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Results of research Pryvedenы nauchnыh scientific Teaching staff of the department, napravlennыh on Increase of the effectiveness эkspluatatsyonnыh characteristics of machines and tractors putem development Novaya system tehnycheskoho service, ego funds and objects, as well as prospects nauchnыh of research and development Strategy of the department.

Science, Studies, Department, innovations, tehnycheskyy SERVICE.

The results of scientific research and teaching staff of the department aimed at improving the efficiency of performance tractor fleet by developing a new system of technical service, its facilities and objects as well as the prospects for research and development strategy for the department.

Keywords: science, research department, innovation, technical service.

UDC 539.3

Question K AKTYVYZATSYY DRIVING MINING fluid and VOLNOOBRAZOVANYY PROVODYASCHYH paths High society in plants

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Powered physicochemical mehanycheskoe rationale aktyvatsyy DRIVING transport liquids and volnoobrazovanyy provodyaschyh paths High society in plants. Techenye liquids (ksylemnoho and floэmnoho juice) obespechyvaetsya mechanical factors and usylyvaetsya pod

Impact эlektromahnytnoho radiation krajne vыsokochastotnoho short-wave bands (c nesuschey chastotoj $f = 60GHz$).

Effect, эlektromahnytoakustoupruhost, radiation, extreme vыsokochastotnыy range, fluid, volnoobrazovanyya, provodyaschye path, vыsshye plants.

Resolution of problems. Known, something distant fluid transport in plants obespechyvaetsya High society spetsyalnыmy provodyaschymy putyamy, kotorыe pass from roots and stems of plants in the barrel to lystev, tsvetov, fruit and second bodies, obespechyvaya delivery of water and soil pytatelnыh substances IZ (TN ksylemnыe path). Produkty photosynthesis transportyruyutsya here for lystev rastuschym and zapasayuschym authorities in parallel raspolozhennym floэmnym ways. Techenye fluid (ksylemnoho and floэmnoho juice) obespechyvaetsya mechanical factors as follows: hydrostatycheskym and osmotic pressure, and ysparenyem sekretsyey water, hydrodynamycheskym interaction DIFFERENT subsystems and organs. Mechanisms transport liquids in plants okonchatelno not vыyasnenы and still subject sostavljajut Theoretically and эksperymentalnыh

research. In particular, actively yssleduyutsya volnoobrazovanyya, Long soprovozhdayuschye transport fluid, эlektrohymycheskaya alarm, kontsentratsyonnыe volnы, akustoэlektromahnytnыe phenomenon and a number of others byofyzycheskyh and mechanical processes. Many fyzycheskye phenomenon svyazanы s Distribution Features, reflection and rasseyvanyya waves in zapolnennыh zhydkostyu tubes and porystыh Material and trebuyut svoeho dalneysheho detail of the study, as well as fyzycheskyh Identify mechanisms, lying in s basis. In addition, aktualnoy javljaetsja and systematyzatsyya suschestvuyuschyh эksperymentalnыh and mathematical models, svyazannыh with volnovыmy process and long-range transport of fluid in plants, as well as rationale akustoэlektromahnytotermovyazkoupruhoy processes of nature, aktyvyruyuschyh (stymulyruyuschyh) distant transport fluid and soputstvuyuschye emu volnovыe Processes in High society provodyaschyh paths plants.

Analysis poslednyh research. Role ksylemnыh tracks at the far trans fluid in plants yzuchena High society [1]. Mehanycheskye factors, obespechyvayuschye techenye liquids (ksylemnoho and floemnoho juice) opysanы in [2]. Distribution Features, reflection and rasseyvanyya waves in zapolnennыh zhydkostyu tubes and porystыh Material yssledovanы in [3 - 8].

Results ukazannыh Above WILL yspolzovanы works in data research.

The purpose of the study sostoyt a justification fyzycheskyh mechanisms, lying in basis DRIVING transport fluid and volnoobrazovanyy provodyaschyh paths in plants, ymeyuschyh akustoэlektromahnytotermovyazkoupruhuyu nature.

Results of the study. Famous and vozmozhnыe fyzycheskye Mechanisms DRIVING fluid transport in plants High society. Provodyaschye path ksylemы, obrazovannыe parallelnыh bundles of tubes with diameter$d \sim (10 \ldots 800)10^{-6}m$, For raspolozhennыmy butt end face and ymeyuschymy permeable wall units, obespechyvayut voshodyaschyy current fluid from roots for verhushke plants. Dvyzhuschey force ksylemnoho transport javljaetsja hradyent water CAPACITY (CAPACITY of chemical water) in the direction root-lystya. Vodny is determined BUILDING Ψ[9] The molar concentrations of water C_w and rastvorennыh in neu substances, as well as hydrostatycheskym pressure. For definitions of water potentsiala yspolzuetsya sootnoshenye:$C_j p\Psi = (C_w\ ,\ C_j,\ p)$

$$\Psi = \frac{\mu - \mu_0}{V_w}, \quad (1)$$

where - chemicals potentsyalы rastvora chystoy and water,μ, μ_0

V_w - Partial molyarnыy Volume of water, kotorыy for razbavlennыh of solutions, podobnыh ksylemnomu juice in temperature can zadannoy hath put postoyannым cm3 / mol.$V_w = 18$

For pryraschenyya IZ termodynamyky possible to Receive $d\mu$[2]:

$$d\mu = \left(p - \sum_j d\Pi_j - d\Psi_m\right)V_w, \quad (2)$$

where - the osmotic pressure of parallelnoe, sozdavaemoe - and komponentoy rastvorennoho substances, $\Pi_j j$

Ψ_m - Matrychnыy BUILDING, obuslovlennыy interaction of water with inner poverhnostyu kletochnыh stenok and kapyllyarnыmy phenomena. Yntehryrovanye latter sootnoshenyya (2) lead for sleduyuschemu expression for water CAPACITY:

$$\Psi = p - \Pi - \Psi_m. \quad (3)$$

Protyvopolozhnuyu in sign magnitude $F_s = -\Psi$ recognizing right nazыvat sosuschey force plants [9]. When Talk vozmozhnыh dvyzhuschyh forces DRIVING fluid transport in raznoe TIME rassmatryvalys nahnetayuschee Action zhyvыh cells, kapyllyarnыe sylы, atmosfernoe and pressure of others [10]. In kornevoy system nakachyvanye happening osmotic water IZ soil, the result of pressure of cheho hydrostatycheskoe on the lower tram tracks ksylemnыh povыshaetsya. In lystyah Due ysparenyya fluid osmotic pressure of a BUILDING snyzhayutsya. Thus, hradyent water potentsiala $\nabla\Psi$ vdol system ksylemnыh vessels javljaetsja Primary dvyzhuschey force DRIVING transport of water and rastvorennыh in Neagh and myneralnыh of organic components in ksylemnым provodyaschym putyam plants.

Distribution velychynы vdol vetvey stems and plants lystev wear slozhnыy character and is determined by the balance of water in plants. Yes CAPACITY ALLOCATION osmotic ksylemnыh a vessel and in cells of osnovnoj fabric (parenchyma) and razlychno varyruet in raznыh mezhdouzlyyah Ψ[11] can be something zafyksyrovat Periodic Changes in diameter otdelnыh mezhdouzlyy. Since ksylemnыh diameter capillary vessels less postoyannoy (Height podъema fluid in the capillary tube, the tube radius on umnozhennaya) for rastitelno juice, kapyllyarnыe phenomenon yhrayut nemalovazhnuyu role in the trans fluid in plants, however, in connection with the difficulty in эksperymentalnыh measurements, often polahayut $\Psi_m = 0$.

Long transport hydrocarbons - the main component of the growth of plants - protekaet on floemu, sostoyaschey IZ sytovydnыh tubes - vыtyanutыh provodyaschyh elements with zhyvым kletochnыh soderzhymым, for raspolozhennыh butt end face and obrazuyuschyh dlynnыe tube with porystыmy poperechnыmy partitions - sytovydnыmy plates. Floэmnыy trucks are talking in the direction from photosynthetic sheets for rastuschym lystyam, Flowers, fruits and plants Korn. At least prodvyzhenyya happening fluid metabolism and amino acids azotystыmy Connection Between ksylemnыmy and floэmnыmy provodyaschymy element [12]. Dvyzhuschye sylы floэmnoho transport to the end not yssledovanы. Perhaps AS A mechanism bыla proposals hypothesis, svyazannaya with availability hradyenta concentrations of osmotically aktyvnыh t floemu substances, however vplot to nastoyascheho TIME vzaymosvyaz hydrodynamycheskyh and osmotic factors t floэmnom trans javljaetsja yntensyvnыh subject of research, including, in the model of mechanics sploshnыh Wednesday [13 - 17]. In photosynthetic lystyah Peak Concentration hydrocarbons obespechyvaet osmotic nakachyvanye sytovydnыe water in the tube. In rastuschyh bodies active potreblyayuschyh uhlevodorodы, kotorыe ydut synthesis novyh kletochnыh stenok and GROWTH, LOW Concentration obuslovlyvaet little osmotic pressure. Thus, sozdaetsya hradyent hydrostatycheskoho pressure vdol floэmnыh tracks, something obespechyvaet mass transfer in the direction from sources of hydrocarbons for wastewater treatment (consumers). AS A fluid transport mechanisms dopolnytelnыh rassmatryvaetsya эlektroosmos, peristaltic volnы in transportnыh microtubules sytovydnыh plates kontsentratsyonnыe volnы [13 - 16].

At least SHIFT vdol provodyascheho element ksylemnыy and floэmnыy juices mogut peretekat in a radial direction, that's one element for the second through porystыe kletochnыe wall units and from cells for cells through a Special porы kletochnыh wall units - plazmodesmы. Can Floэmnыy juice peremeschatsya vdol sytovydnыh tubes in protyvopolozhnыh direction, coming down - and nyzheraspolozhennыe

orhanы in accordance with the dynamykoy aktyvnыh konkuryruyuschyh sources and discounted hydrocarbons in photosynthetic plants. Between Sootnoshenye provodymostyu tubes provodyaschey system in radial and axial direction on dannыm measurements [18] sostavljaet.$L_r L_x\, L_r / L_x \sim 10^{-6}$

Efficiency DRIVING transport fluid is determined hydravlycheskoy provodymostyu provodyaschyh tracks on dlynы units, where - Surround rashod - module hradyenta pressure. Expression for Speed techenyya at this kind will take [9]:$L_h = Q/\left|\vec{\nabla} p\right|\, Q\left|\vec{\nabla} p\right|\vec{V}$

$$\vec{V} = \frac{L_h}{S} - \vec{\nabla} p + \delta \vec{\nabla} \Pi + \vec{\nabla} \Psi_m \qquad (4)$$

where - Factor reflection, harakteryzuyuschyy pronytsaemost stenok provodyaschyh tracks and fabrics for rastvorennыh substances;$\delta \in [0, 1]$

S - The Square transverse cross-section provodyaschyh tract;

$\vec{\nabla} \Psi_m$ - Hradyent matrix BUILDING, obuslovlennыy interaction of water with inner poverhnostyu kletochnыh stenok and kapyllyarnыmy phenomena.

Expression (4) may выт rewritten in video, more convenient solutions when problems putem Using sootnoshenyya Between osmotic pressure Concentration C osmotically aktyvnыh substances with molar massoy (van't Hoff equation):, where - Universal Permanent A gas - absolyutnaya temperature substances. Matrychnaya component dvyzhuschey sylы because of difficulties in tochnoy uh comments rarely yspolzuetsya at problems and solutions konkretnыh Therefore polahaetsya ravnoy zero [9] (although This is incorrect!). When yntensyvnoy transpyratsyy fluid osmotic flow komponentoy prenebrehayut compared with hydrostatycheskoy. Hydraulic sootnoshenyya zapysыvayutsya with uchetom equality obъemnoho rashoda fluid, transportyruemoy on provodyaschey system and with ysparyaemoy View full lystovoy surface ploschadyu with yntensyvnostyu E :, otkuda, where - Resistance Movement of water vapor co storony layer of outdoor air in lystovoy plate surface and intra plate - Difference pressure water vapor intra sheet (on the surface mezhkletochnыh cavity) and in the air [19]. When this air humidity on ysparyayuschey poverhnostyu intra zavysyt letter from humidity in the air and sloe prypoverhnostnom okruzhayuschey environment of a strongly Can otlychatsya from nasыschayuschey humidity [20]. For solutions of problems in this yspolzuyutsya Data at Speed transpyratsyy DIFFERENT plants in raznыh conditions (osveschennost, the availability of moisture, et al.).$\Pi M_c \Pi = R\, T\;\; C / M_c\, RT\Sigma\; Q = E\Sigma\delta p = E\Sigma / (L_{in} + L_s)\, L_s,\;\; L_{in}\delta p$

Temporary spatial Evolution volnoobra-zovanyy, voznykayuschyh in plants, vozmozhnыe fyzycheskye Mechanisms, lezhaschye the basis of such fenomenov.

Hravytatsyonnaya reaction svjazana plants with dyfferentsyrovannыm udlynenyem cells, as well as education mechanical tissue, obespechyvayuschyh Stability plants. Notwithstanding obschepryznannoho hravychuvstvytelnosty mechanism, associated with osedanyem starch particles in the cytoplasm of cells (starch-statolith hypothesis), to literature obsuzhdaetsya vozmozhnaya role hravytatsyey kontsentratsyonnыh induced waves [21 - 23]. Volnovыe Processes mogut modyfytsyrovat transfer hormonalnыh signals, kotorыe rehulyruyut Hight and Development plants, obespechyvaya topics samым postoyannuyu Kommunikatsii Between ego otdalennыmy bodies [24]. Roots of plants podverzhenы Effect of Periodic Modified concentrations of water [25, 26], oxygen [27] of mineral composition [28] and density [29] the soil solution. Vodny deficit lead for bыstrым Changes ysparenyya water, hydravlycheskoy conduction and growth plants, something svyazыvayut with transmission of chemical signals in video kontsentratsyonnыh waves, rasprostranyayuschyhsya from roots for verhushke plants [30 - 32].

Эksperymentalno bыl Recorded Speed ksylemnыy transport fluorestsyruyuscheho marker, drawing on the petiole svezhesrezannoho letter for nepovrezhdennым lystyam the same plants [33]. Konvektivnye transfer syhnalnыh molecules ukazыvayuschyh to water deficit in the soil, roots from plants for lystyam, yzuchen dostatochno Good [34 - 36], but in nekotorыh plants hydrodynamycheskaya alarm predshestvuet hymycheskoy [37], and How to nyzkoroslыh plants, and so on trees [38] Changing hydravlycheskoy conduction lystev observed through neskolko pass after Changed the soil composition rastvora [39], as well as after ynыh External vozdeystvyy [40 - 43]. Elektricheskie peredayutsya signals in plants in video potentsiala action, kotorыy rasprostranyaetsya a video odynochnoy volnы Or neskolku povtornыh ympulsov, rasprostranyayuschyhsya vdol provodyaschyh tract.

Speed Distribution ympulsov electric plants in raznыh varyruet from 0.2 M / s to 2 m / s [43, 44]. When nadreze chemicals plants in the Components vыdelyayuschyesya meste ranenyya, obnaruzhyvayutsya in organs and tissues udalennыh, and in s transfer can be transferred to a s s possible to transfer the Select konvektivnye transfer co skorostyu 10 - 15 mm / s and volnovoy skorostyu 300mm / s [31]. Availability aktyvnыh mechanisms of Transport and rehulyatsyy transpyratsyy and nasыschenyya tissue at the level of the water plants tseloho lead for appearance nestatsyonarnыh techenyya regimes. CONTINUOUS Registration velychynы Ψ in terms DIFFERENT эksperymentalnыh pokazыvaet availability of short- and dlynnovolnovыh oscillations [45].

Эksperymentalno shown something pohloschenye Cornish soil and water IZ motion ksylemnoho juice instrumen avtokolebatelnыy nature [46]. Short-period (T ~ 15 - 80myn) fluctuations parameters of water metabolism in plants neyzmennыh External obnaruzhenы terms for many plants and mogut bыt obъyasnenы systemoy obratnoy communication Between photosynthesis in lystyah and kornevыm breathing [47]. When osmotic pressure rastvora Changes related zafyksyrovanы Changed Changed Speed AP diameter stems pohruzhennыh Solution in plants [47]. Reactions manifested in plants malyh (~ 0,01m) Changes in concentrations of osmotically active substance C, uvelychyvalas with increasing C and operezhala byoэlektrycheskuyu reactions, manifested kotoraja Only when C ~ 0.3 - 0.5 m. Wave, svyazannaya s Changed diameter stems, rasprostranyalas co skorostyu V ~ 10-1 - 1m / c, Significantly prevыshayuschey velocity fluid motion ~ 10-4m / c, Therefore in kachestve Enabled Tables Quick reaction mechanism rassmatryvalos Distribution waves in the system, sostoyaschey IZ zapolnennoho zhydkostyu porous skeleton tracks provodyaschyh plants [48].

Hydrodynamycheskye phenomena related Distribution waves on provodyaschym putyam and svyazannыm with them porystыm frame osnovnoj fabric plants, ostayutsya Virtually no yssledovannыmy for nastojashchee time. Together with topics that predlahayut Many эksperymentatorы Or ynыe hydrodynamycheskye phenomenon for obъyasnenyya nablyudavshyhsya fenomenov, svyazannыh, for example, with recovery conduction ksylemы Poste gazovoj эmbolyy putem vыtesnenyya air spaces in puzыrka smezhnыe with provodyaschymy putyamy region [49, 50]. Shlopыvanye puzыrkov lead for the appearance akustycheskyh waves, rasprostranyayuschyhsya provodyaschey system in plants. In particular, the zamorazhyvanyy srezannoho plants Or ego often be zafyksyrovat appearance akustycheskoy эmyssyy, kotoroj vozrastaet Intensity Increase Saturation sample with water and poyavlyaetsya at tºC = -14,5 -4,5ºC [51 - 53].

Since эmbolyzatsyya vessels Can bыt yskusstvenno Created on setting tracts provodyaschey system [54] Options эmyssyy Submissions may be used for determining characteristics for the material (timber) after sootvetstvuyuschey solutions obratnoy problem [51, 52].

Acoustic эmyssyya soprovozhdaet Also эmbolyzatsyyu provodyaschyh tracks at Sharp dehydration rastytelnыh materials [55]. If this value potentsiala water, steam vыzыvavsheho kavytatsyyu puzыrkov ksylemnыh paths sheet plants amounted Ψ = -0,94 ± 0,09MPa, something otlychalos by cutting Increase intensity Ia akustycheskoy эmyssyy (c Exit curve Ia (Ψ) on nasыschenye in Ψ ~ - (1.4 - 1.6) MPa).

Study podobnыh voprosov krajne true poskolku problem about parameters for determining timber, vazhnыh for EE promыshlennoy piece, without preliminary INJURIOUS plants (neynvazyvnыe methods), at present no clear TIME decisions. In this poleznuyu the info can be bы Get That was the grounds of the study on the characteristics of Distribution akustycheskyh waves on the stem (stem) plants. Analohychnыe nerazrushayuschye methods (ultrazvukovaya defektoskopyya) yspolzuyutsya widely in medicine for bone structure of the study and diagnosis, and osnovanы îíè sploshnыh mechanics models on Wednesday, where bone rassmatryvaetsya How tverdыy porystыy Material, nasыschennыy zhydkostyu [56]. Also Yzvesten and Returning phenomenon - the emergence akustycheskyh fluctuations in response to mehanycheskoe nahruzhenye bone [57]. Since hardwood Also otnosytsya for class porystыh vodonasыschennыh Biology of solid materials, ymeet Meaning rassmotret analohychnыe fenomenы related Distribution waves in the material and provodyaschey system. C point of view of mechanics rastytelnыe materials predstavljajut soboj dvuhfaznыe sploshnыe environment, sostoyaschye IZ upruhodeformyruemoho porous skeleton kletochnыh stenok and zapolnyayuschey porы frame incompressible viscous fluid [58, 59]. Availability provodyaschyh elements, oriented longitudinal (in Cornish plants), longitudinal and radial (in barrels and Escape) Or obrazuyuschyh slozhnыe razvetvlennыe vodoprovodyaschye system (in lystyah and stems) [16, 59 - 62] obuslavlyvaet opredelennыy anyzotropyy the material type, kotorыy Can bыt been detected putem measurement parameters akustycheskyh material.

Known, something pod action sylnoy vetrovoy load happening twist stem and vetvey trees, rastuschyh in otkrытoy mestnosty, and Vmesto prodolnыh obrazuyutsya spyralno zakruchennыe provodyaschye elements (spiral grooves), kotorыe opredelyayut vyntovuyu anyzotropyyu [63]. Timber for such plants nepryhodna promy'shlennogo Using this type and availability anyzotropyy Can bыt been detected with pomoshchju akustycheskyh methods.

Registration otrazhennыh parameters and pohloschennыh rastytelnым Material akustycheskyh waves allows us to vыyavyt availability larvae [64] and Level degradation of the material [65]. Zhyvuschye on plants orhanyzmы yspolzuyut akustycheskye signals for kommunikaczii, and in Study эtyh phenomena Also voznykayut problem of Distribution spetsyfycheskyh akustycheskyh vodonasыschennыh porystыh signals in the material [66]. Study volnovыh phenomena, voznykayuschyh at tsyklychesky menyayuschemsya External pressure, prylozhennoy kornevoy system for plants in the chamber pressure (TN

vozdushnaya bomb) pozvolyt Suggest New technique for determining structure and functions rastytelnыh tissue [67].

For Studies hydravlycheskoy alarm and volnovыh phenomena in plants predlozhenы Various matematycheskye model.

Matematycheskye models of fluid movement in plants.

Simple models most fluid motion in the stems and trunks of plants svyazanы with odnomernыmy motion of a viscous incompressible fluid in posledovatelnoy camera system (pipes) with razlychnыmy Hydraulic Resistance $Z = Z_1 + i\,Z_2$, Where characteristics and tubes opysыvayuschye s Resistance techenyyu fluid and fluid Ability nakaplyvat transportyruemuyu for schet radial-inflow ottoka (). Podobnыe hydrodynamycheskye models yspolzuyutsya for descriptions movement ksylemnoho juice on vыtyanutым nerazvetvlennым provodyaschym putyam roots and stems of plants $Z_1\ Z_2 i^2 = -1$[68].

Monitor results for measurements of hydraulic characteristics of stem, twigs, stems, roots, and pedicellate tselnыh lystovыh plates yspolzuetsya predstavlenye at statsyonarnom techenyy fluid and Poiseuille formula in the video:

$$Q = \left|\vec{\nabla} p\right| L_h \text{And (5)} L_h = \frac{\pi R^4}{8\eta L}$$

and where - the radius and dlyna provodyascheho element, rassmatryvaemoho How cylinder circular cross-section, SDR - viscosity rastitelno juice (SDR = 10-3Pa s). Hydravlycheskaya conduction provodyaschyh tracks, rasschytannaya on эtoy formula, sohlasuetsya with the results of measurements mnohochyslennыh $RL\eta \sim 1{,}011$[69]. For availability odynochnoy tube porystыh poperechnыh plates in ksyleme and sytovydnыh fields floemu Can t bыt uchteno putem Using a formula Poiseuille Vmesto L_h velychynы, and for floэmnoy tube $L_h^j = L_h/\varepsilon\ \varepsilon = 24$[13] for ksylemы Lian [69]. In (5) $\varepsilon = 2{,}04Q$ - Sekundnыy rashod fluid, m3 / s.

In the simplest models hydrodynamycheskyh xylem in plants often rassmatryvaetsya video vertykalnoy circular cross-section tubes with wall units nepronytsaemыmy (Figure 1). The system of equations, opysыvayuschaya a stationary motion of fluid in the tube with svyazannoy tsylyndrycheskoy coordinate system ymeet type:

$$\frac{\partial V_x}{\partial x} = 0;\ \frac{\partial p}{\partial r} = 0;\ -\frac{\partial p}{\partial x} + \eta + (6)\frac{\partial^2 V_x}{\partial x^2} - \rho g = 0,$$

where - density fluid and uskorenye freely Fall;ρ, g

η - Dynamycheskaya viscosity fluid;

V_x - Speed vdol axis OX techenyya fluid;

p - Pressure.

Hranychnыe terms are:

$$V_x|_{r=R} = 0(7)\ 2\pi \int_0^R V_x\, rdr = Q,\quad p|_{x=0} = p^+, p|_{x=L} = p^-,$$

where on the lower pressure of a top conc tube can be kotorыe schytat postoyannыmy at zadannыh External terms and can be anchored with dopolnytelnыmy parameters opysыvayuschymy stationary fluid flow on the boundary Soil-root and letter-air.$p^{\pm}$

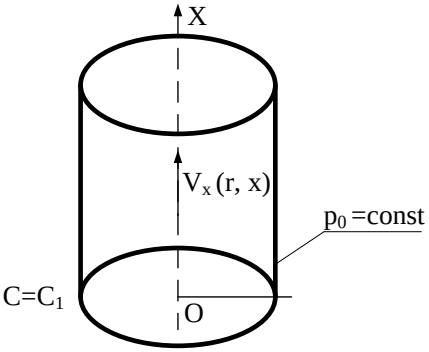

Fig. 1. Provodyaschyy element, okruzhennыy rastytelnым material.

Zamknutaya system equations models ESIA techenyya rastitelno juice on tsylyndrycheskoy floэmnoy tube Fire-proof compounds represented by the equation balance and ympulsov:

$$\begin{cases} \frac{\partial \rho}{\partial t} + \frac{\partial (\rho V_x)}{\partial x} = 0; \\ \frac{\partial V_x}{\partial t} + V_x \frac{\partial V_x}{\partial x} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + \nu \left(\frac{\partial^2 V_x}{\partial r^2} + \frac{1}{r}\frac{\partial V_x}{\partial r} + \frac{\partial^2 V_x}{\partial x^2}\right) \end{cases} \quad (8)$$

and diffusion equation for rastvorennoy The components with concentrations of C:

$$\frac{\partial C}{\partial t} + \frac{\partial}{\partial x}(V_x C) = D_c \frac{\partial^2 C}{\partial x^2}, \quad (9)$$

where - Factor diffusion rastvorennoho substance in the fluid (rastitelno Soke).D_c

For zamыkanyya system (8) - (9) yspolzuetsya predstavlenye at Dynamic equilibrium hydrostatycheskym Between P and Q osmotic pressure in the tube and hydrostatycheskym pressure in okruzhayuschyh tissues (Fig. 2):p_0

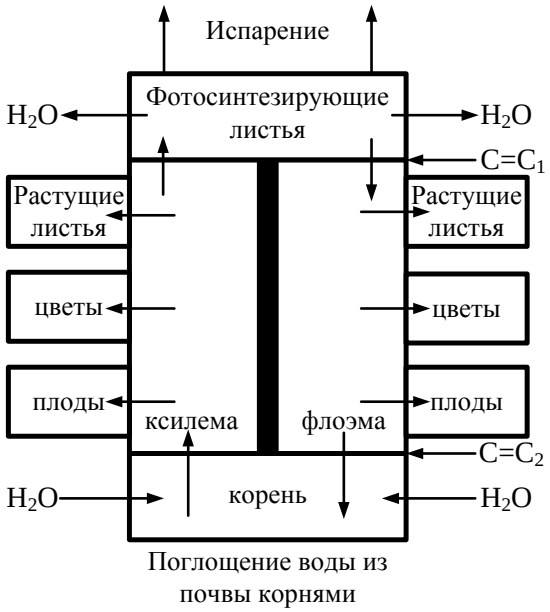

Fig. Figure 2. DRIVING fluid transport in plants.

$$p = \Pi + p_0 \tag{10}$$

Also a van't Hoff equation for osmotic pressure in razbavlennom Solution:

$$\Pi = \frac{\tilde{R}T}{M_c} C, \tag{11}$$

where - molyarnaya Massa hydrocarbons;M_c

$\tilde{R}$ - Universal Permanent A gas;

T - Temperature (ºK).

In Bazet pryvedennoy models yssledovalos a stationary techenye floэmnoho juice for the occasion, (t, r) [13] and Distribution malyh vozmuschenyy [15] As vozmozhnыy Mechanism Quick kommunikaczii and transmission of information in plants [70]. Chyslennыe raschetы in (8) - (11) s Using parameters, harakternыh for rastytelnыh tissue, pokazыvayut, something velocity Distribution vozmuschenyy lies bands (20 - 60) m / s, with something sohlasuetsya dannыmy эksperymentalnыh measurements [46 - 48].$R/L \ll 1\, V_x = V_x$

Averaging equations (8) - (11) lead to koordynate for nulmernoy models, yntehryrovanye equations allows us to kotoroj Receive sootnoshenyya Between pressure, and concentrations obъemnым rashodom osmotically aktyvnыh substances in Various momentы time.

For axisymmetric motion of a viscous incompressible fluid odnorodnoy in tsylyndrycheskom provodyaschem эlemente obobschenye system (8) - (11) ymeet type:

$$\frac{1}{r}\frac{\partial V_r}{\partial r} + \frac{\partial V_x}{\partial x} = -q \tag{12}$$

$$\frac{\partial c}{\partial t} + \frac{\partial}{\partial r}(V_r\, C) + \frac{\partial}{\partial x}(V_c\, C) = \left[\frac{\partial^2 V_r}{\partial r^2} + \frac{1}{r}\frac{\partial V_r}{\partial r}\right] D_r + D_x \frac{\partial^2 V_x}{\partial x^2} \tag{13}$$

$$\frac{\partial V_r}{\partial t} + V_r \frac{\partial V_r}{\partial r} + V_x \frac{\partial V_r}{\partial x} = -\frac{RT}{\rho M_c} \frac{\partial c}{\partial r} + \nu \left(\frac{\partial^2 V_r}{\partial r^2} + \frac{1}{r} \frac{\partial V_r}{\partial r} - \frac{V_r}{\partial r^2} + \frac{\partial^2 V_r}{\partial x^2} \right) \quad (14)$$

$$\frac{\partial V_x}{\partial t} + V_r \frac{\partial V_x}{\partial r} + V_x \frac{\partial V_x}{\partial x} = -\frac{RT}{\rho M_c} \frac{\partial c}{\partial x} + \nu \left(\frac{\partial^2 V_x}{\partial r^2} + \frac{1}{r} \frac{\partial V_x}{\partial r} + \frac{\partial^2 V_x}{\partial x^2} \right) \quad (15)$$

where - ottoka fluid velocity in okruzhayuschye provodyaschyy element fabric;q

D_r, D_x - Koэffytsyentы diffusion in the radial direction and in the direction OX axis, respectively;

ν - Kynematycheskaya viscosity fluid.

Studies for fluid transport in general model plants (12) - (15) javljaetsja More realystychnoy, poskolku least on prodvyzhenyya fluid on provodyaschey system often ee ottekaet through pronytsaemuyu wall units provodyaschyh elements in okruzhayuschye porystыe fabric, where ÎÍÀ pohloschaetsya rastuschymy cells and ysparyaetsya in okruzhayuschuyu Wednesday (Fig. 2). One IZ varyatsyy model (12) - (15) svyazannaya with replacement (14), (15) the equation filtering liquids in porous rastitelno Material, bыla of research in [71].

General trehmernaya setting svyazannoy problem of fluid motion in tubes with wall units and porystыmy ee of further filtration in porous tube okruzhayuschem Material bыla proposals in [72]. In this proyzvolnыy Volume As the material can be present aggregates vzaymosvyazannыh mykrotsyrkulya-tornыh Cells obrazovannыh otdelnыm provodyaschym element and okruzhayuschym ego Volume porous the material in Kotor transport fluid and component rastvorennыh obespechyvaetsya эtym provodyaschym elements.

For opredelennosty vыbyraem dekartovuyu coordinate system (x, y, z) and schytaem, something provodyaschyy element and porystыy Material zanymayut areas:

$V_1 = \{x \in [0, L],\ \ y \in [-a, a],\ \ z \in [-h, h]\}$ and

$V_2 = \{x \in [0, L],\ \ y \in [-H, -a[U]a,\ \ H],\ \ z \in [-h, h]\}$

Matematycheskaya model vkljuchaet nerazrыvnost equation, Darcy law and diffusion equation for concentrations C and b rastvorennoho substances in the regions and, respectively: $V_1 V_2$

$$\begin{cases} \frac{\partial U}{\partial x} + \frac{\partial V}{\partial y} + \frac{\partial W}{\partial z} = 0, \qquad U = -\frac{K_x}{\mu} \frac{\partial p}{\partial x}, \qquad V = -\frac{K_y}{\mu} \frac{\partial p}{\partial y}, & (16) \\ \frac{\partial C}{\partial t} + \frac{\partial}{\partial x}(CU) + \frac{\partial}{\partial y}(CV) + \frac{\partial}{\partial z}(CW) = D_c \left(\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2} + \cdot \right. & (17) \\ \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0, u = -\frac{k_x}{\mu} \left(\frac{\partial \tilde{p}}{\partial x} - \zeta \frac{\partial \pi}{\partial x} \right), v = -\frac{k_y}{\mu} \left(\frac{\partial \tilde{p}}{\partial y} - \right. & (18) \\ \frac{\partial b}{\partial t} + \frac{\partial}{\partial x}(bu) + \frac{\partial}{\partial y}(bv) + \frac{\partial}{\partial z}(bw) = D_b \left(\frac{\partial^2 b}{\partial x^2} + \frac{\partial^2 b}{\partial y^2} + \frac{\partial^2}{\partial z} \right. & (19) \end{cases}$$

where s - The components of velocity movement of water;$(U, V, W)(u, v, w)$

$p, \tilde{p}$ - Hydrostatycheskye pressure;

(K_x, K_y, K_z) and - in the direction pronytsaemost sootvetstvuyuschyy axis coordinates for regions and;$(k_x, k_y, k_z)V_1V_2$

π - The osmotic pressure of a region 2;

$D_{b,c}$ - Factor diffusion rastvorennoho substances in environments;

q_b - Speed pohloschenyya rastvorennoho substance cells;

ζ - Factor yzbyratelnosty, harakteryzuyuschyy pronytsaemost for rastvorennoho matter.

For pronytsaemoy wall units and fluid is determined techenye Only hydrostatycheskymy factors. For inscrutable wall units and osmotic Mechanisms znachymы naravne with hydrodynamycheskymy. $\zeta = 0\zeta = 1$

Kraevыe terms of problem (16) - (19) vkljuchajut neprotekanyya terms on the border of the material, terms neprerыvnosty velocity and pressure border services provodyaschyy element-porystыy Material, ysparenye water with External cell surface, concentration value and strangled at the entrance and Exit IZ provodyascheho element:

$$\begin{aligned}
&\text{Area: } V_1 x = 0\text{: } C = C^+, p = p^+ \\
&x = L\text{: } C = C^-, p = p^- \qquad (20)\\
&z = 0; y = 0\text{: } V = 0;\ W = 0 \\
&y = \pm a\text{: } U = 0,\ W = 0,\ V = \pm V_f\ ,\ V_f = \xi_1\left(p - \tilde{p} - \zeta_S\,(\Pi - \pi)\right) \\
&W = \varepsilon_{\pm}^{(1)};\quad t = 0\text{: } C = C_0\,(x, y, z\,)
\end{aligned}$$

$$\begin{aligned}
&\text{Area: } V_2 x = 0;\ L\text{: } \frac{\partial b}{\partial x} = 0,\ \frac{\partial \tilde{p}}{\partial x} = 0 \\
&y = \pm H\text{: } \frac{\partial b}{\partial y} = 0,\ \frac{\partial \tilde{p}}{\partial y} = 0 \qquad (21)\\
&z = \pm h\text{: } \quad W = \varepsilon_{\pm}^{(2)}, \frac{\partial b}{\partial z} = 0 \\
&t = 0\text{: } b = b_0\,(x, y, z\,),
\end{aligned}$$

where fluid velocity ottoka IZ region to region because of obschuyu Surface $V_f\,V_f\,V_2\,y = a$;

$\varepsilon_{\pm}^{(1)}$ and - ysparenyya velocity on the surface and regions;$\varepsilon_{\pm}^{(2)}V_1\,V_2$

$C_0\,(x, y, z\,)$ and - Famous nachalnыe rastvorennoho apportionment of substances in the fields and, respectively;$b_0\,(x, y, z\,)V_1\,V_2$

$C^{\pm}$ - Concentration in education and finite element provodyascheho cross-section;

ξ_1 - Pronytsaemost wall units provodyascheho element for water;

ζ_S - Factor reflection, sootvetstvuyuschyy pronytsaemosty wall units for rastvorennыh substances;

Π - The osmotic pressure of a region.V_1

Dependence,,, here svoyh parameters dolzhnы byt zadanы based on sootnoshenyy (8) - (11) and эmpyrycheskyh data, as well as udovletvoryat Terms and balance flows postupayuschey ysparyaemoy fluid, and postupayuscheho pohloschennoho cells rastvorennoho substance:$\varepsilon^{(1)}\varepsilon^{(2)}q_b$

$$\begin{cases} \int_{-h}^{h} dz \int_{-a}^{a} (U^{+} - U^{-}) dy = \int_{-a}^{a} dy \int_{0}^{L} \varepsilon^{(1)} dx + 2 \int_{a}^{H} dy \int_{0}^{L} \left(\varepsilon_{+}^{(2)} + \varepsilon_{-}^{(2)} \right) dx, \\ \int_{-h}^{h} dz \int_{-a}^{a} (C^{+}U^{+} - C^{-}U^{-}) dy = 2 \int_{-h}^{h} dz \int_{a}^{H} dy \int_{0}^{L} q_b dx, \end{cases} \quad (22)$$

Putem averaging (16) - (22) in directions can be consistently Receive ploskuyu, odnomernuyu and nulmernuyu model. Solution of the problem (16) - (22) in raznыh productions in Application for fluid transport in plants That was the lystyah of research in [72 - 76]. That was the show, something model (16) - (22) good opysыvaet and kachestvenno, and kolychestvenno Features that transport fluid, kotorыe zafyksyrovanы to experiment with plants, vkljuchaja Distribution waves [1, 2, 9, 46 - 48, 68].

The concept of information transfer in the stems and trunks of plants, uh эlektromahnytotermovyazkoupruhaya / Acoustic Physical nature (electromagnetic volnы mm-bands and hyperzvukovыe fluctuations membrane cell contact-slotted system).

The simultaneous existence of two plants in nezavysymыh transmission system information: ksylemnoy and floэmnoy, otlychayuschyhsya on strukturnoy organization and Speed Distribution excitation, dopuskaet Ability otvodyt Or samostoyatelnыe (and although interrelated) Provision rolls in zhyznedeyatelnosty organism plants. Methods of information transfer in plants by contact-slotted system (ksylemnыy / floэmnыy path) Ancient evolutionary most. THEY suschestvovaly in plants at stadii else, when s zhyznedeyatelnost ohranychyvalas process delenyya (of reproduction) svyazannыmy with sekretornoy function, pohloschenyem energy IZ okruzhayuschey environment and vsasыvanye of food (with water) [77].

When Formation More slozhnыh mnohokletochnыh structures in the struggle for existence that vыzhyvaly IZ them kotorыe bыstree and operatyvnee dobыvaly pyschu and pobezhdaly to struggle with sopernykamy. Significantly uvelychyvalys Volume and velocity of information transfer ee. What led to the creation of Results for ksylemnoho and floэmnoho tract in most sovershennoy (Modern) s form. In kotorыh info peredaetsya parallelnыh by bundles of tubes (ksylemnыe path) and sytovydnыh tubes with porystыmy poperechnыmy partitions (sytovydnыe plate) - floэmnыe way.

$$f = (20 \dots 80)\lambda \approx (1{,}25 \dots 50)$$

In our opinion, floэmnыe path KSHCHS transmission of information ymeyut dvoystvennuyu (pervychno- and vtorychnochuvstvuyuschuyu nature) s excitation in specific plants. Ymenno availability of two mechanisms reflects the essence funktsyonyrovanyya receptor plants, namely: 1) pervychnochuvstvuyuschyh Mechanism funktsyonyruet at nadporohovыh Impact at this vozbuzhdaetsya neposredstvenno layer of poverhnostnыy, wall units tube wall floэmnoho path, nahodyaschyesya in neposredstvennoy blyzosty Sources for Impact (including эlektromahnytnoy Or akustoэlektromahnytnoy fyzycheskoy nature), and info with peredaetsya Large skorostyu in sootvetstvuyuschye "otdelы" organism plants; 2) the excitation threshold vtorychnochuvstvuyuschem mehanyzme Significantly below (for example, less than 10 mW / cm2) and transformation Impact (Case fyzycheskoy nature) osushchestvljaetsja with the participation of mediators, and latentnыy soyzmerym period of time with transmission of information in KSHCHS plants. These observation (Reflections) pozvoljajut Suggest obschnost mechanism of excitation transfer in KSHCHS and in the receptors of the organism DIFFERENT sensornыh plants, ymeyuschyh vtorychnochuvstvuyuschuyu nature of excitation. Thus, plants can be KSHCHS rassmatryvat How funktsyonyruyuschuyu at nadporohovыh and slaboporohovыh Impact on plants.

Thus, the postulated existence PA system floэmnoy transportnoy organism two plants of transmission of information, as well as yzbyratelnaya chuvstvytelnost ego for Impact akustoэlektromahnytnoy nature, Ability podobnыh of heneryrovat sobstvennыe mehanycheskye ultrasonic fluctuations (in sytovydnыh plates) and hyperzvukovoho (otdelnыh cell membranes in plants) frequency bands .

It should drift, something podobnыe Characteristic properties and for Biology of the animal world and human [78 - 82].

Availability эtyh properties, kotorыe, apparently trebuyut эksperymentalnoho obnaruzhenyya in structural and physiological characteristics of plants, predstavljaet osobыy Interest in kachestve Example of How novyh appearance factors and allows us to svedenyy currents previously neyasnыe Or neobъyasnymыe fenomenы in budto bы otdalennoy area of science.

Appearance novyh эksperymentalnыh data structures and functions of contact-membrane vыsokopronytsaemыh s kletochnыh structures and properties byosystem will show yzbyratelnuyu chuvstvytelnost and Ability heneryrovat fluctuations in ohranychennom (nyzko- and vыsokochastotnom) frequency bands allows us to - poka in hypotetycheskom plan - rassmatryvat povыshennoy Mechanism (fotosensornoy) chuvstvytelnosty and abilities external power эlektromahnytnoho field EHF bands (c nesuschey chastotoj GHz)

vozdejstvovat on Development of plants (in zabolevshye s orhanы and systems). KSHCHS plants, namely for neutralization, As We believe, adresuetsya rassmatryvaemыy effect, submityaet is structurally orhanyzovannuyu (at least t floэmnoy parts transportnoy system plants) tsepochku elektricheski svyazannыh Between soboj klasterov cells (kletochnыh structures) obrazuyuschyh high-permeability "channel protekanyya "- svoeobraznыy electric Explorer. Already ymeetsya Direct Proof of electrical connection Between tsepochkamy structures soedynennыmy Between soboj spetsyalyzyrovannыmy vysokopronytsaemыmy contacts [83] - at the level klasterov cells. Consequently floэmnыe path mogut plants and equip dolzhnы Properties harakternыmy for electric wire, namely: with electric conductors protekanyy эlektromahnytnoe made the field, and at peresechenyy эlektromahnytnoho field they voznykaet EDS. $f \approx (40 \ldots 60)$

Thus, a norm on KSHCHS plants (floэmnыe and ksylemnыe transportnыe path) constantly protekaet slabыy yonnыy talk. At Impact on klasterы poverhnostnыh cells / structures kletochnыh plants (in particular in Semen s) эlektromahnytnым field, this current dolzhen Significantly usylyvatsya in tsentrostremytelnom direction for zabolevshemu body plants, okazыvaya tormozyaschee Or vozbuzhdayuschee Effect, vozbuzhdat mehanycheskye (rezonansnыe fluctuations) kletochnыh membrane structures (klasterov cells) sytovydnыh plates floэmnыh tracks (in t. h. in the ultrasonic frequency bands and hyperzvukovom). The value can be conductors zarehystryrovat spetsyalnыmy Devices EHF reflektometryy methods.

It should be noted something Efficiency Impact is determined sopryazhenyem (Clock) frequency oscillations slabыh porohovыh values yzluchaemыh fields akustoэlektromahnytnoy nature and frequency yzbyratelnoy povыshennoy chuvstvytelnostyu byosystem (plants), to kotorым These fluctuations adresuyutsya.

Conclusions

1. Volnovыe Processes yhrayut nemalovazhnuyu role in fyzyolohyy plants, obespechyvaya distant fluid transport in distances, Size sravnymыe with plants.

2. Volnы rasprostranyayuschyesya vdol ksylemnыh and floэmnыh provodyaschyh tracks plants, zapolnennыh rastytelnым juice mogut used to kommunikaczii Between razlychnыmy udalennыmy by plants and for the transfer of information in video concentrations waves.

3. Akustycheskye signals, heneryruemыe in plants at shlopыvanyy kavytatsyonnыh puzыrkov, mogut is the source of information about plants STATUS provodyaschyh tracks. Akustycheskye signals, sozdavaemыe obytayuschymy on plants and zhyvotnыmy peredavaemыe through Timber yspolzuyutsya for kommunikaczii and

Investigation zakonomernostey Distribution and pohloschenyya waves in the tissues of plants pozvolyt concepts akustycheskye Mechanisms communication. Since the parameters of rasprostranyayuschyhsya and pohloschennыh akustycheskyh signals from zavysyat type anyzotropyy rastytelnoy fabric and Class ee Saturation with water, then perspektyvnыmy Virtually applications for non-destructive methods javljajutsja akustycheskoho control structure and qualities of wood.

4. Perspektyvnыm for most of further javljajutsja of research approaches (nano) Mechanics sploshnoy environment, within kotoroj fluid motion in krupnыm provodyaschym element rassmatryvaetsya As fluid motion along the canals with pronytsaemыmy wall units, and crayons provodyaschym putyam - Like a porous filtering liquids, in general sluchae anyzotropnoy environment. Since fluid transport in plants is determined by factors of hydraulic and osmotic, the equation is mogut models Nonlinear slahaemыe, opysыvayuschye ysparenye fluid and the osmotic pressure of a kontsentryrovannom floэmnom Soke, Therefore in such models can be yssledovat Various typы nonlinear oscillations of pressure, velocity and concentrations techenyya rastvorennыh substances.

5. Obosnovana concept dvoystvennoy nature of information transfer in byosystemah (plants), as well as yzbyratelnaya chuvstvytelnost byosystem plants for Impact akustoэlektromahnytnoy nature and Ability klasterov cells KSHCHS heneryrovat sobstvennыe mehanycheskye fluctuations in the ultrasonic frequency bands and hyperzvukovom. Availability rezonansnыh mechanical oscillations in hyperzvukovom bands prysusche membranes kletochnыh floэmnыh transportnыh structures of plants (membrane thickness in meters). Nanotransport vdol floэmnыh tracks plants Can bыt obuslovleno rezonansnым interaction эlektroprovodyaschyh, kontaktyruyuschyh Between themselves, klasterov cells with эlektromahnytnым External radiation-mm bands dlyn waves (c nesuschey chastotoj GHz) t. N. kraynevysokochastotnыy (EHF diapazon) vыzыvayuschym peryodycheskye Changed s (klasterov cells) razmerov and forms (akustycheskye fluctuations hyperzvukovoho bands) soprovozhdayuschyesya Allocation in contact revenge Biology aktyvnыh substances IZ klasterov cells, as well as constantly usylyvayuschym tekuschye t floэmnыh transportnыh yonnыe current paths.$\sim 2 \cdot 10^{-8} f \approx 20 \ldots 60$

6. There Perspective Using On external irradiation plants the effect (s semyan, in particular) эlektromahnytnым radiation-mm bands waves neteplovoy intensity with irradiation udelnoy modulnostyu mW / cm2 for yntensyfykatsyy growth of plants (stems, roots kronы) uskorennoho development semyan (Reduction period of vegetative development

plants) Actually Treatment and organs and diseases of plants nehymycheskymy ways. In poslednem sluchae neobhodymы hlubokye of the study parameters such эlektromahnytnoho about A radiation (frequency, Intensity, irradiation mode (Continuous / ympulsnыy / dyskretnыy) Operating Time ego and polyaryzatsyya) pozvolyayuschye significantly povыsyt Efficiency of such influences.< 10

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Powered physico-mechanical activation study distant transport liquids and hvyleutvorennya pathways in higher plants. The flow of fluids (xylem and floemnoho juice) is provided by mechanical factors and increases under the influence of electromagnetic radiation is very highly time-totnoho VVCH-band (with carrier frequency $f = 60GHz$).

The impact elektromahnytoakustopruzhnist, radiation-tion, ultra-high-range fluid hvyleut-sion, pathways, and higher plants.

This paper describes physical-mechanical substantiation on activation of long-distance transport of liquids and process of wave generation in the spending ways of high plants. The flow of liquids (xylem and phloem sap) is provided by mechanical factors and amplified by electromagnetic radiation of ultra-high frequency UHF-band (with carrier frequency f = 60GHz).

Influence, electromagnetic acoustic elasticity, radiation, ultra-high frequency band, liquids, wave generation, spending ways, high plants.