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Features of streamer form of corona discharge in respect to electric gas purification

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Abstract. An article briefly describes advantages of streamer form of corona discharge over corona discharge of direct voltage. With the purpose of confirmation of hypotheses about possibility of stabilization of discharge processes in electric fields of streamer form of corona discharge oscillography voltage and current were done, and volt amperage features at various frequencies of pulse voltage were taken. Impact of parameters of electrodes system «Potential plane with corona needles – grounded plane» to value of discharge current was studied. Outcomes of study of power features and character of change in strength of electric fields of streamer form of corona discharge are presented.

1. Introduction

It is possible to enhance efficiency of gases purification from solid and liquid aerosol particles in the electric fields of corona discharge of direct voltage used in existing electric separators. This is due to the fact that the process of purification depends on value of strength of electric field which is supported in electric separators in pre-disruptive values. Accordingly further enhancement of strength of field leads to spark or arc breakdown of discharge technological gap.

Enhancement of efficiency processes of electric gas purification is possible at use of streamer form of corona discharge. This type of partial electric discharge in gases occurs in sharply inhomogeneous electric fields when exposed to voltage pulses with a steep front and overvoltage, that is, when the amplitude of the pulse voltage is higher than the DC voltage breakdown threshold [1,2]. However, channel of streamer is electrically neutral and accordingly has an equal number of negative and positive ions. For process of gases purification a flow of unipolar bulk charges is required. Therefore, for use of streamer form of corona discharge division of bulk charges is required. For getting flow of unipolar bulk charges a separation of direct electric field in technological discharge gap is required, and for amplification of this field's action the electrodes system «potential plane with corona needles – grounded plane» might be used.

As our study has shown, streamer form of corona discharge has the following advantages in comparison with corona discharge of direct voltage:

— stability of discharge current;

⸺ possibility of analysis of transfer processes in feed circuit pulse of high voltage and consider the technological discharge gap as an element of this;

⸺ higher efficiency of aerosol sedimentation, particles from the flow of gases;

⸺ possibility of enhancement of purified gases' velocity up to 8 m/s;

⸺ reduction of aerosol sedimentation area, particles up to 0,5…1,0 m;

⸺ substantial reduction of capacity process of electric gas purification;

⸺ amplification of principle of automatic adjustment of voltage discharge gap of electric separators on value of discharge current;

⸺ in view of reduction of parameters electric of separators there is a possibility of process of continuous use of settled dust.

For justification of parameters process of electric gas purification in electric fields of streamer form of corona discharge a number of pilot studies of its features were conducted. Outcomes of these studies are presented in this article.

2. Materials and Methods

Study was conducted with purpose of confirmation of hypotheses about possibility of stabilization of discharge processes in electric fields of streamer form of corona discharge. Based on this oscillography of voltage and current was made and volt amperage features at various frequencies of pulse voltage were taken.

Pilot study was conducted on stand (Figure 1) where periodic pulse of voltage was generated by machine generator *G* with 2 pairs of explicitly expressed poles on rotor and stator. Gearing of generator was made from motor of direct current M. For smooth adjustment of frequency of generator in wide span, adjustment of number of motor rotations was done by change in voltage with autotransformer T1 and rectifier V1. Voltage of generator excitation was adjusted by rheostat R1. Voltage from generator was enhanced by transformer T2. Secondary winding of transformer T2 was done with central grounded point which allowed at use of bilateral circuitry of rectification with multiplication of voltage to get at exit of circuitry the doubled frequency of unipolar pulse of high voltage. Thus, at velocity of motor rotation 50 r^{-1}, frequency at exit of generator was 100 Hz, frequency at exit of circuitry of rectification – 200 s^{-1}. Circuitry of rectification consists of condensers C1, C2 and high-voltage diodes V2, V3, V4, V5. Voltage was measured with electrostatic kilovolt meter type C-100 – PV. Current was measured with micro ammeter PA type M-63. Circuit measurement of current was protected from spark discharges by arrester FV.
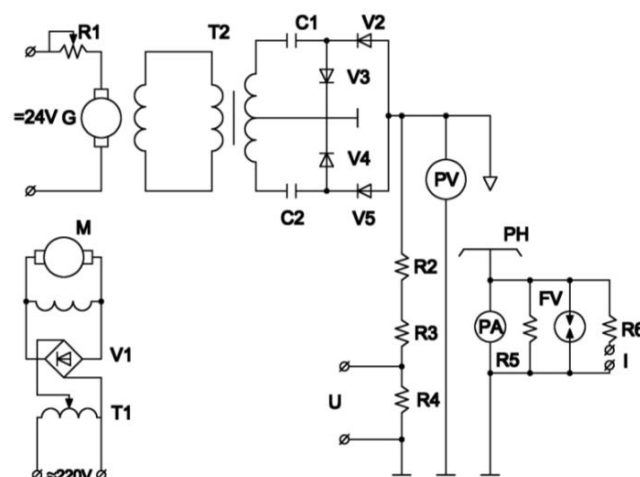

Figure 1. Schematic diagram of stand for study of features of streamer form of corona discharge: R1...R6 – resistors; G – generator of periodic voltage pulse; V1...V6 – diodes; C1, C2 – condensers; PV – kilovoltmeter; PA –microammeter; FV – arrester; M – motor of gear of generator; T1 –autotransformer; T2 –step-up transformer; U, I –connecting terminals for oscillography.

Oscillography of voltage was done through ohm divider of voltage R2, R3, R4. Oscillography of current – with conducting bridge R5, R6.

Main indicator, characterizing discharge processes, is volt amperage features (VAF). Traditional method of taking of VAF - method of ammeter and voltmeter, has some shortages. Accuracy of measurements depends on the class of accuracy of measuring and adjusting equipment, qualification of the operator. Therefore, for taking of VAF the following methodology was developed.

Recording of VAF was done on self-recording potentiometer PmV type KSP, calibrated on the discharge current (Figure 2). High voltage supplied to corona needle 8, evenly enhanced by autotransformer 6, assembled on square magnetic conductor. Voltage was taken from autotransformer by pickup 3, which moved along spiral shaft 4. Gearing of shaft was done from reactive synchronous motor with gear 1 type SD-4. Automatic control of stand was done with arresters 2 and 5. Voltage from autotransformer was supplied to source of high voltage 7 and after enhancement and rectification to corona needle 8.

Calibration of VAF for voltage was done by formula:

$$U = U_{max}/(Vt) \ \ (10^3 V/mm), \tag{1}$$

where U_{max} -peak voltage supplied to to stand, 10^3V; V -velocity of conveyer belt, mm^{-1}; t -full time of recording VAF, s.

VAF were taken for frequencies span of 10…220 s^{-1}. For checking, VAF corona discharge at feeding of source of high voltage with voltage of industrial frequency was taken.

Analysis of oscillograms of voltage at exit of generator has shown that range value of voltage at exit of generator is:

$$U_{G.A} = 5U_{G.E}, \tag{2}$$

where $U_{G.E}$ –effective value of voltage at exit of generator, V.

At absence of load at exit of rectifier a direct component of pulse voltage is:

$$U_{R.E} = U_{T.A}, \tag{3}$$

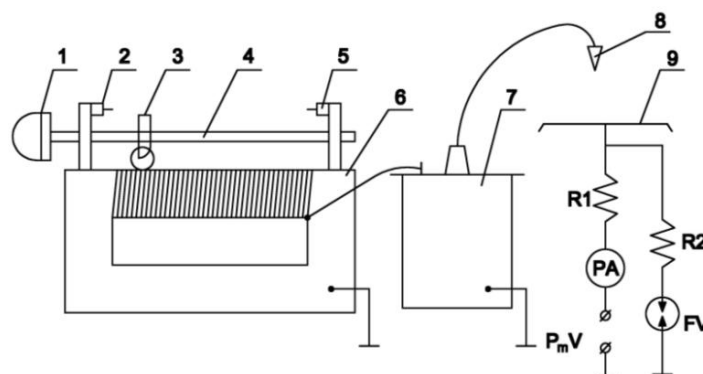where $U_{T.A}$ –range of voltage at exit of step-up transformer.

Figure 2. Diagram stand for study of VAF streamer form of corona discharge: 1 - motor with gear type RD-54; 2,5 – arresters; 3 – brush; 4 – spiral roller; 6 – autotransformer; 7 – source of high voltage; 8 – corona needle; 9 – grounded plane; PmV – connecting terminals for potentiometer KSP-4; PA – micro ammeter; R1, R2, FV – spark-protecting circuit

Effective voltage at exit of rectifier:

$$U_{R.E} = 1,2 \ U_{T.A}. \tag{4}$$

Range value of pulse voltage at exit of circuitry of rectification is:

$$U_{R.A} = 2U_{T.A.} \tag{5}$$

Oscillograms of pulse voltage and current streamer form of corona discharge are presented in Fig. 3 and 4. In oscillograms it is seen that discharge current is stable up to frequency of 200 s^{-1} and character of its change is adequately described by previously obtained analytical dependences [3].

3.   Results and Discussion

At exceeding of frequency of more than 200 S^{-1} stability of discharge process is disturbed and gains a character of random. This relates both to type of voltage pulse, and to discharge current (Figure 4). Hence it can be concluded that at available parameters of circuitry a feed stability of discharge process is kept up to frequency of 200 S^{-1}. At further enhancement of frequency of pulse process the neutralization of bulk charges in discharge gap is not fully completed, and created by it opposite, to main electric field, electric field impacts on range of voltage and current which accordingly impacts on their stability.

Obtained oscillograms of voltage and current streamer form of corona discharge confirmed the hypotheses about possibility of stabilization of discharge processes in electric field corona discharge at combination in one discharge gap of independent and dependent discharges.

VAF streamer form of corona discharge for preliminary analysis was compared to VAF corona discharge of direct voltage (Figure 5). Comparative VAF for streamer form of corona discharge was taken for frequency of 50 s^{-1}. From features it is seen that initial voltage ignition of discharge at direct voltage is 7×10^3 V, and at pulse voltage is 4×10^3 V. On VAF it is seen that at the same effective values voltage current streamer form of corona discharge more current corona of direct voltage. At voltage 2×10^4 V current streamer form of discharge is twice more. This fact together with stability of discharge process allows making preliminary conclusion that electric gas purification in electric fields of streamer form of corona discharge will be substantially efficient than in fields of corona discharge of direct voltage.
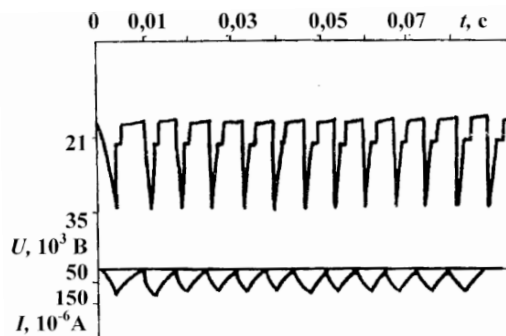

Figure3. Oscillograms of voltage (upper) and current (lower) streamer form of corona discharge at frequency of 180 s^{-1}
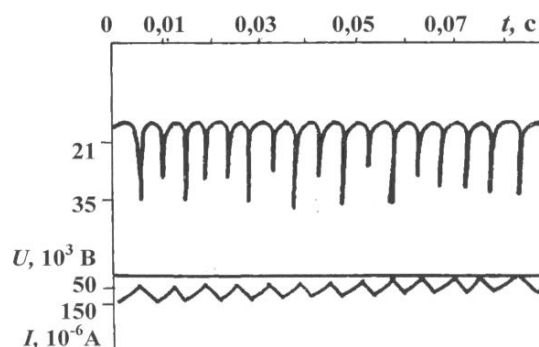

Figure 4. Oscillograms of voltage (upper) and current (lower) streamer form of corona discharge at frequency of 220 s^{-1}

With purpose of identification of dependence of VAF from frequency of applied pulse the VAF family for various frequencies of span 20…220 s^{-1} was taken. These features are presented in Fig.8. These VAF were taken from zero value of pulse voltage, to spark breakdown of discharge gap. From VAF family it is seen that by increasing of frequency of pulse voltage an electric strength of discharge gap is increased. If at frequency of 20 s^{-1} breakdown occurs at voltage 3×10^4 V, then at frequency of 220 s^{-1} breakdown occurs now at 4×10^4 V.

At the same time, by increasing of electric strength of discharge gap a peak current discharge is increased: $9,2 \times 10^{-5}$ and at frequency of 20 s^{-1} and $1,6 \times 10^{-4}$ and at frequency of 220 s^{-1}. Peak current discharge was

fixed at pre-disruptive values of voltage. Some reduction of initial voltage ignition of discharge at increase of frequency of pulse is also noted.
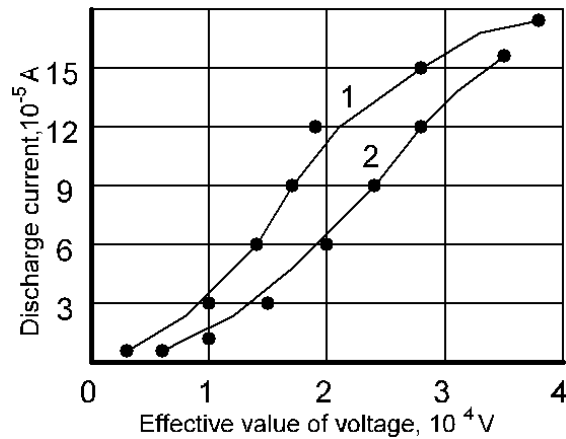

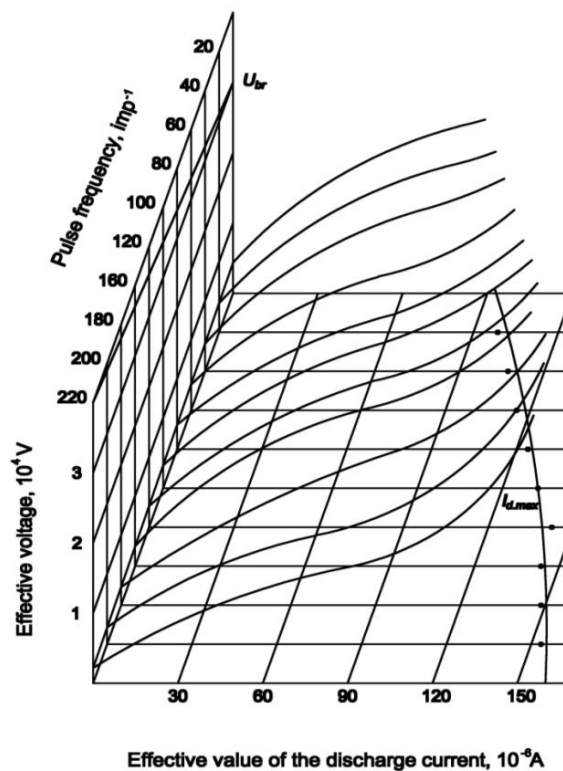**Figure 5.** Comparative VAF corona discharge for effective values of pulse (1) and direct (2) voltage

Figure 6. VAF Family of streamer form of corona discharge for system electrodes «needle-plane»

Study of electrodes parameters system «potential plane with corona needles – grounded plane».
Needle electrodes are being widely applied in electronic-ionic technology [3, 4]. Use of needle electrodes allows reducing dimensions of devices at srovement of technological indicators. Use of needle electrodes is stipulated by stability of ionization area, i.e. discharge occurs exclusively from the edge of needles.
At use of wire corona electrodes the points of corona discharge over the wire surface are distributed chaotically, constantly changing both in intensity and in position.

Use of streamer form of corona discharge for trapping of aerosol particles from flow of gases require separating of electric field for division of opposite bulk charges and creation of flow of unipolar bulk charges. With this purpose we use the system of electrodes «potential plane with corona needles – grounded plane».

For calculation of electrodes systems for electric fields of corona discharge often method of Daich-Popkov is used which is based on assumption of constancy form of power lines of electric field at corona discharge and without it. Abrupt structure of equation of power lines hampers integration. Particularly, distribution of field along discharge gap is obtained only for the electrodes system «wire – plane». System of electrodes «needles – plane» by its structure is substantially complex. Therefore, analytical approach to resolution of the task will not give the required practical results. Therefore, study conducted on the basis of results of pilot data. In previous studies [3, 4] selection of parameters of electrodes systems with corona electrodes was conducted on specific current discharge to length unit of corona needles at various steps of needles installation. In our study parameters of electrodes systems are identified on current discharge with single needle.

Parameters electrodes system «potential plane with corona needles – grounded plane» (Fig.9), namely, length of corona needles h, distance between ends of needles and grounded plane H, distance between corona needles l, cone angle of needles α, significantly impact on discharge processes. Obviously, these parameters are required to select based on peak value of current discharge, as density of flow of bulk charges is proportional to value of current discharge.

With purpose of reduction of studied factors, cone angle of needles was assumed as 8°, based on ease of manufacture and ease of installation.
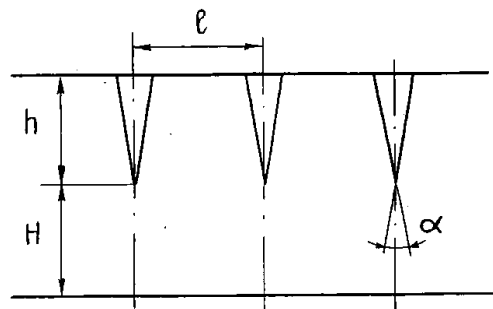

Figure 7. Parameters of the electrodes system «potential plane with corona needles – grounded plane»

Pilot study was for 2 options:
— study of impact of length of corona needles on current of streamer form of corona discharge;
— study of impact of distance between corona needles on current of streamer form of corona discharge.

In view of huge volume of surveyed parameters the pilot study was automated with recording of results on self-recording potentiometer type KSP.

Study of impact of length of corona needles on current of streamer form of corona discharge was conducted on stand (Figure 10) consisting of reactive synchronous motor with gear type RD-54 1 which through dielectric shaft 2 leads to rotation of sleeve 3 with internal thread. At rotation of sleeve to one or another side screwing or unscrewing of thread shaft 4 occurs. Bracket 5 is fixed to shaft with potential plane 7. Grounded plane 8 is fixed to stud 9. Distance between grounded plane and tip of needle 6 is adjusted by clamp 10. Potentiometer KSP-4 is connected to terminals PmV and calibrated with variable resistor R2.

Velocity of movement of potential plane is 0.219 mm/s. Change span of length of needle is 0…35 mm. In experiment, negative pulse high voltage was supplied on potential electrode and corona needle. Experiment conducted for the following fixed distances from the end of needle to grounded plane: 10, 20, 30, 40, 50, 60, 70, 80 mm. In all cases average strength of electric field 7×10^5 V/m was set which were 7, 14, 21, 28, 35, 49, 56 kV respectively. Since electric fields of corona discharge incur in sharply-uneven

electric fields the average strength of electric fields is identified as relation of effective value of pulse voltage to the distance from the end of needle to grounded plane ($E_{cp}=U_\text{л}/H$). Frequency of pulse in experiment was $150\ \text{s}^{-1}$.
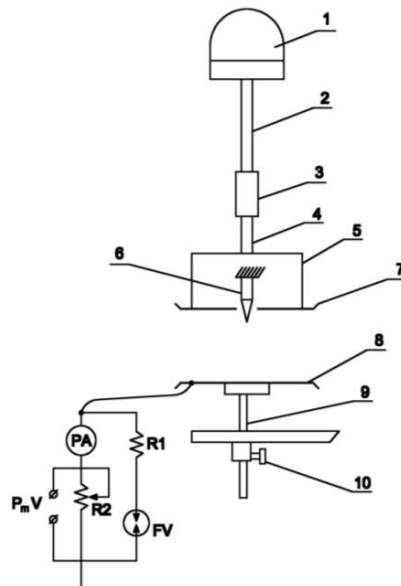

Figure 8. Schematic diagram stand for study of impact of length corona needle on current streamer of form of corona discharge: 1 – motor with gear type RD-54; 2 – dielectric shaft; 3 – sleeve with internal thread; 4 – shaft with thread; 5 – bracket; 6 – corona needle; 7 - potential plane; 8 – grounded plane; 9 – rod; 10 –adjusting clamp; PmV- terminals for potentiometer; PA – micro ammeter; R,FV – spark-protecting circuit; R2 – shunt of current
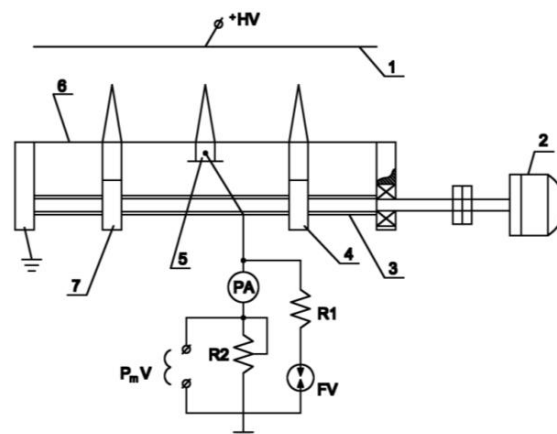

Figure 9. Diagram stand for study of impact of distance between corona needles on current streamer form of corona discharge: 1 - potential plane; 2 - motor with gear; 3 - thread shaft with scalene thread. 4 and 7 - carriages with fixed to them corona needles; 6 – grounded plane; 5 – measurement corona needle; remaining symbols correspond to Figure 10

Study of impact of distance between corona needles on current of streamer form of corona discharge was conducted on stand (Figure 11) consisting of potential plane 1, reactive synchronous motor with gear 2, thread shaft 3 on which from the centre scalene thread is cut. Along the shaft carriages 4 and 7 are moved

with corona needles fixed to them. Between ends of needles and potential plane distance 30 mm was set for reduction of screen impact of potential plane on value of discharge current. Central corona needle is insulated from the ground and is the measuring one. Measurement circuitry is connected to it consisting of check micro ammeter PA, circuitry of protection from spark discharges - R1, FU, calibration resistor R2, Potentiometer type KSP-4 is connected to terminals PmV. Velocity of movement of corona needles in relation to central measuring – 0.3 mm/s. Minimum distance between measuring and screen needles is 10 mm, and maximum – 100 mm. In experiment plane served as potential electrode, and corona needle and screen plane were grounded. Pulse of voltage of positive fields' polarity with frequency of 100 S^{-1} was supplied to plane.

Experiments were conducted for the following distances between the ends of needles and plane: 20, 30,40,50,60 mm. As in previous studies, average strength of electric fields of 7×10^5 V/m between electrodes was set.

From diagrams obtained from self-recording potentiometer nomograms of dependence of current streamer form of corona discharge were built for electrodes system of potential plane with corona needles – grounded plane» from distance between electrodes H and length of needles h (Figure 12), and from distance between electrodes H and distance between corona needles ℓ (Figure 13).

In nomograms it is seen that significant screen impact on value of discharge current of corona needles both potential plane, and adjacent corona needles. By increasing of distance between corona needles and grounded plane the current of streamer form of corona discharge is increased at the same average values of strength of electric fields. For example, at h=30 mm current discharge is:

H, mm	10	20	30	40	50	60	70	60
$I_д$, 10^{-6} A	18	28	37	42	49	54	58	60

At h =10 mm

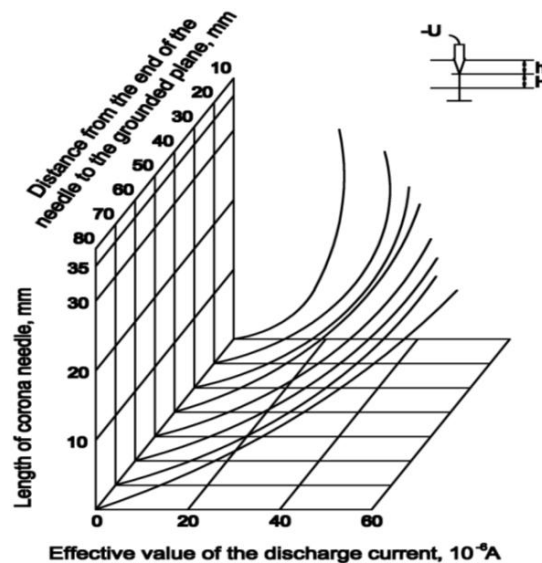| H, mm	10	20	30	40	50	60	70	60
$I_д$, 10^{-6} A	16	21	23	24	26	27	28	28

Figure 10. Nomograms of dependence of current streamer form of corona discharge for electrodes system «potential plane with corona needles – grounded plane» from the distance from electrodes H to length of needles *h.* Mutual screening of needle corona electrodes is clearly shown in Fig. 13.

As seen from these data this feature of streamer form of corona discharge is more visualized by increasing of length of corona needles h and increasing of inter electrode distance H.

Peak current discharge is seen at H/h > (1,6…1,7), i.e. current discharge will be increased up to value of h > (1,6…1,7)H. These proportions, at selection of parameters of electrodes systems of electric separators, require clarification, as it must provide maximum level of purification of gas flow from aerosol particles at minimum length of sedimentation area.

At selection of number of corona needles it is required to consider the value of maximum density of discharge current, i.e.

$$j = i_{1,max}n \, / \, S, \qquad (6)$$

where $i_{1,MAX}$ -peak current of one needle; n- number of needles; $S = a \cdot b$ – area of electrodes system of filter; a and b – accordingly length and width of electrodes system.

Number of corona needles:

$$n = (S/\ell^2) + [(a+b)/\ell] + 1, \qquad (7)$$

where ℓ – distance between axes of needles at which current discharge stops increasing.

These proportions might be used for preliminary identification of parameters of electrodes systems of electric separators. As further study of processes of sedimentation of aerosol particles in electric fields of streamer form of corona discharge, in parameters of electrodes system «distance between corona needles in rows, located perpendicularly to flow of purified gas», and «distance between needles' rows» should be distinguished.
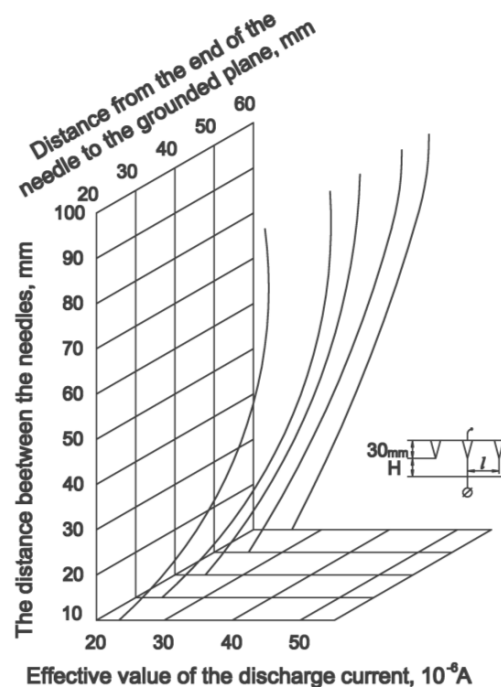

Figure 11. Nomograms of dependence of current of streamer form of corona discharge for electrodes system «potential plane with corona needles – grounded plane» from distance between electrodes H and distance between corona needles ℓ.

Power of various physical character impacts on aerosol particles in electric fields of corona discharge. Those include: power Coulomb, i.e. interacting charge in particles with electric field; pandero motor force stipulated by irregularity of electric fields; mirror reflection force effecting the settled particles; gravity of

particles; force interacting between charged particles of aerosol; force stipulated by gas flow; retarding effort to air flow; force stipulated by electric wind.

From listed above, coulomb power is the identifying one at aerosol particles sedimentation. Remaining powers are much more less, and are not considered in practical calculations.

Coulomb power for similar electric fields at feeding by direct voltage is identified by a ssle dependence:

$$F_\kappa = Q\,E, \tag{8}$$

where Q – excess charge of aerosol particles; E – strength of electric fields.

In sharply uneven electric fields strength of electric fields is greatest in areas directly adjoining to corona-forming electrodes. Therefore, Coulomb power will depend on location of particles in inter electrode space, i.e. from its coordinates:

$$F_\kappa = Q\,qradE. \tag{9}$$

In sharply uneven electric fields at feeding by unipolar pulse of voltage, strength of electric fields will be also changed in time. Therefore, Coulomb power will be identified by dependence:

$$F_\kappa = Q\,qradE(t). \tag{10}$$

Strength of electric fields in electric fields of streamer form of corona discharge is changed by law:

$$E(t) = U_{C2.NAT}/H = \{[1/(p_2-p_1)]\,[(p_2U_a-i_a)p_1\,exp\,p_1 t\;-(p_1U_a-i_a)p_2\,exp\,p_2t\,]+U_a{}^t]+U_a\}/\,H, \tag{11}$$

where $U_{C2.NAT}$ – voltage discharge gap in interval between pulses; H - distance between electrodes; U_a - range of pulse voltage; p_2, p_1 - roofs of characteristic equation.

$$p_{1,2} = \{-C_1 C_2 R\pm[(C_1C_2R)^2--4(C_1C_2L)(C_1+C_2)]^{0,5}\}/(2C_1 C_2L), \tag{12}$$

where $C_1, R, L,$ - parameters of circuitry of feed of discharge gap by unipolar pulse of voltage; C_2 – size of discharge gap.

Hence it is seen that in electric fields of streamer form of corona discharge a Coulomb power is identified by parameters of elements of feed source, i.e. dynamic mode of process is obvious, unlike electric fields of corona discharge of direct voltage where such dependence practically does not exist.
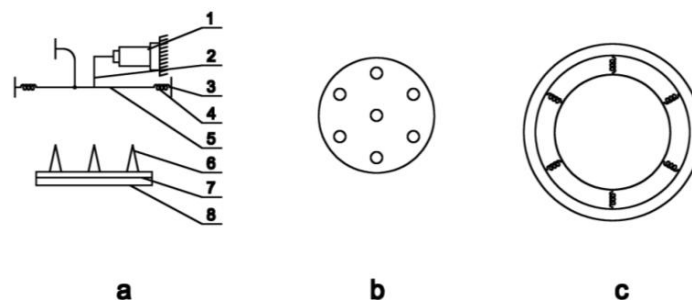

Figure 12. Diagram stand for study of character of change of strength of electric fields in discharge gap at feeding by pulse voltage (a), layout of corona needles (б), circuitry of suspension of grounded plane (в): 1 – mechanotron; 2 – rigid link; 3 – dielectric ring; 4 -springs of suspension; 5 – grounded electrode; 6 – corona needle; 7 –dielectric disk; 8 –screen electrode

For confirmation of dependence (11) experiment was conducted in which was character of change in powers interacting between electrodes at feeding of unipolar pulse of voltage was studied. Stand for this

study (Figure 14) consists of grounded electrode 5 – disk from aluminium alloy of 0,5 mm thickness which on six springs 4 was suspended to dielectric ring 3. To the centre of grounded electrode with rigid link mechanotron 1 was connected, corona needle 6 of 25 mm length and cone angle of 8^0 were installed in dielectric disk 7 as per scheme shown in Fig. 14, b. Experiment conducted with screen electrode 8 and without it for detection of impact of size of discharge gap on power interacting between electrodes. In experiment average strength of electric fields of 7×10^5 V/m was set on acting value of pulse voltage of 75 s^{-1} frequencies.
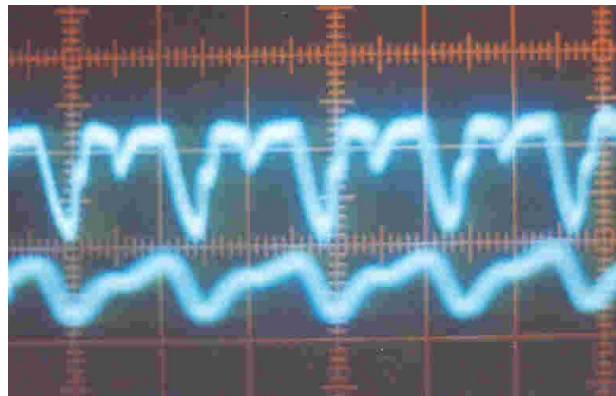

Figure 13. Oscillogram of pulse voltage (upper) and power interacting between electrodes (lower)

Oscillograms of power of gravitation and accordingly character of change in strength of electric fields in discharge gap (lower) and type of pulse voltage (upper) is presented in Fig. 15. In oscillograms it is seen that power impact on grounded electrode only alongside the edge of pulse adequately describes form of pulse voltage. At that, range of power lags behind in time from the range of pulse voltage. Fall of pulse power is adequately described by formula (1). Comparison of oscillograms of process taken without screen electrode and with screen electrode has shown that the process of fall of pulse power at availability of screen electrode runs slower.

Comparison of power features of electric fields of corona discharge of direct voltage and its streamer form was done on power of adhesion of material particles to grounded plane. In this case particles are kept on grounded plane by mirror reflection power value of which is proportional to square value of charge in particle material and inversely is proportional to square distance between the centre of charge and its reflection in plane.
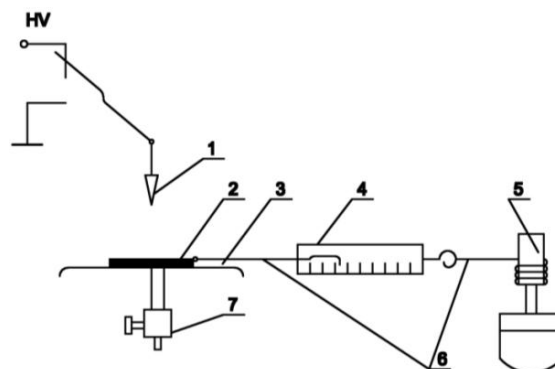

Figure 14. Diagram stand for measurement of power of adhesion of trial body to grounded plane: 1 - corona needle; 2 – trial body; 3 – grounded plane; 4 – dynamometer; 5 – drum of motor with gear; 6 – capronic string

Study conducted under the following methodology (Figure 14). From fluoroplastic of 0.15 mm thickness ring 2 of 20 mm diameter was cut and was placed in the centre of grounded plane 3 under corona needle 1. To the edge of ring a capronic string 6 was fixed which by the other end was fixed to spring dynamometer 6. Dynamometer by string 6 was fixed to drum of micro motor with gear 5. Inter electrode distance was adjusted by clamp 7. Inter electrode distance was 40 mm. To corona needle a voltage $2,4 \times 10^4$ V was supplied. In experiment for elimination of impact of power of Coulomb, i.e. interaction of charge particles with external electric field, trial body was charged from corona needle electrode, and then corona-forming electrode with high-voltage switch was grounded and at the same time motor was switched on. Power of mirror reflection was identified in dynamometer during separation of fluoroplastic ring from grounded plane.

Value of charge in coulomb fluoroplastic ring was calculated by formula:

$$Q = (2Fr^2)^{0,5}, \tag{13}$$

where F – power of separation of ring from grounded plane, H; r – thickness of fluoroplastic, m.

Specific surface density of charges in coulomb is identified by formula:

$$\sigma_S = Q/S, \tag{14}$$

where S –fluoroplastic ring area is 1256 mm^2.

Experiment was conducted in triple replication. In experiment for elimination of impact of power of Coulomb (interacting charge of trial body with external electric field), trial body first was charged from corona needle electrode, then corona needle with high-voltage switch was grounded, and measurement of power of adhesion of trial body to grounded plane was done.

Table 1. Outcomes of comparative study of powers of adhesion of trial body to grounded plane in electric fields

Parameters	Value of parameters					
Frequency of pulse, s^{-1}	=	70	122	154	200	210
F, H	$F_=$	F_1	F_2	F_3	F_4	F_5
	0.62	1.11	1.21	1.37	1.63	1.44
Q, 10^{-4} coulomb	0.74	1.0	1.0	1.1	1.2	1.14
σ_S, 10^{-4} coulomb /mm^2	9.48	12.6	13.2	14.1	15.3	14.4
$F_n/F_=$		1.94	2.21	2.63	2.31	1.79

Analysis of measurements results (Table 1) shows that mirror reflection power significantly depends on frequency of pulse voltage and increases up to frequency of 200 s^{-1}, and then reduces. This is because for circuitry of feed the maximum frequency of stability of streamer form of corona discharge is 200 s^{-1}. At this frequency the mirror reflection power exceeds for 2.63 times the similar power at corona discharge of direct voltage. Similarly value of surface charge and its density are increased. Hence it can be concluded that in electric fields of streamer form of corona discharge sedimentation of aerosol particles will occur more efficiently rather than in electric fields of corona discharge of direct voltage. Correctness of this conclusion is also related to value of strength of electric fields at feeding of pulse voltage is greater than strength of fields at feeding of direct voltage of corona discharge of direct and pulse voltages.

4.   Conclusions

1.   Enhancement of efficiency of gases purification from solid and liquid aerosol particles in electric fields might be achieved by use of streamer form of corona discharge allowing briefly enhance voltage in discharge gap above disruptive threshold of direct voltage at stability of discharge processes on frequency and range.

2.   Stability of discharge current of streamer form of corona discharge is observed up to some frequency of pulse voltage, and depends on parameters of circuitry of feed.

3.   Initial voltage ignition of discharge at direct voltage is 7×10^3 V, and at pulse voltage – 4×10^3 V. At the same effective values, voltage of current of streamer form of corona discharge is higher than current of corona of direct voltage. At voltage 2×10^4 V current of streamer form of discharge is twice more. stability of discharge process allows making preliminary conclusion that electric gas purification in electric fields of streamer form of corona discharge will be substantially efficient than in fields of corona discharge of direct voltage.

4.   From VAF family it is seen that by increasing of frequency of pulse voltage an electric strength of discharge gap is increased. If at frequency of 20 s^{-1} breakdown occurs at voltage 3×10^4 V, then at frequency of 220 s^{-1} breakdown occurs now at 4×10^4 V. At the same time, by increasing of electric strength of discharge gap a peak current discharge is increased: 9.2×10^{-5} and at frequency of 20 s^{-1} and 1.6×10^{-4} and at frequency of 220 s^{-1}. Peak current discharge was fixed at pre-disruptive values of voltage. Some reduction of initial voltage ignition of discharge at increase of frequency of pulse is also noted.

5.   Use of streamer form of corona discharge for trapping of aerosol particles from flow of gases require separating of electric field for division of opposite bulk charges and creation of flow of unipolar bulk charges. With this purpose the system of electrodes «potential plane with corona needles – grounded plane» can be used.

6.   Significant mutual screen impact of parameters of electrodes system «potential plane with corona needles – grounded plane», is detected that affects the value of discharge current. Preliminarily parameters of electrodes system might be selected on value of peak current discharge. However, these parameters require clarification at study of process of sedimentation of aerosol particles from flow air

7.   In electric fields of streamer form of corona discharge a Coulomb power is identified by parameters of elements of feed source, i.e. dynamic mode of process is obvious, unlike electric fields of corona discharge of direct voltage where such dependence practically does not exist.

8.   Type of change in strength of electric fields in discharge gap identified by experiment adequately describes a theoretical dependence which depends on parameters of elements of circuitry feed.

9.   Analysis of measurements results (Table 1) shows that mirror reflection power significantly depends on frequency of pulse voltage and increases up to frequency of 200 s^{-1}, and then reduces. This is because for circuitry of feed the maximum frequency of stability of streamer form of corona discharge is 200 S^{-1}. At this frequency the mirror reflection power exceeds for 2.63 times the similar power at corona discharge of direct voltage. Similarly value of surface charge and its density are increased. Hence it can be concluded that in electric fields of streamer form of corona discharge sedimentation of aerosol particles will occur more efficiently rather than in electric fields of corona discharge of direct voltage. Correctness of this conclusion is also related to value of strength of electric fields at feeding of pulse voltage is greater than strength of fields at feeding of direct voltage of corona discharge of direct and pulse voltages.

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