- As the same structure has been adopted for a long time, there will be an impact if the structure can be made simpler

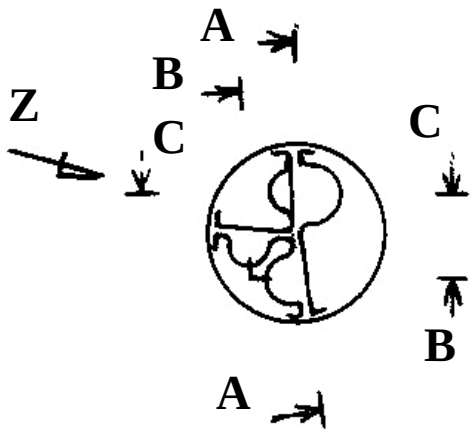
Function model of the Muffler

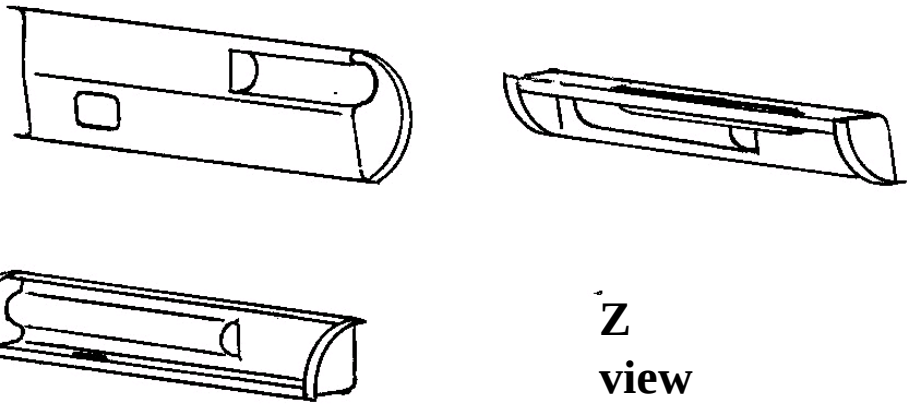


As our objective is to reduce parts maintaining the current expansion type muffling method and not to think of a new one, the solving of harmful effects will be neglected, and physical actions relevant to the structure will be targeted.

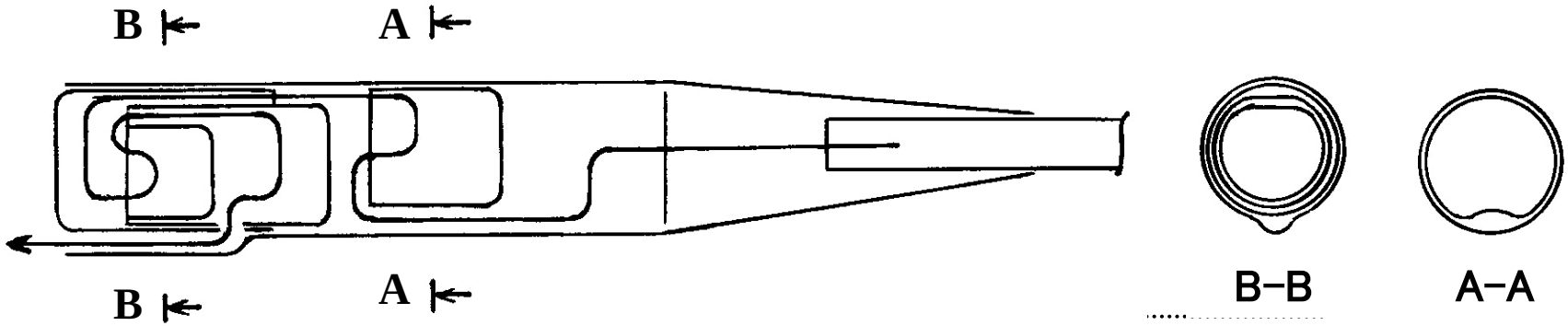
Ideas obtained by trimming

An idea that substitutes the action of communicating vessel with the partition





An idea to substitute the communicating vessel with the partition and the outer cylinder



Further trimming?

This time

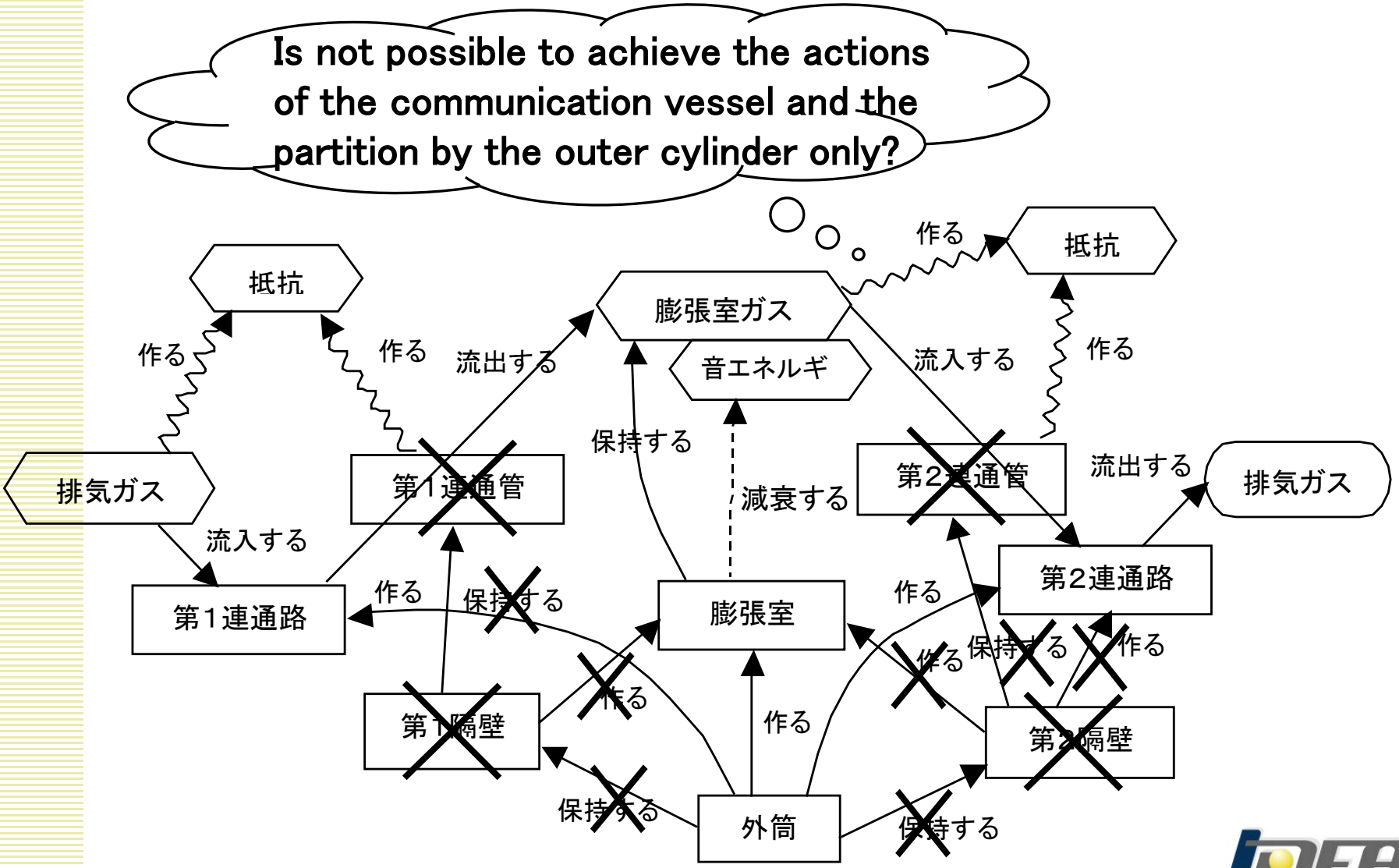
- Seeing the function model, an idea could be generated by substituting the action of the communicating vessel with the partition and the outer cylinder to trim it, and it was announced last year.

- It was a new idea through trimming, and it could provide a simple structure that was conventionally not available (it was not an introduction of something already in actual use as a trimming case study).

- However, as it was a trimming of just the communicating vessel and hadn't reached the perspective of trimming the partition, it was yet insufficient from the viewpoint of reducing the components.

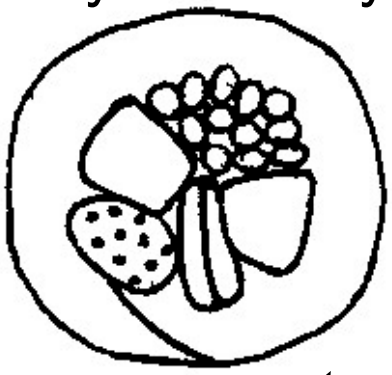
- As the ultimate form is to also trim the partition and realize with just the component outer cylinder (only one component), further trimming will be considered.

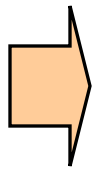
Trimming model substituting with the outer cylinder only

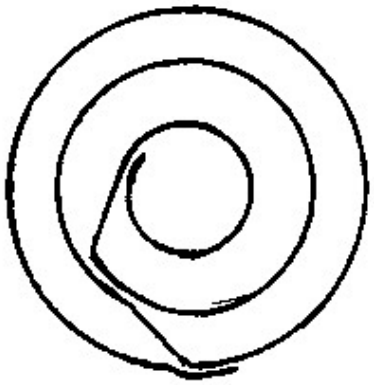


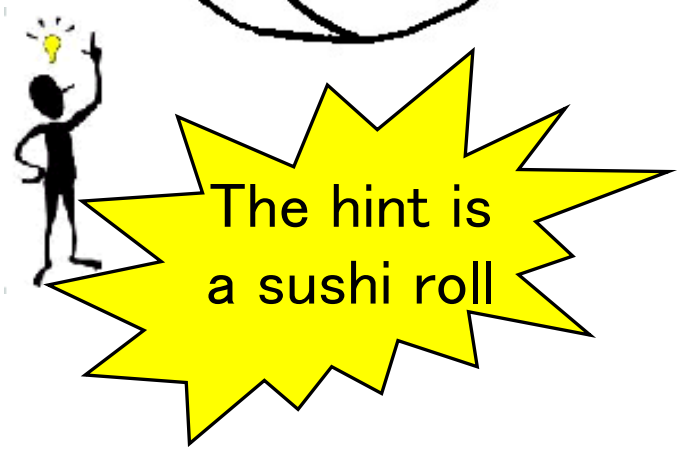
Idea substituting with the outer cylinder only

To form the expansion chamber with the outer cylinder only



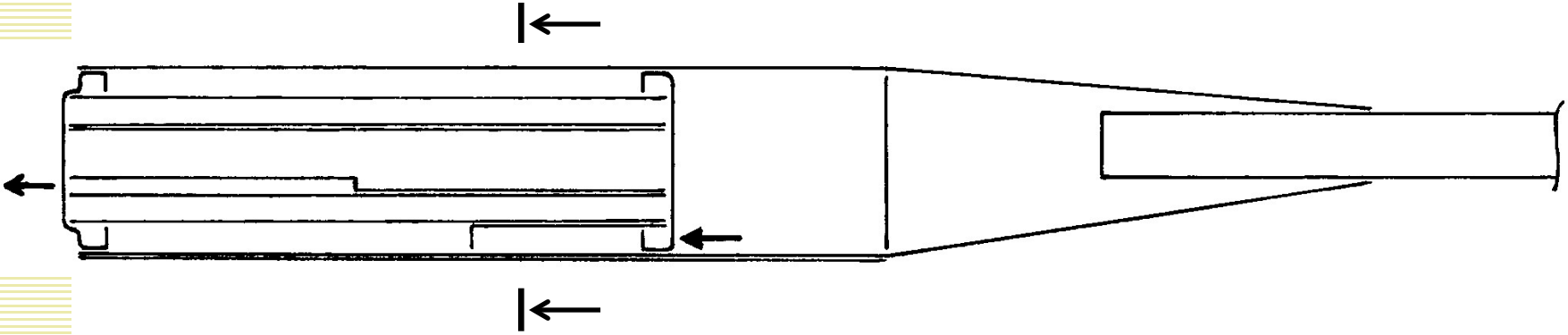


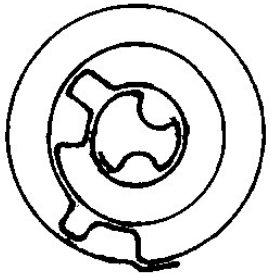


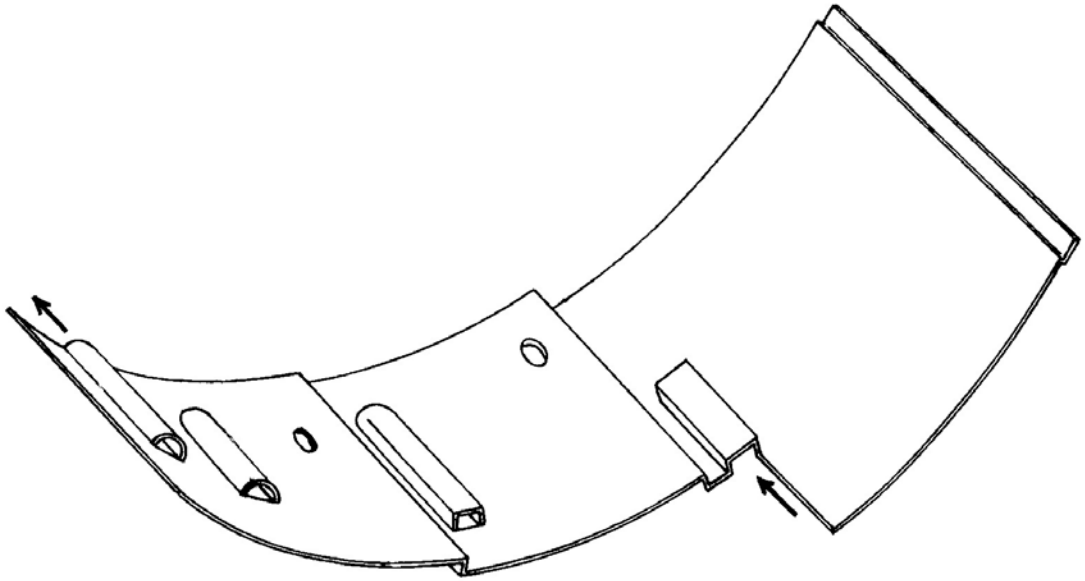


It is possible to divide into rooms if rolled spirally

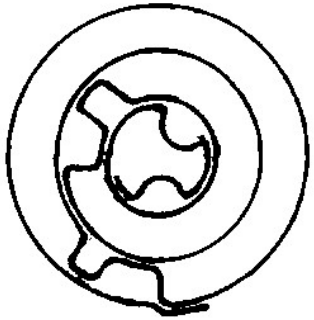
Idea substituting by the outer cylinder only

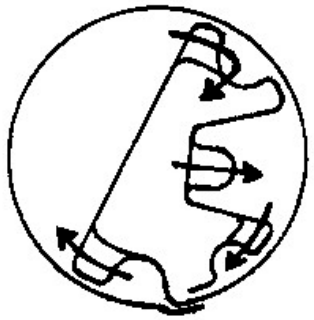






Association of ideas



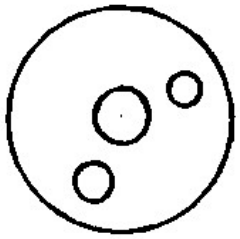
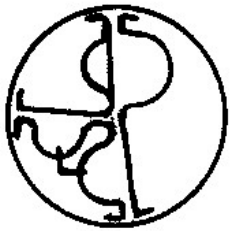
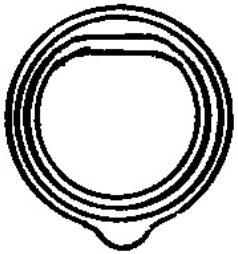
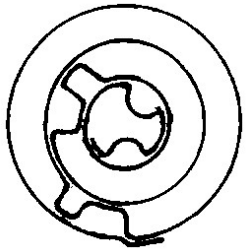


Doesn't it need to be a spiral to partition rooms?

This also can divide into 3 rooms and provide a communicating vessel

These kinds of ideas can be generated even though it is necessary to consider the sealing of the overlapping parts

Reduction comparisons of components

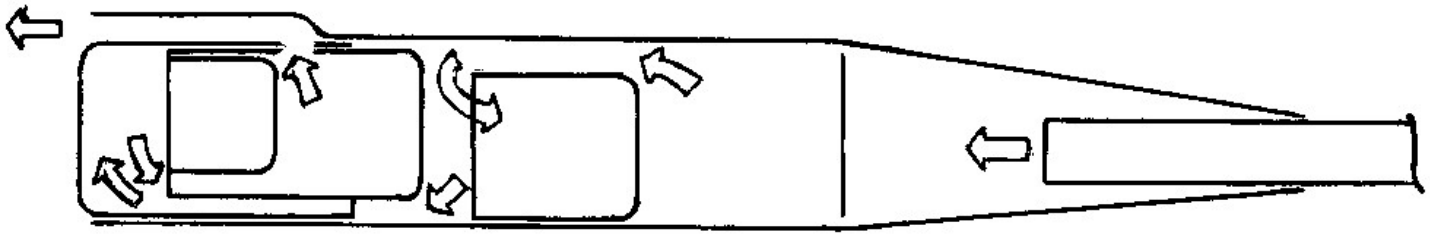
	Original: partition + communicating vessel	Substituting with partition	Substituting with partition and outer cylinder	Substituting with outer cylinder
Specification				
Number of components	Partition: 4 Lead tube 4 Outer cylinder: 1	Partition: 3 Outer cylinder : 1	Partition: 4 Outer cylinder: 1	Partition: 2 Outer cylinder: 1

① Delete the action itself
② Substitute the component with another
③ Provide the action by the component itself
④ Substitute with another new cheap component
⑤ Delete the component

Try to force yourself to think of various substitution targets in the view shown through trimming

Further reduction from the trimming idea

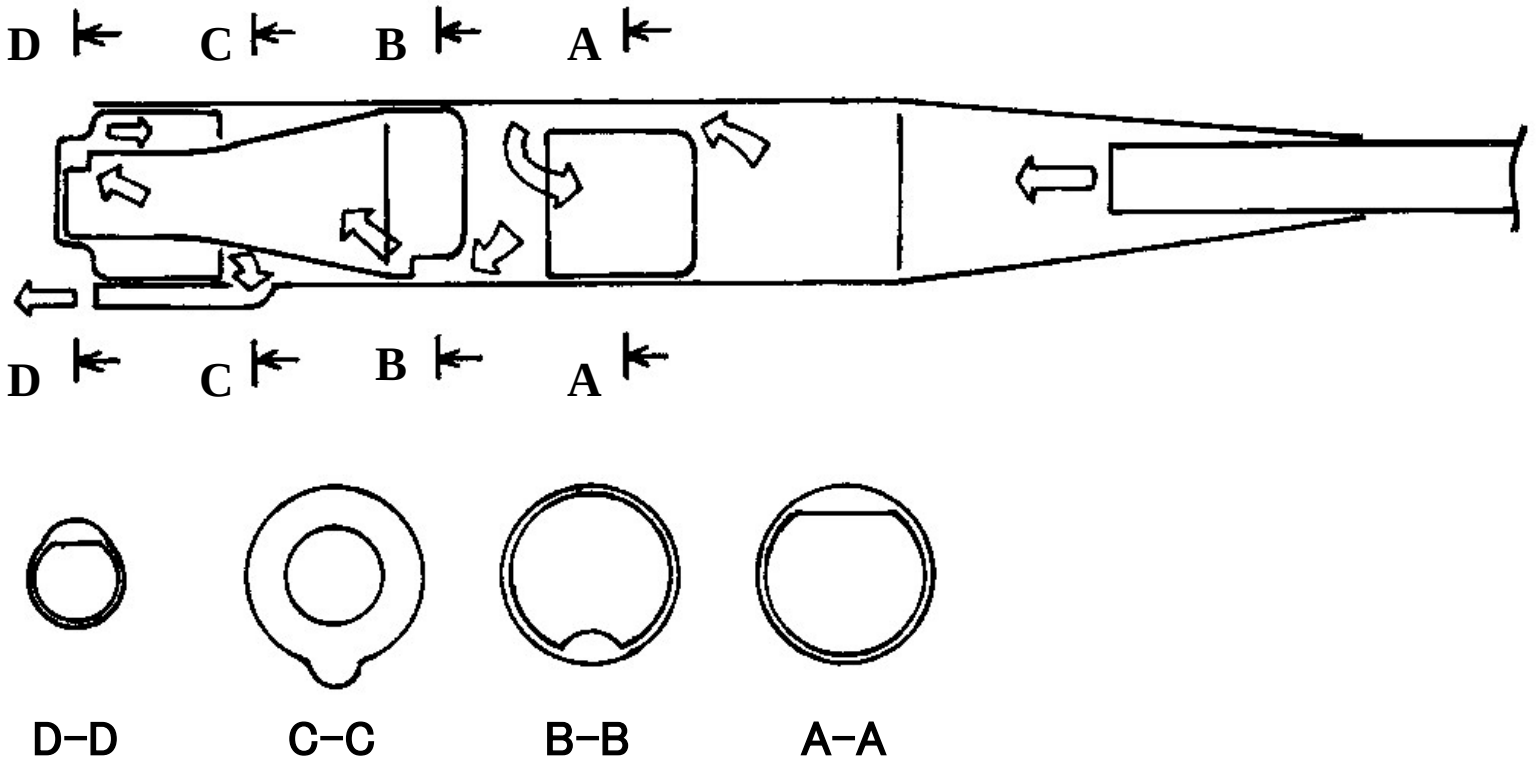
When generating trimming ideas, we generally tend to search for ideas with high feasibility rating. Consequently, we are apt to get easily satisfied saying like ″The communicating vessel could be trimmed, …”



To go further ahead, more components should be trimmed.

Based on the already-generated trimming ideas, isn't it possible to generate further ideas where the partition can be trimmed by thinking without the restriction of manufacturing, etc. and disregarding the feasibility?

Association of ideas

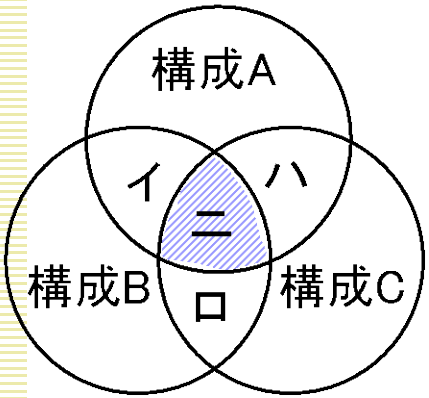


This is an idea, which was forcibly generated disregarding feasibility, decreasing the number of partitions from 4 to 3 and composing 3 expansion chambers. When you consider the alternative, clues and chances to new manufacturing technology development can be obtained from this.

New invention

Trimming for a new invention

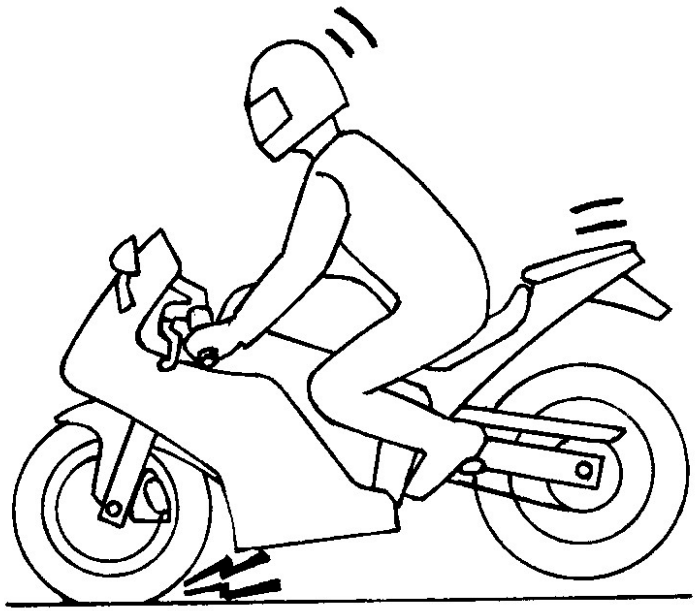
As the view by trimming is “Reduction of components,” whereas problem solving is “Solution of contradictions,” is it not possible to use trimming to complete a new invention without infringing an existing patented invention?

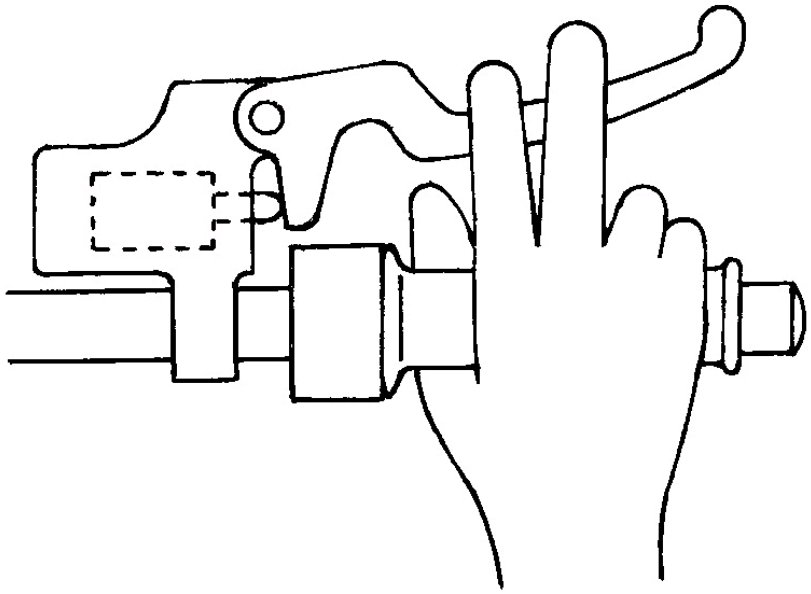


If the patented invention consists of A, B and C
・Patent infringing case
[ニ] (includes all compositions A, B and C)
・Patent non-infringing case
[イ] (includes compositions A and B, but not C)
[ロ] (includes compositions B and C, but not A)
[ハ] (includes compositions A and C, but not B)

Since purposes, actions, effects and detailed descriptions of the invention are taken into consideration as the technical range, trimming is examined including cases where the composition requirement is an attribute

Front brake of the motorcycle

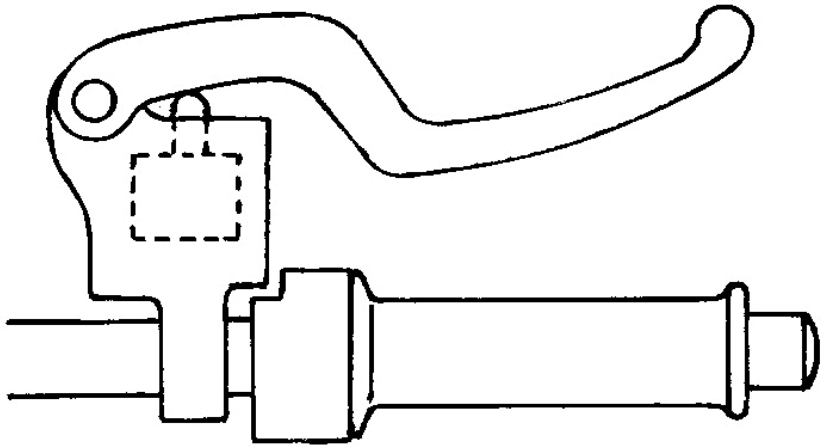




Thrust piston type master cylinder

- To increase the breaking force, caliper pistons with 4 or 6 pots are commonplace
- Should be effective without enlarging the lever stroke
- However, delicate lever operation should be possible

Radial piston type master cylinder

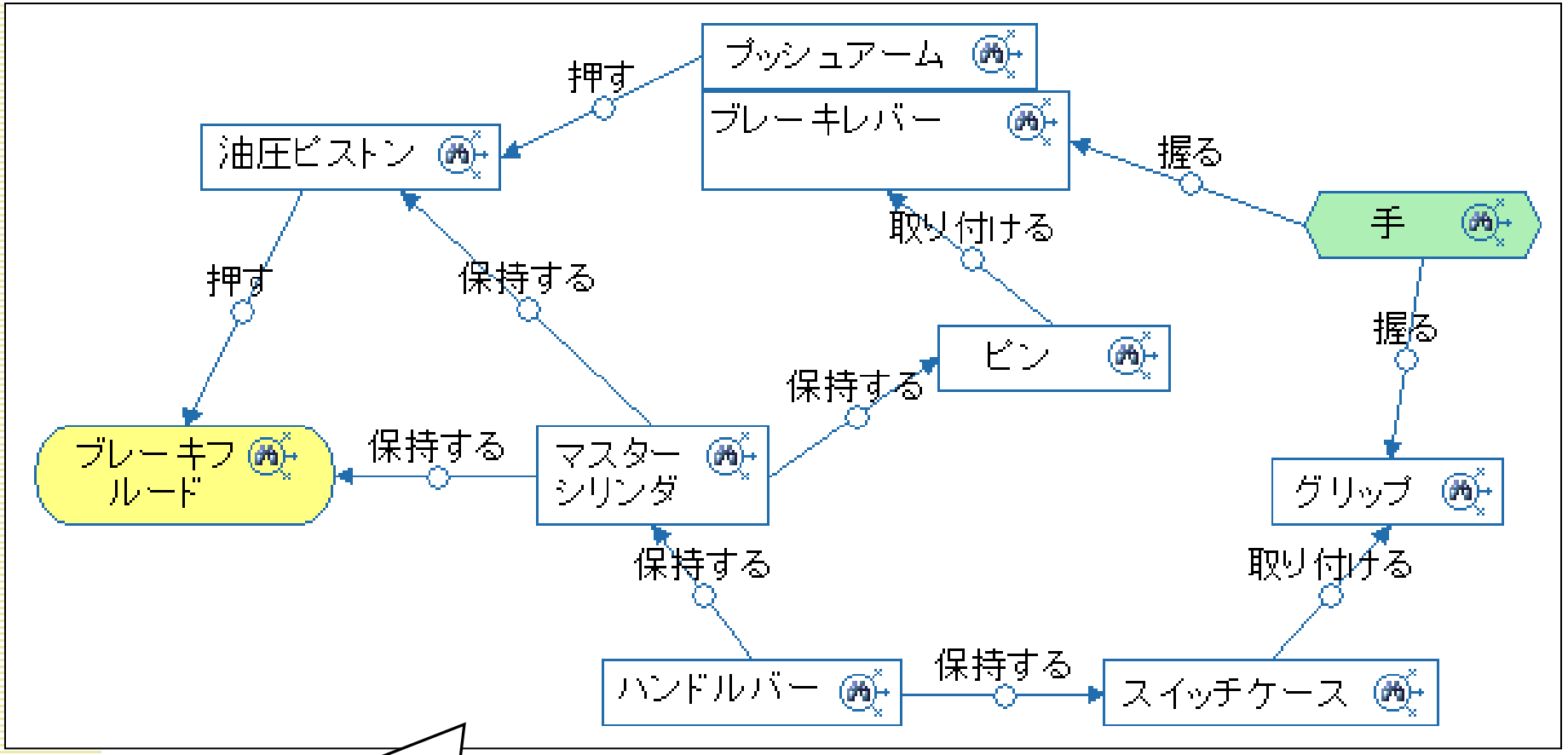


・Delicate lever operation is possible because the brake lever can be lengthened

・As the piston diameter can be enlarged, the oil feed amount can be increased, so a short stroke can give a reaction even in 6 pots, etc.

To enable such idea generations …

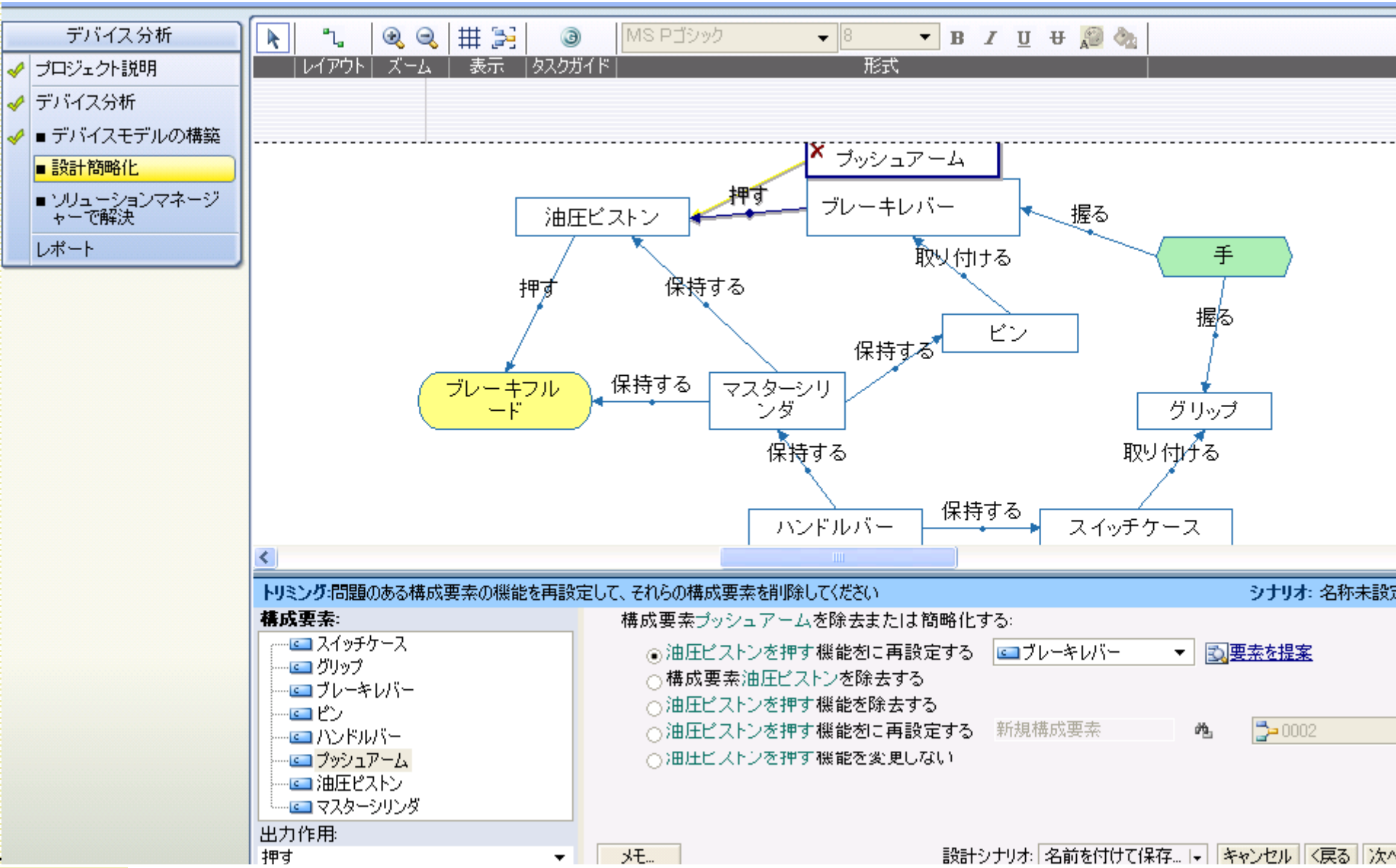
Function model of thrust piston type master cylinder



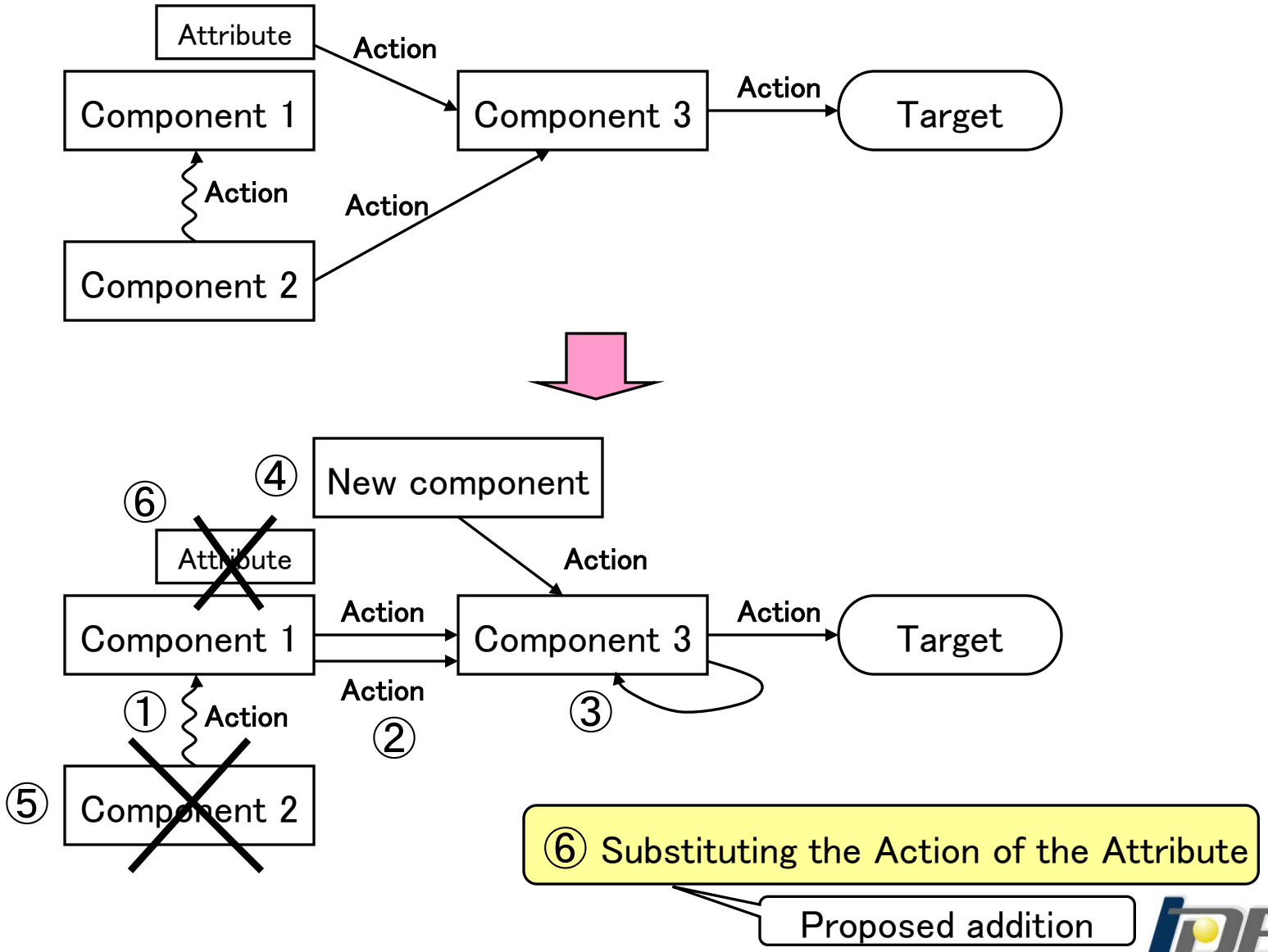
Using “Goldfire Innovator ™ ”

Seal, return spring, reservoir tank, etc. are omitted

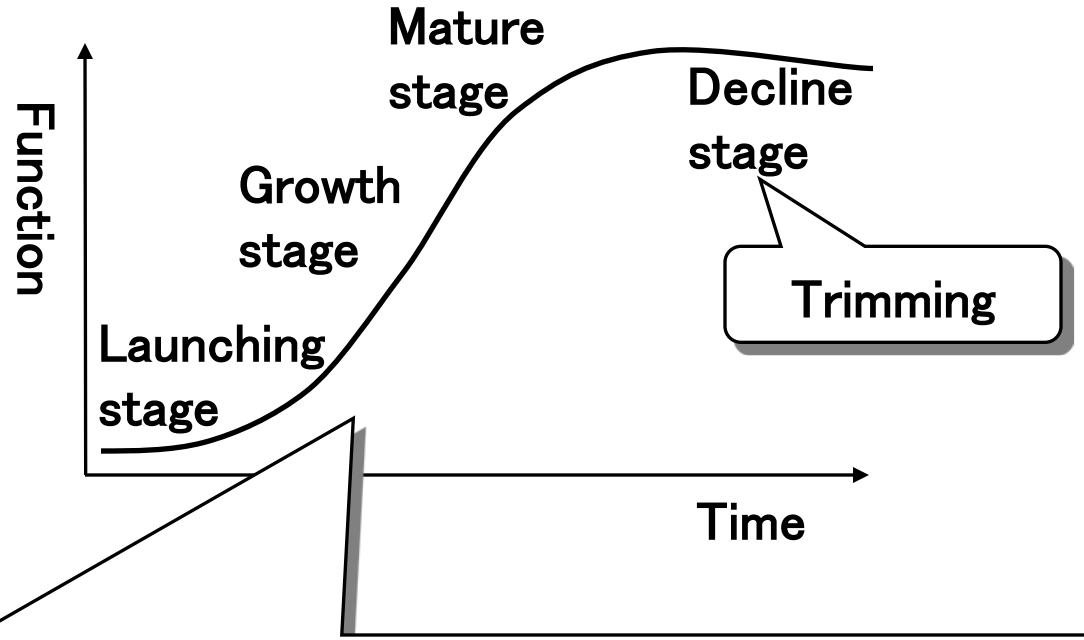
Function model for trimming



Trimming for a new invention examination



Application scene of trimming

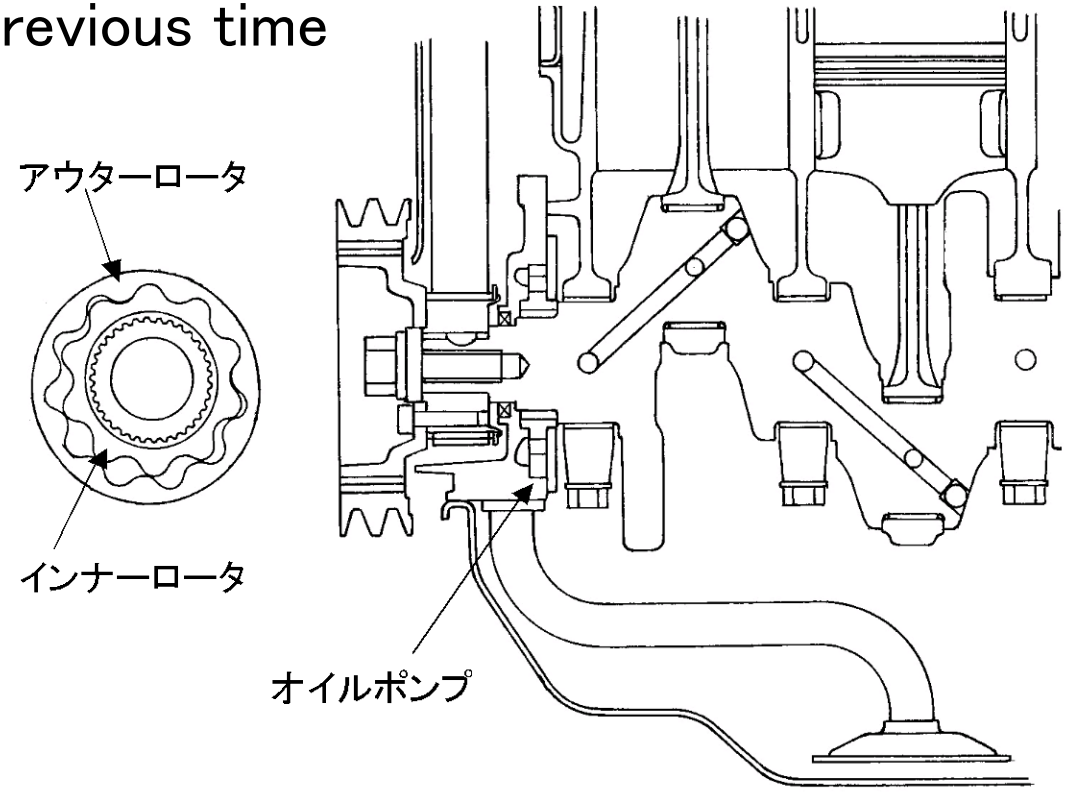


Up to now, trimming was regarded to be applicable at the decline stage of the technology evolution pattern, but, as it is also applicable for generating new inventions circumventing patent rights, it can also be applied at stages other than the declination. –> Trimming can be used as an tool for idea generation which not only resolves contradictions.

Case

Parts reduction trimming case study

Structure of the oil pump heavily used in car engines in previous time

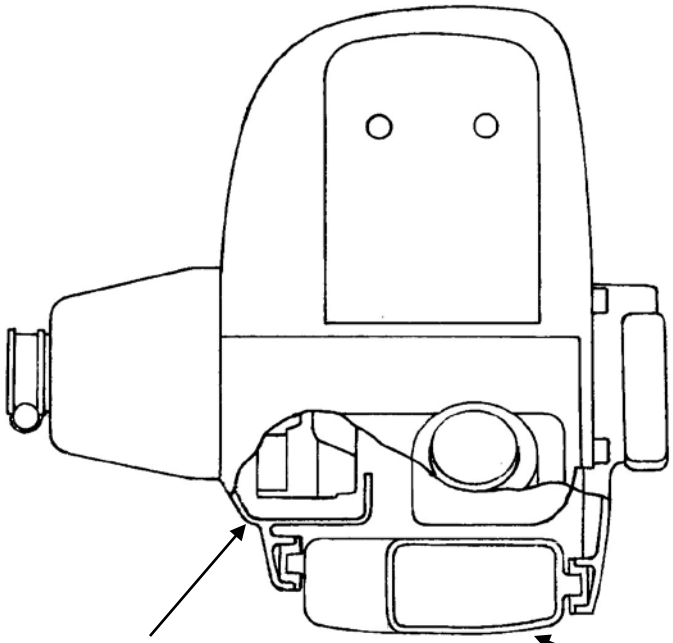


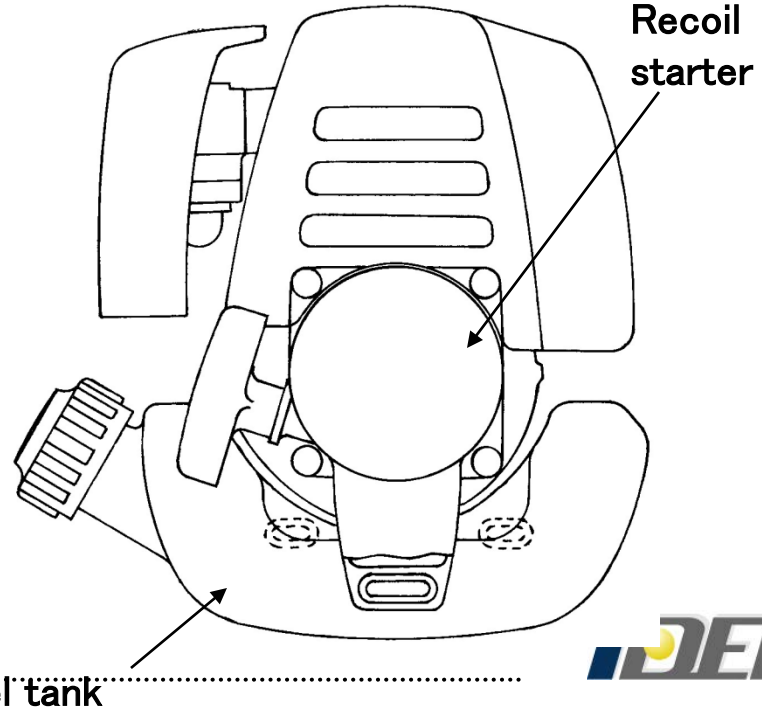
Simplification and cost-cutting design by not contradiction resolution but parts reduction

Parts reduction trimming case

The installation of the fuel tank on a portable engine such as brush cutters was achieved just by tucking it with the fan case and the bracket from the recoil starter

A simplification and cost-cutting design making mounting bolt, etc. unnecessary





Use of trimming

Purpose

"Good design" reducing components
"New invention" circumventing patent rights] realization

Effect

Design improvement through an expert's viewpoint can be enabled systematically independent of individual skills

Point

1. It is easy to generate ideas when "Substituting with other components" is applied if multiple substitute targets are checked up
2. It is easy to go ahead if associated or developed from the trimming idea disregarding the feasibility, etc.
3. It is easy to lead to inventions if thinking about trimming not only the component but also the attribute

Summary

Summary

- As trimming can be used from the view how to decrease components even where contradictions cannot be defined, it can easily used also for reviewing systems which are thought to have no alternatives
- As trimming can be used as a tool to generate ideas circumventing rights of patented inventions which seem to have no alternative compositions, it should also be used for the purpose of strengthening one's own patents
- As any stage of technological evolution asks for simplifying the design, we should consider to use trimming actively instead of just applying it at the decline phase in the evolutionary stage
- For trimming, by drawing accurate function models, the view of deleting and substituting functions in the function model is easy to lead to ideas which can not be gotten by just looking on pictures or things

End

Thank you for your attention

IDEA Inc. can support problem solving also for themes which have been thought impossible such as inescapable patents, unchangeable designs or dramatic cost reductions.
Only those who use TRIZ will benefit from it.
The important thing is to implement it early.

The future is created with TRIZ.

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