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Research of Force Effects During Mass-dynamic Interaction in Vacuum

Annotation

This article presents the results of the experimental research of rotating mass force effects in vacuum having a variable quadrupole moment on solids. During the research the values of forces, exciting repulsion of solids from rotating mass were measured.

Contents

1. Introduction

In our former experiments it was ascertained that in moderate vacuum (under 0.001 Torr) rotating mass (an aluminum or a cardboard disc) force effects appear, having a variable quadrupole moment on solids which are closely located (e.g. a screen, a disc, a torsion pendulum) both made of nonmagnetic and of conductive materials – mass-dynamic interaction [1-4].

The effect of interaction does not depend on material conductivity of both the disc and the screen and it is followed by the occurrence of electrostatic field or electromagnetic radiation, i.e. it does not have an electromagnetic origin [3, 4]. The necessary condition for a mass-dynamic force interaction occurrence is dynamic (moment) imbalance rotating mass (of the disc), i.e. a variable quadrupole moment.

The main afore experimentally ascertained mass-dynamic interaction force effects in moderate vacuum are as follows:

- Exciting of a flexural wave and a “flow around” rotating in opposite direction dynamically imbalanced discs located with original geometrical clearance of 1,5…3 mm resulting in residual deformation of the fine aluminum disc surface. See: http://www.youtube.com/watch?v=-O_PnrAa1lM&feature=relmfu;
- Exciting of the disc torsion pendulum rotation with different disc surface orientation relative to the surface of rotating dynamically imbalanced disc (at a distance under 120 mm). See: http://www.youtube.com/watch?v=r94Lr2CiyBo&feature=relmfu;
- Exciting of forced rotation of a “driven” disc located with geometrical clearance of 1.5…4 mm from the dynamically imbalanced “driving” disc and to stop which it is necessary to supply the voltage of 0.3…0.8 from the voltage feeding of the electric motor rotating the “driving” disc. See: http://www.youtube.com/watch?v=ochBewD6tVw&feature=relmfu http://www.youtube.com/watch?v=o9bUi1agnYw&feature=relmfu.

It is experimentally ascertained that with the increase of vacuum depth the value of the force effect (the frequency of forced rotation of the “driven” disc) under other equal conditions grows with the increase of vacuum depth (Fig.1);

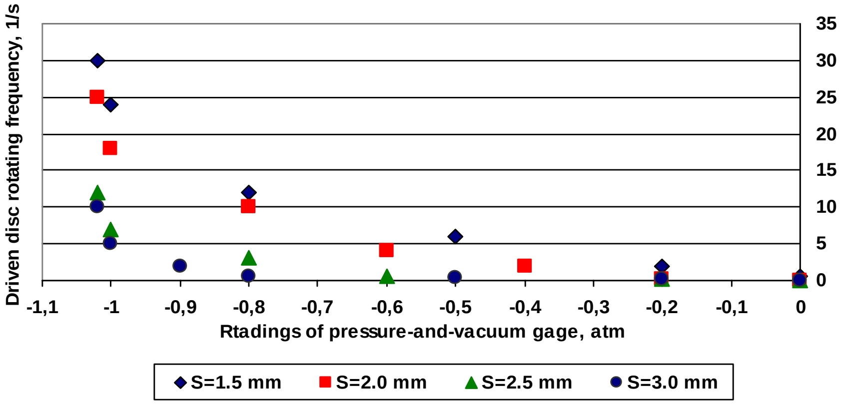
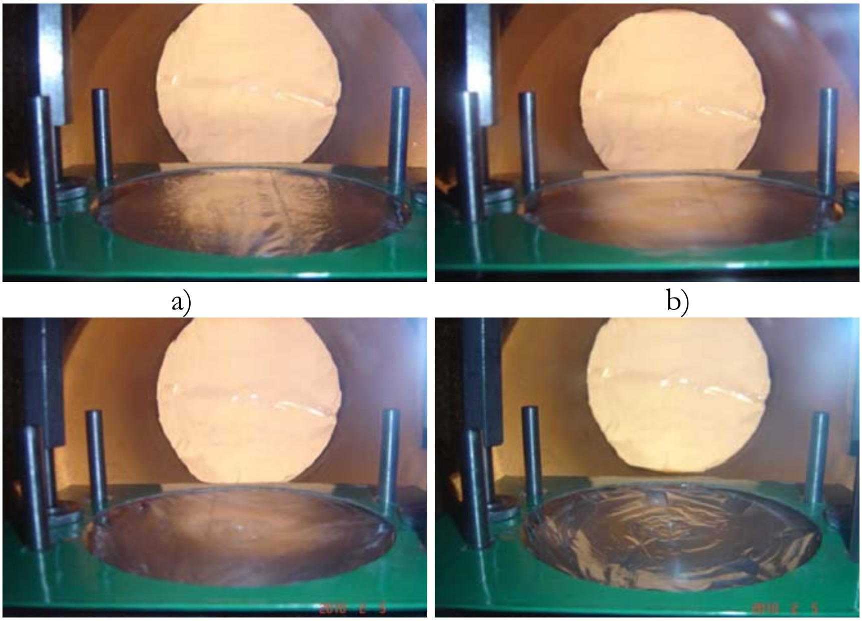


Fig.1. Relationship of frequency of forced rotation of driven disc with clearance (S) between discs and decompression value in vacuum chamber

- Erepulsion (‘blowing’) of the screen made of fine aluminum foil or stretch film resulting in its irreversible deformation (stretching) and screen material breaking. See Fig. 2, from: http://www.youtube.com/watch?v=os6naiyT_TU&feature=relmfu

The objective of set forth below series of experiments was the study of the intensity of the force mass dynamic interaction in moderate vacuum (from 0.1 to 0.001 Torr).



a) b)

c) d)

Fig.2. Effects of mass dynamic forces on screen made of stretch film: a) original state, b) screen repulsion from disc, c) vibration waves of stretched screen, d) screen film state after disc was stopped

2. Experimental equipment and tools

The experiments were carried out in the research centre of space energetics of Samara State Aero-Space University (the national research university). The same small vacuum chamber and experimental device were used which the author had used before in the laboratory of Samara State Railway University. But that vacuum chamber was connected to a bigger one at the national research centre (Fig.3.), which has two-stage system of vacuumizing.

Initial air exhaust was carried out by a vacuum forepump НВЗ-300 up to 0.1 Torr and then some deeper vacuum (up to 0.0008 Torr) was supplied to the chamber by a booster oil-vapor vacuum pump 2НВБМ-160. The control and the measurement in the chamber were carried out by a thermocouple vacuum gage ВТ-2А-П.

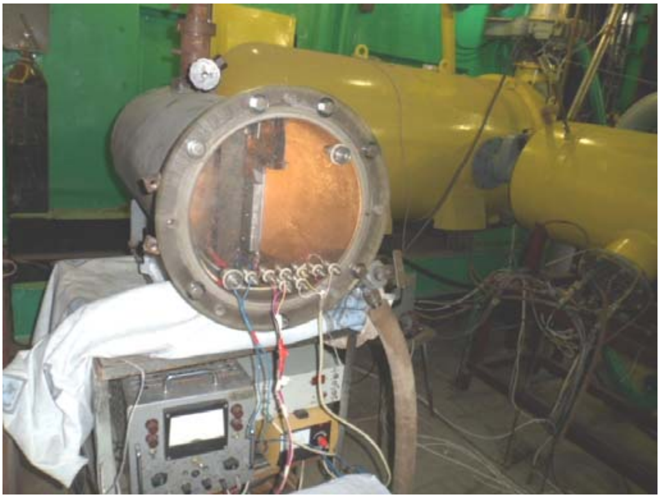


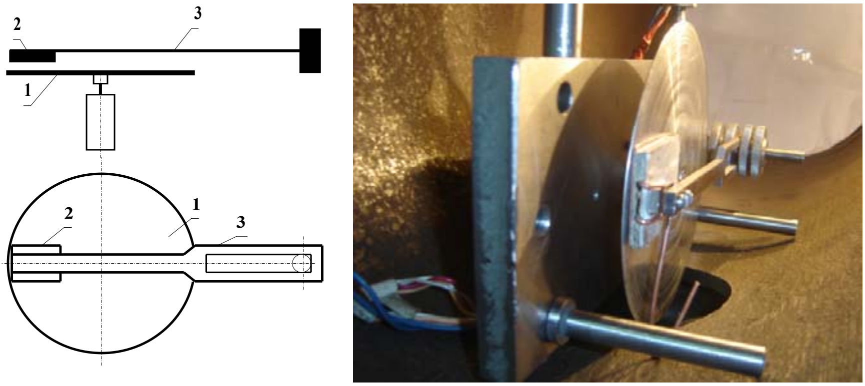
Fig.3. Experimental equipment

This gage includes the dynamically imbalanced disc made of aluminum alloy AMr3, with the diameter of 164 mm, the thickness of 0.9 mm, and the mass of 50 gr, being rotated by a direct current electric motor Д-14ФТ2c (U_H=27 V, n=12500 rpm. Electric motor was connected to the source of direct current supply located outside the chamber, which allowed to maintain stable preset voltage. The experimental gage was placed in thrust inside the vacuum chamber. The great thickness of the chamber walls (15 mm) and its great mass together with the rigid placement of the gage almost excluded its vibration while the disc was rotating, which had dynamic (moment) imbalance.

3. Force mass dynamic interaction of rotating disc and rigidly placed screen

The screen was fastened on the rigid and firm console: a steel plate with the cross-section of 5×12 mm (Fig.4.).

The console had an additional support made of bimetallic wire being in contact with the inside surface of the vacuum chamber, it was made to exclude the turn of the console which was clamped by screws. A copper plate with the thickness of 1.3 mm fastened on the cardboard substrate was turned towards the surface of the rotating disc.



a) b)

Fig. 4. Basic diagram (a) and overall view (b) of gage with rigidly placed screen: 1 – rotating disc, 2 – screen, 3 – screen fastening console

As the experiments showed while the screen was placed with the clearance of 2 mm from the disc surface, after the beginning of rotation with the supplied voltage U= 30 V of the electric motor, flexural vibration with the amplitude up to 1 mm was excited. Herewith, the vibration intermittently transformed into a flexural wave similar to that which occurred during the interaction of two discs having opposite rotational direction [1]. The amplitude of the flexural wave was about 1 mm under the frequency of its rotation 1…3 1/s (the frequency of the disc rotation was approximately 120…150 1/s). The vibration of the screen was not observed. The mechanical contact of the disc with the screen did not occur. The copper surface of the plate was treated with fine sandpaper to obtain dead surface before each experiment. It was made in order to register traces of mechanical contact of the screen with the rotating disc if they occurred during the experiment.

When fastening the screen with a clearance of about 1,5 mm from the disc surface, after the beginning of the disc rotation with the feeding voltage *U*=30 V a strong flexural wave was excited. The observed flexural wave frequency on the disc was 1…3 1/s while its amplitude was up to 1.5 mm which resulted in intermittent contact between the disc and the screen. See:

http://www.youtube.com/watch?v=CTF76t3YcA4&feature=relmfu.

When fastening the screen with a clearance of more than 3 mm from the disc surface the described above effect did not occur. After the beginning of the disc rotation even under the high electric motor voltage feeding (*U*= 35…40 V) and the high disc rotation frequency (up to 180 1/s), a flexural wave on its surface was not excited, i.e. a flexural wave is a consequence of a force interaction of the rotating dynamically imbalanced disc and the screen. The force interaction falls sharply with an increased clearance between the objects owing to a shielding effect of the residual medium in the vacuum chamber like in our former experiments.

Since the screen was almost motionless (in some cases with minor clearances there is a small forced vibration), so it could not generate considerable mass-variational radiation. Therefore the flexural wave excitation was the consequence of the mass-variational interaction (variable mass-variational) field of the rotating dynamically imbalanced disc, with an induced mass-variational field in the screen material.

Since the screen had a small area, so it resulted in local zone effect of the mass-dynamic forces on the screen surface which owing to its relatively low rigidity resulted in flexural wave occurrence on the rotating disc surface.

Without the screen or if it was placed at a distance enough to absorb the energy of the quadrupole (mass-variational) radiation of the residual air medium, the flexural wave on the gyrating disc did not occur.

The value of the force interaction of the rotating dynamically imbalanced disc and the screen resulted in not only excitation of a strong flexural wave. As the measurement of the disc geometry showed after carrying out of 20 experiments (according to above mentioned diagram), initially the flat disc surface transformed into a dome-shaped one (Fig.5.), i.e. a resilient deformation of its material (aluminium alloy AMr3) occurred. The dome height was approximately h=2.4 mm. Since the wall thickness of the disc equaled 0.9 mm, hence the bending arrowhead forming the dome was about 1.5 mm.

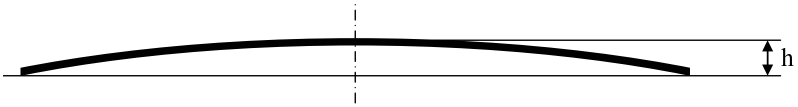


Fig. 5. Disc generating shape after its deformation by quadrupole radiation pressure reflected from screen

The screen copper plate having the thickness of 1.3 mm also obtained a residual deformation. We observed a bending of its corners and there was a bending of its console part located outside the cardboard substrate.

The measurement of the geometry of the discs used before in the experiments with two counterrotating discs showed that the height of their domes was approximately 3 mm, i.e. the bending arrowhead was approximately 2.1 mm. The obtained results are the additional evidence of the considerable value of the mass-dynamic interaction force.

In the experiments with the clearances with the disc (1) movable screens were placed (2), which had the ability of free rotation in the bushes placed on the cardboard substrates (3).

Screen frame “tabs” (2a) were in contact with the cardboard substrates (3) (they rested on it), which excluded a mechanical contact of the screens with the disc (1).

The cardboard substrates (3) (thick cardboard with the thickness of 2.5 mm) also allowed to suppress microoscillations, which could be transferred to the rocker and correspondingly to the screen from the working electric motor and rotating imbalanced disc. Additionally, for account of damping properties of the cardboard a resilient bounce of the screen from the base during their contact in the process of collision was almost excluded.

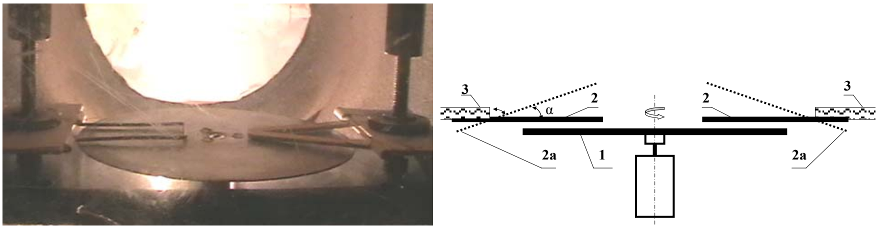
The cardboard substrates (3) were able to move along spiral columns of the gage, which allowed to place the screens at different distances from the disc with their rigid fixturing. Since the gage itself was placed in thrust in the thick-walled (15 mm) and heavy vacuum chamber it almost excluded the vibration transfer from electric motor through the steel plate of the gage base to its racks and then to the frames (screens).

Initially, two screens were placed above the disc simultaneously (Fig. 6.). The first screen (rectangular frame) was made of bimetallic steel-copper wire with the diameter of 2.4 mm. The second screen (triangular frame) was glued of wooden plates with the width of 10 mm and the thickness of 2 mm.

The wire frame was placed with a clearance of 2 mm with the disc while the wooden frame was placed with a clearance of approximately 3.5 mm.

The clearances are given approximately because the disc had initial axial runout of about 1.5 mm which fell with the increase of the number of the disc rotation revolutions owing to the great centrifugal force effect and its relatively small rigidity (disc thickness was 0.9 mm).

Initially, air pumping was carried out with a vacuum forepump up to residual pressure (0.1 Torr). While feeding voltage (30V) was supplied and the disc was rotated up to 100…120 1/s continuous cyclic vibration of the wire frame was observed at first, as it was placed closer to the disc. The deviation angle of the frame was approximately α=20º…30º, the vibration frequency was approximately 4…5 1/s. The vibration of the lighter wooden frame which was placed further from the disc occurred only intermittently. Its deviation angle was up to α=30º…40º.



a) b)

Fig.6. Overall view in vacuum chamber (a) and basic diagram (b) of experimental tool with horizontal screens: 1 – rotating disc, 2 – movable screens (2a – screen frame backing sections "tabs"), 3 – cardboard substrates.

Thereupon without opening the chamber and resetting the gage the air pumping was carried out with an oil-vapor pump up to residual pressure (0.1 Torr). As the experiments showed, the intensity of the mass-variational (quadrupole) radiation force effect of the disc on the screens considerably increased. Continuous vibration was excited in both wire frame and wooden frame. See: http://www.youtube.com/watch?v=3XF0gCaoqTM&feature=relmfu.

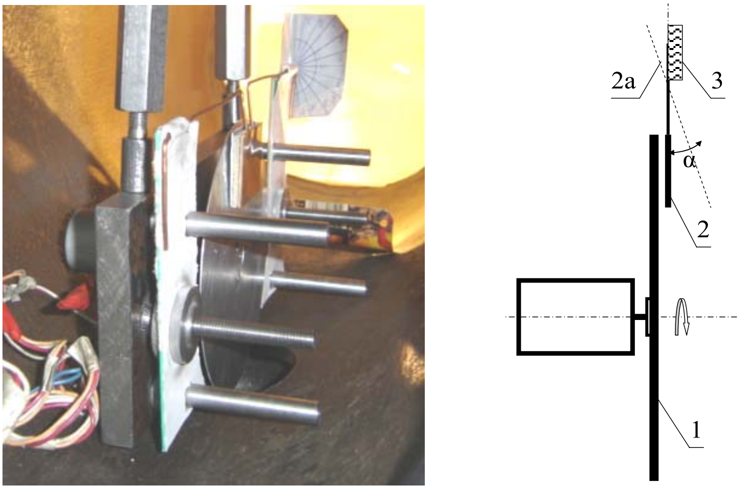
The deviation angle of the wooden frame was up to 70º…80º. The deviation angle of the wire frame was approximately 45º. The greater value of the deviation angle of the wire frame was constructively impossible owing to the frame "'tab" contact with the steel plate of the gage.

In the second series of our experiments the wire frame was placed with a clearance of 3 mm to the disc with a constant setting of the gage and constant electric motor feeding voltage (U=30 V), but with 3 different vacuum values in the chamber: 0.1, 0.01 and 0.001 Torr.

As the experiments showed, with the residual pressure in the vacuum chamber P=0.1 torr, the wire frame repulsion did not occur. When P=0.1 Torr the frame repulsion was excited with a small deviation angle α = 10º…20º, while when P=0.001 Torr the repulsion intensity attained the greatest value limited by the "tabs" of the frame. The vibration frequency of the wire frame was approximately 6…10 1/s. Thereby, the intensification of mass-dynamic and mass- variational (quadrupole) radiation force effects with the increase of the vacuum depth in the examined range (from 0.1 up to 0.001 Torr) were ascertained.

In the third series of our experiments both vacuum depth and the distance from the disc varied. The experiment carried out by us showed that when the vacuum depth was increased from 0.1 up to 0.001 Torr, the distance, at which the wire frame repulsion was observed, increased approximately twice from 1.5…2 up to 3.5…4 mm, under other equal conditions (i.e. constant frequency of the disc gyration and constant value of its moment imbalance).

When both wire and wooden frames were placed at the distance of more than 5 mm from the disc and when its gyration frequency was 100…120 1/s the wire frame repulsion was not observed even with P=0.001 Torr.



a) b)

Fig.7. Overall view in vacuum chamber (a) and basic diagram (b) of experimental tool with vertical screen: 1 – rotating disc, 2 – movable screens (2a – screen frame backing sections “tabs”), 3 – cardboard substrates.

The objective of the next series of our experiments was to reveal the impact of the gyrating disc axis spatial orientation and the screen plane location on the process of their non-contact force interaction in moderate vacuum – the vertical screen (Fig.7.). The disc gyration axis was horizontal while the screen was suspended vertically on the wire frame at the distance of 1.5 …2 mm from the screen plane.

The screen dimensions in the diagram are 50×40 mm, the mass is 16.5 gr. The screen (2) is removable – it is moved on and removed from wire frame work of the rocker (3), which allowed to change the screen plate material turned towards the disc. From the opposite sides of the screen on its base the plates from different materials were fixed. The first plate was made of copper with the thickness of 0.3 mm while the second one was made of aluminum with the thickness of 1.3 mm.

As our experiments showed, when the feeding voltage (U=25 V) was supplied to the electric motor and the disc began to rotate a cyclic deviation of the screen from the disc was observed. The rotary angle of the wire frame was approximately α=30°…45°. When the increased feeding voltage (up to U=35 V) was supplied to the electric motor the repulsion angle of the screen increased up to α=60°…75°. See: http://www.youtube.com/watch?v=exraNXii2-I&feature=relmfu.

Conclusion

Thereby, it was experimentally ascertained that the rotating disc force effect on the screen occurred independently of the rotating disc axis spatial orientation and the screen plane, i.e. it resulted from the mass-dynamic force effect from the rotating dynamically imbalanced disc.

References

1. Samokhvalov V.N. Dynamic Interaction of Unbalanced Masses in Vacuum. Galilean Electrodynamics, vol. 22, Special Issues 1, 2011, p. 3-6.
2. Samokhvalov V.N. Interaction of Rotating Masses in Vacuum and Their Effect on Solids / Fundamental Problems of Natural Science and Technology. Series “Problems of Universe Research”, Issue 34 (М-У). – Snt. Petersburg: Typ. Snt. Petersburg SUCA, 2010. – P. 114-138 (in Russian).
3. Samokhvalov V.N. Mass-dynamic and Mass-variational interaction of moving masses, "Papers of Independent Authors", publ. «DNA», Israel-Russia, 2009, issue 13, printed in USA, Lulu Inc., ID 7803286, ISBN 978-0-557-18185-8 (in Russian).
4. Samokhvalov V.N. Kvadrupolnoye radiation of the rotating masses, "Papers of Independent Authors", publ. «DNA», Israel-Russia, 2010, Issue 14, printed in USA, Lulu Inc., ID 8183012, ISBN 978-0-557-28441-2 (in Russian).