

VARIANTS OF STRUCTURE OF DOUBLE-STAGE ONE-ROW PLANETARY GEARS

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1. Introduction

Multi-stage planetary gearboxes with a continuous change in gear ratios find always wider application namely in the field of transport, production automation, etc. The variability of kinematic structure of these gears is significant in dependence upon the function incorporation of single row elements. The survey on polymorphism of motion bonds in this paper is concentrated exclusively on double-stage one-row planetary gears, because any n — stage gear can, as a rule, be divided into $n + 1$ of double-stage gears. Any eventual consideration to use also two-row gears will result in a numerous increase of final number of variants.

2. Theoretical Section

A logic of structure arrangement of the mentioned gear types can be described by means of mathematical linguistics knowledge. To formalize the initial propositions a suited symbol dictionary should be selected. For the given task a three-element system is considered to be suitable, e.g. p , c and k while such system appears to be sufficient to form a considerable family of motion relations between the sun pinion, carrier and crown gear. The incorporation of these elements into the first and second stages is — in the sense of power input flow — indexed by digits 1 and 2 (see peculiarities in Figs. 28 and 29 in Tab. 4 and also in 9 and 11 in Tab. 3).

In accordance with the system theory designed to reach an indisputable correctness of machine-aided translation there are two logical approaches available. One of them is an axiomatic approach which is concentrated to verify a correctness of characters, words and syntax modifications from the point-of-view of planetary gear mechanics, as well. To analyse the arranged structures the second approach, so called logic one, seems to be more suitable and it stresses on the following:

— to modify the characters — at the inception in intuitive manner ensued by intentionally justified connection of formalized sentence decisions,

and — to form a system of rules designed to derive other sentences being consequence of judgements and ascertained internal continuity of models.

3. Variants with Non-closed Contour of Power Input Flow

The first group of twenty-four-variants in Tab. 1 is formed by a connection of only one couple of elements originated from the rows of both stages. In this case always one element is braked in both rows (Tab.3). The driving element in the first part of variants 1 to 12 is formed by a sun pinion while in the second part 13 to 24 by a crown gear. This group may be completed by the third part of variants where the driving element is to be a carrier. a certain number of variants, however, can be disadvantageous from various point-of-view, see for example Figs. 22 and 24 in Tab. 3.

Tab. 1

N	i	w	e	b
	1	12	2	12
1	p	cp	c	kk
2	p	cp	k	kc
3	p	cc	p	kk
4	p	cc	k	kp
5	p	ck	p	kc
6	p	ck	c	kp
7	p	kp	c	ck
8	p	kp	k	cc
9	p	kc	p	ck
10	p	kc	k	cp
11	p	kk	p	cc
12	p	kk	c	cp

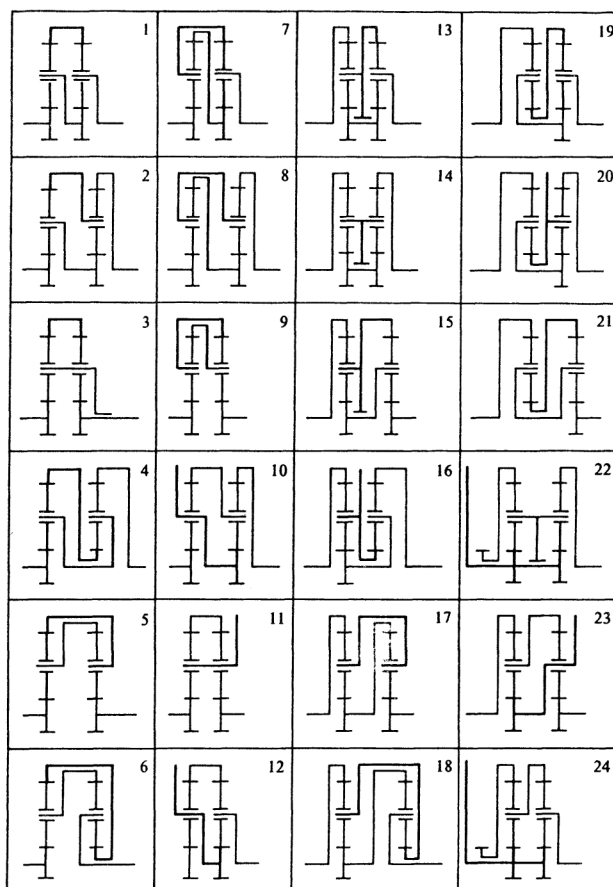
Tab. 2

N	i	w	we	b
	1	12	12	2
25	p	cp	kc	k
26	p	kk	cp	c
27	p	ck	kp	c
28	p	cp	kk	c
29	p	kp	ck	c
30	p	kp	ck	c
31	k	cp	pc	k
32	k	cp	pk	c
33	p	cp	kc	k
34	p	kp	ck	c

The motion elements of the mentioned group are in Tab. 2 classed in **four** categories as follows:

- input number *i* formed by one element,
- two-element number *w* integrated in motion manner by a **constructional** coupling,
- output member *e* formed by one element,
- two-element member *b* in motionless state.

Tab. 3



The common features of separate variants with non-closed contour of power input flow can be classed as follows:

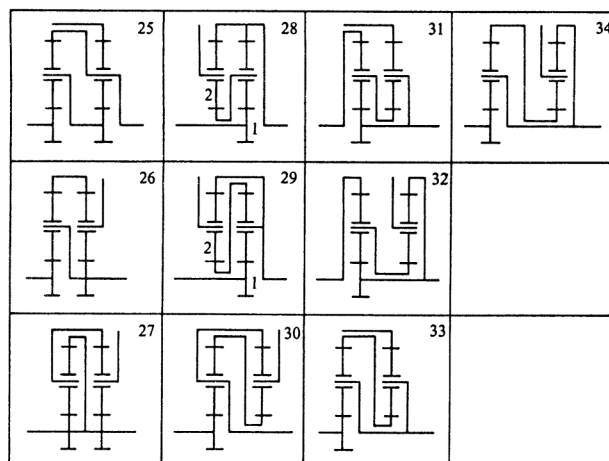
— the categories i_1 , w_1 and b_1 comprise every of the elements p , c and k just only once as well as the categories w_2 , e_2 and b_2 ,

— to occupy the categories i_1 , w_1 and b_1 there are four possibilities, but to occupy the categories w_2 , e_2 and b_2 there are as much as six possibilities,

— for the category i_1 comprising the elements p , and k it is possible to form 24 possibilities and with complete occupying by the element c the total number of possibilities amounts to 36,

— the occupying of the two-element category b by using just the element p seems to be disadvantageous since it imposes an intervention communication upon the gearbox (see for example Figs. 22 and 24).

Tab. 4



4. Variants with Closed Contour of Power Input Flow

The second incomplete group of variants is designed on the basis of connection of two couples of elements while only one element is braked from both rows. A complete design of other variants can be done in accordance with the above mentioned details.

5. Conclusion

The evaluation of designed variants may be more detailed provided that the number of particular operational requirements and parameters is specified. Moreover, it is required to consider a connection of elements from the technological point-of-view and the ability to be assembled and inspected. A certain part of variants which can be generated has not yet been realized. For this reason this paper completes the theory of planetary gear only partially.

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