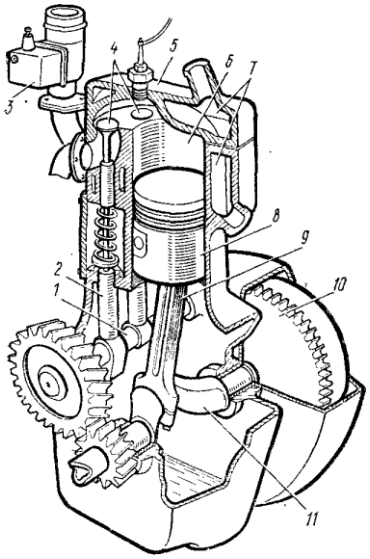
IYODLARI VA UNING KO'RSATKICHLARINI HISOBLASH.

Ichki yonuv dvigatellari deb- yoqilg'ining issiqlik energiyasini mexanik energiya aylantirib beruvchi qurilma.



3.1-rasm. Porshenli ichki yonuv dvigateli qurilmasining sxemasi.

1-kulachokli val; 2-turtgich; 3-karbyurator; 4-klapan; 5-silindr kallagi; 6-silindr; 7-silindr g'ilofi; 8-porshen; 9-shatun; 10-maxovik; 11-tirsakli val.

Hisob ishi uchun ko'rsatkichlar tanlanganda silindrning o'lchami, dvigatelning aylanishlar soni aralashmani hosil qilish dagi taktlar yoqilg'ini qabul qilish shamollatish darajasi (shamollatish qo'llanilsa) hisobga olinadi.

3.1-masala: To'rt taktli statsionar turdagi quvvati $N_e = 294\,kVt = 400\,ot.kuchi.$; $n = 1000\frac{ayl}{min}$; silindrlar soni i=6; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=86%; N=13%; 0=1%). Yonishdagi issiqlik ajralishi $Q_n^P = 42000\frac{kj}{kg}$. Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013\cdot 10^5\, H/m^2; \quad T_0 = 288\, K.$$

Talab etiladigan nazariy havo miqdori:

$$L_0 = (1/0{,}21)(C/12 + H/4 - O/32) = (1/0{,}21)(0{,}86/12 + 0{,}13/4 - 0{,}01/32) = 0{,}495$$

kmol/kg;

$$\alpha L_0 = 1{,}8 \cdot 0{,}495 = 0{,}891 \text{ kmol/kg};$$

$$L_0^1 = 28{,}95 L_0 = 28{,}95 \cdot 0{,}495 = 14{,}32 kj/kg$$

Quyidagicha topamiz:

$$M_{CO_2} = C/12 = 0{,}86/12 = 0{,}0717 \text{ kmol/kg}; \quad M_{H_2O} = H/2 = 0{,}065 \text{ kmol/kg};$$

$$M_{O_2} = 0{,}21(\alpha - 1)L_0 = 0{,}083 \text{ kmol/kg}; \quad M_{N_2} = 0{,}79\alpha L_0 = 0{,}704 \text{ kmol/kg};$$

$$M = 0{,}924 \text{ kmol/kg}; \quad M' = 26{,}78 \text{ kg/kg}.$$

Yonishdagi zarralar ajralishi soni

$$\Delta M = M - \alpha L_0 = 0{,}924 - 0{,}891 = 0{,}033 \text{ kmol/kg};$$

Molekulyar o'zgarishning ximik koeffitsienti

$$\mu_0 = M/(\alpha L_0) = 1{,}036.$$

To'rt taktli tez yurar dizel uchun tavsiya etilgan belgilarni qabul qilamiz.

$$r_a = 0{,}85 \text{ bar};$$

$$r_r = 1{,}1 \text{ bar};$$

$$\Delta T = 17 K; \; T_r = 750 K.$$

Shunda

$$\gamma = [(T_0 + \Delta T)/T_r] \cdot [p_r/(p_a - p_r)] = [(288 + 17)/750] \cdot [1{,}1/(4{,}5 \cdot 0{,}85 - 1{,}1)] = 0{,}04,$$

$$\mu = (\mu_0 + \gamma)/(1 + \gamma) = (1{,}036 + 0{,}04)/(1 + 0{,}04) = 1{,}035;$$

$$T_a = (T_0 + \Delta T + \gamma T_r)/(1 + \gamma) = (288 + 17 + 0{,}04 \cdot 850)/(1 + 0{,}04) = 323K;$$

$$\eta_V = \frac{\varepsilon}{\varepsilon - 1} \cdot \frac{p_a}{p_o} \cdot \frac{T_0}{T_a(1 + \gamma)} = \frac{14{,}5}{14{,}5 - 1} \cdot \frac{0{,}85}{1{,}013} \cdot \frac{288}{326(1 + 0{,}04)} = 0{,}78.$$

Adiabatik siqilish dagi o'rtacha belgilashni quyidagicha qabul qilamiz. $k_1 = n_1 = 1{,}37;$ shunday qilib.

$$T_c = T_a \varepsilon^{k_1 - 1} = 326 \cdot 14{,}5^{0{,}372} = 871K; \qquad t_c = 598^0 C.$$

$$p_c = p_a \varepsilon^{k_1} = 0{,}85 \cdot 14{,}5^{1{,}37} = 33{,}6 \qquad bar.$$

Yonish bosqichdagi oxirgi haroratdan yonish tenglamasini hosil qilish uchun foydalanamiz.

$$\frac{\xi_z Q_H^P}{\mu(1+\gamma_r)L_0}+\frac{c_v' t_c+8{,}314\lambda T_c+2270(\lambda-\mu)}{\mu}=c_p'' t_z,$$

bu yerda $c_v' = (c_v + \gamma c_v'')/(1+\gamma_r)$

havo uchun issiqlik sig‘imini jadvaldan topamiz t_c =598^0C belgilanish s_r = *30,42* kj/kmol · grad, bu yerda s_v=c_p-*8,314=22,1* kj/kmol · grad. Qoldiq gaz uchun *a = 1,8* ва t_c = *598* ^0C; $c_p^n = 31{,}894$ kj/kmol · grad; $c_v^n = 31{,}894 - 8{,}314 = 23{,}58$ kj/kmol · grad; shunday qilib, $c_v^r = (22{,}1 + 0{,}04 \cdot 23{,}58)/(1+0{,}04) = 22{,}15$ kj/kmol·grad.

qabul qilamiz ζ = 0,8 i λ = 1,6.

Sonli belgilanishlar asosida yonish jarayoni tenglamasini quyidagicha yozamiz.

$$c_p^n t_z = \frac{0{,}8 \cdot 42000}{1{,}035(1+0{,}04)0{,}891}+\frac{22{,}15 \cdot 598+8{,}314 \cdot 1{,}6 \cdot 598+2270(1{,}6-1{,}035)}{1{,}035}=56700 \quad \text{kj/kmol.}$$

tanlash asosida belgilashni qabul qilamiz t_z=1615 ^{0}C, T_z=1888K

keyingi,

$$\rho = (\lambda T_z)/(\varepsilon T_c) = (1{,}6 \cdot 1888)/(14{,}5 \cdot 871) = 1{,}4;$$

$$\rho_z = \lambda p_c = 1{,}6 \cdot 33{,}6 = 53{,}8 \quad bar.$$

keyingi bosqichdagi kengayish

$$\delta = \varepsilon / p = 14{,}5/1{,}4 = 10{,}35$$

qabul qilamiz n_2 = 1,24 kengayish oxiridagi bosimni aniqlaymiz:

$$p_b = p_z / \delta^{n_2} = 53{,}8/10{,}35^{1{,}24} = 2{,}94 \quad bar.$$

$$T_b = T_z / \delta^{n_2-1} = 1888/10{,}35^{0{,}24} = 1080K.$$

O’rtacha indikator bosim

$$\rho_{iT} = \frac{p_c}{\varepsilon-1}\left[\lambda(\rho-1)+\frac{\lambda\rho}{n_2-1}\left(1-\frac{1}{\delta^{n_2-1}}\right)-\frac{1}{n_1-1}\left(1-\frac{1}{\varepsilon^{n_1-1}}\right)\right]=$$

$$=\frac{33{,}6}{14{,}5-1}\left[1{,}6(1{,}4-1)+\frac{1{,}6 \cdot 1{,}4}{1{,}24-1}\left(1-\frac{1}{10{,}35^{0{,}24}}\right)-\frac{1}{1{,}37-1}\left(1-\frac{1}{14{,}5^{0{,}37}}\right)\right]=7{,}38 bar.$$

φ_p=0,93, dan foydalanib topamiz

$$p_i = p_{iT\varphi\Pi} = 7{,}38 \cdot 0{,}93 = 6{,}9 \quad bar.$$

O’rtacha effektiv bosim

$$p_e = pi\eta м = 6{,}9 \cdot 0{,}8 = 5{,}5 \quad бар = 5{,}5 \cdot 10^5 H/м^2, \text{ qabul qilamiz } \eta_m = 0{,}8.$$

Dvigatelni asosiy o'lchamlarini aniqlaymiz:

$$V_h = \frac{N_e \cdot 12 \cdot 10^7}{\rho_e n i} = \frac{294 \cdot 12 \cdot 10^7}{5{,}5 \cdot 10^5 \cdot 1000 \cdot 6} = 10{,}7 \text{ л.}$$

Berilgan ma'lumotga asosan qabul qilamiz *S/D = 1,2*

$$D = \sqrt[3]{\frac{V_h}{0{,}785 S / D}} = \sqrt[3]{10{,}7 / 0{,}785 \cdot 1{,}2 = 2{,}25} \quad .$$

qabul qilamiz *D*=230 mm; *S*=260mm; V_h=10,8 l.

Porshenni tezlikdagi o'lchamlari asosida

$$C_m = Sn/30 = 0{,}26 \cdot 1000/30 = 8{,}67 m/s.$$

Dvigatelni indikator i effektiv ko'rsatkichlari

$$N_i = N_e / \eta_m = 294/0{,}8 = 367 \quad kVt;$$

$$\eta_i = 8{,}314 \frac{\alpha L_0 p_i T_0}{Q_H^P \eta_V p_0} = 8{,}314 \frac{1{,}8 \cdot 0{,}495 \cdot 6{,}9 \cdot 288}{42000 \cdot 0{,}78 \cdot 1{,}013} = 0{,}442;$$

$$\eta_e = \eta_i \eta_m = 0{,}442 \cdot 0{,}8 = 0{,}354;$$

$$g_i = 3600/Q_H^P \eta_i = 3600/(42000 \cdot 0{,}442) = 0{,}195 \quad kg/kVt \cdot s;$$

$$g_e = 3600/Q_H^P \eta_e = 3600/(42000 \cdot 0{,}354) = 0{,}242 \quad kg/kVt \cdot s;$$

$$G_T = g_e N_e = 0{,}242 \cdot 294 = 71{,}2 \quad kg/s;$$

$$N_л = N_e / iV_h = 294/6 \cdot 10{,}8 = 4{,}5 \quad kVt/l.$$

φ =1,0 Dvigatelni zaryadka qilish uchun havoning sarfi

$$G_B = G_{T\alpha\varphi} L_0' = 71{,}2 \cdot 1{,}8 \cdot 1 \cdot 14{,}32 = 1840 \quad kg/s = 0{,}51 \quad kg/s.$$

3.2-masala. To'rt taktli statsionar turdagi quvvati $N_e = 362 \quad kVt = 300 \text{ л.с}; \quad n = 1000 \, ay/\min$: silindrlar soni *i=6*; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=86%; N=13%; 0=1%). Yonishdagi issiqlik ajralishi $Q_н^P = 22000 \quad kj/kg.$

Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288 K.$$

$\eta_V = ?$

3.3-masala. To’rt taktli statsionar turdagi quvvati $N_e = 294 \quad kVt = 400\ л.с; \quad n = 1000\ ay/\min:$ silindrlar soni $i=6$; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=86%; N=13%; 0=1%). Yonishdagi issiqlik ajralishi $Q_н^P = 42000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5\ H/m^2; \quad T_0 = 288\ K.$$

$N_л = ?$

3.4-masala. To’rt taktli statsionar turdagi quvvati $N_e = 260 \quad kVt = 500\ l/s; \quad n = 1000\ ay/\min:$ silindrlar soni $i=6$; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=86%; N=13%; 0=1%). Yonishdagi issiqlik ajralishi $Q_н^P = 42000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5\ H/m^2; \quad T_0 = 288\ K.$$

$G_B = ?$

3.5-masala. To’rt taktli statsionar turdagi quvvati $N_e = 240 \quad kVt = 520\ l/s;$ $n = 800\ ay/\min:$ silindrlar soni $i=7$; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=85%; N=18%; 0=1,5%). Yonishdagi issiqlik ajralishi $Q_н^P = 38000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 11{,}5; \quad a = 3{,}8; \quad p_0 = 2{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

D=***?***

3.6-masala. To’rt taktli statsionar turdagi quvvati $N_e = 290 \quad kVt = 300\,l/s; \quad n = 1100\,ay/\min:$ silindrlar soni *i=6*; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=56%; N=23%; 0=4%). Yonishdagi issiqlik ajralishi $Q_n^P = 45000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 20{,}5; \quad a = 6{,}8; \quad p_0 = 5{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$V_h = ?$

3.7-masala. To’rt taktli statsionar turdagi quvvati $N_e = 320 \quad kVt = 600\,l/s; \quad n = 2100\,ay/\min:$ silindrlar soni *i=8*; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=63%; N=15%; 0=4%). Yonishdagi issiqlik ajralishi $Q_n^P = 42000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 19{,}5; \quad a = 1{,}5; \quad p_0 = 9{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$T_b = ?$

3.8-masala. To’rt taktli statsionar turdagi quvvati $N_e = 240 \quad kVt = 450\,l/s; \quad n = 1200\,ay/\min:$ silindrlar soni *i=4*; aralashma hosil qilish oqimli; shamollatish yo’q; dizel yoqilg’isi (S=86%; N=13%; 0=1%). Yonishdagi issiqlik ajralishi $Q_n^P = 40000 \quad kj/kg.$

Dvigateldagi havo va yoqilg’i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o’lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$p_e = ?$

3.9-masala. To'rt taktli statsionar turdagi quvvati $N_e = 320 kVt = 520\,l/s; \quad n = 900\,ay/\min:$ silindrlar soni *i=2*; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=83%; N=14%; 0=3%). Yonishdagi issiqlik ajralishi $Q_n^P = 41000 \quad kj/kg.$

Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}9; \quad a = 1{,}4; \quad p_0 = 5{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$C_m = ?$

3.10-masala. To'rt taktli statsionar turdagi quvvati $N_e = 210 \quad kVt = 200\,l/s; \quad n = 850\,ay/\min:$ silindrlar soni *i=6*; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=96%; N=16%; 0=1%). Yonishdagi issiqlik ajralishi $Q_n^P = 42000 \quad kj/kg.$

Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 24{,}5; \quad a = 3{,}8; \quad p_0 = 5{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$p_i = ?$

3.11-masala. To'rt taktli statsionar turdagi quvvati $N_e = 360 \quad kVt = 310\,l/s; \quad n = 1000\,ay/\min:$ silindrlar soni *i=6*; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=89%; N=14%; 0=1%). Yonishdagi issiqlik ajralishi $Q_n^P = 39000 \quad kj/kg.$

Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 17{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K.$$

$g_i = ?$

3.12-masala. To'rt taktli statsionar turdagi quvvati $N_e = 220 \quad kVt = 560\,l/s; \quad n = 1400\,ay/\min:$ silindrlar soni $i=3$; aralashma hosil qilish oqimli; shamollatish yo'q; dizel yoqilg'isi (S=76%; N=33%; 0=5%). Yonishdagi issiqlik ajralishi $Q_n^P = 46000 \quad kj/kg.$

Dvigateldagi havo va yoqilg'i sarfini, effektiv va indikatorli foydali ish koeffitsientini hamda dvigatel o'lchamini aniqlash.

Tez yurar dvigatel hisob ishi turi uchun quyidagi qiymatlarni tanlaymiz:

$$\varepsilon = 14{,}5; \quad a = 1{,}8; \quad p_0 = 1{,}013 \cdot 10^5 H/m^2; \quad T_0 = 288\,K. \quad p_b = ?$$