ICHKI YONUV DVIGATELLARI NAZARASI

(Theory of Internal Combustion Engines)

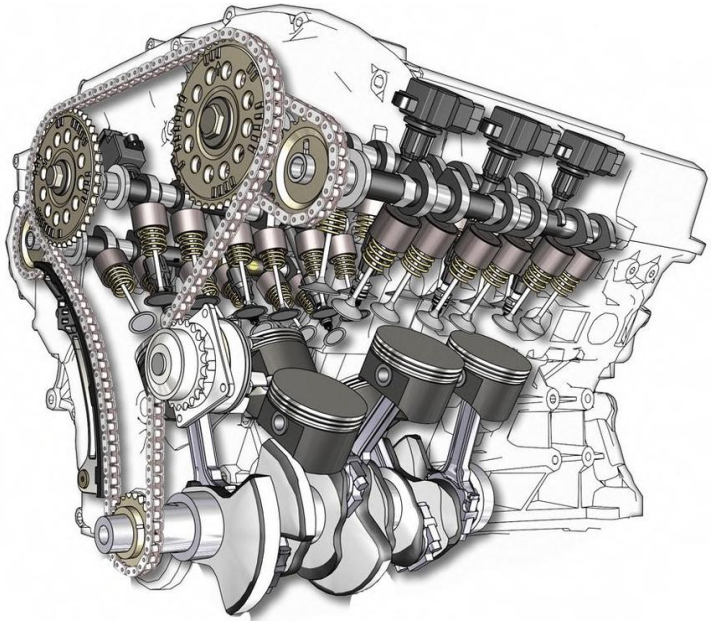

Photo source: https://www.researchgate.net/figure/Illustration-of-a-V6-internal-combustion-engine_fig1_339612888

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2-Ma`ruza: Ichki yonuv dvigatellarining haqiqiy sikllari.

(Topic 2: Actual cycles of Internal combustion engines)

Reja:

1. To`rt taktli IYoDning haqiqiy sikllari. Uchqundan o`t oldiriladigan dvigatellar sikli, dizel sikli, to`g`risida tushuncha.
2. Karbyuratorli to`rt taktli dvigatelning ish sikli.
3. To`rt taktli dizel dvigatelning ish sikli.
4. Ikki taktli IYoD ning haqiqiy sikllari va ularning ko`rsatkichlari

Haqiqiy (ishchi) sikl

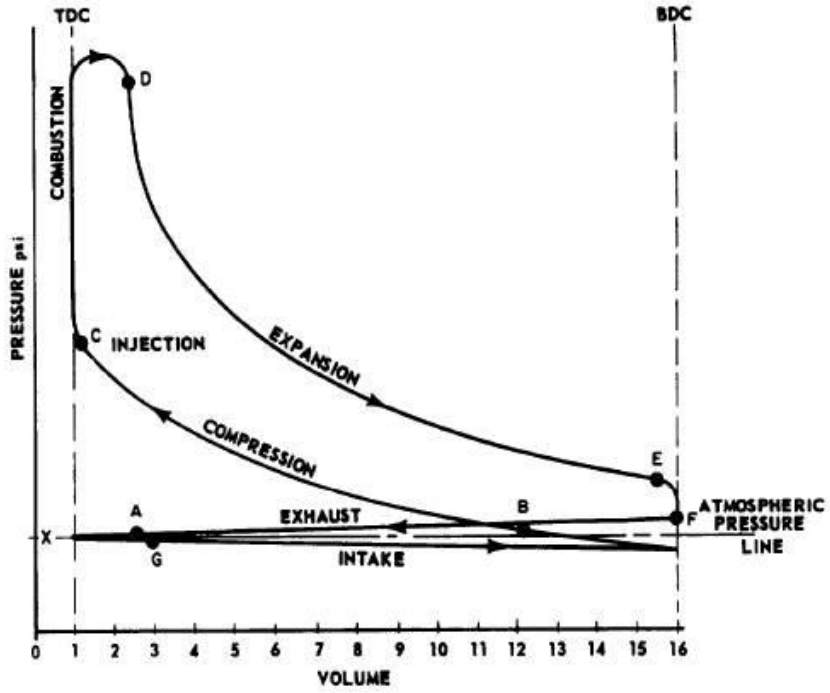

Photo source: http://www.tpub.com/engine3/en3-15.htm

Har bir ishchi silindrda davriy takrorlanib turuvchi va dvigatelning davomli ishlashini ta’minlovchi jarayonlar ketma-ketligining birikmasiga, ichki yonuv dvigatellarining **haqiqiy (ishchi) sikli** deyiladi [2].

Dvigatel ko’rsatkichlari

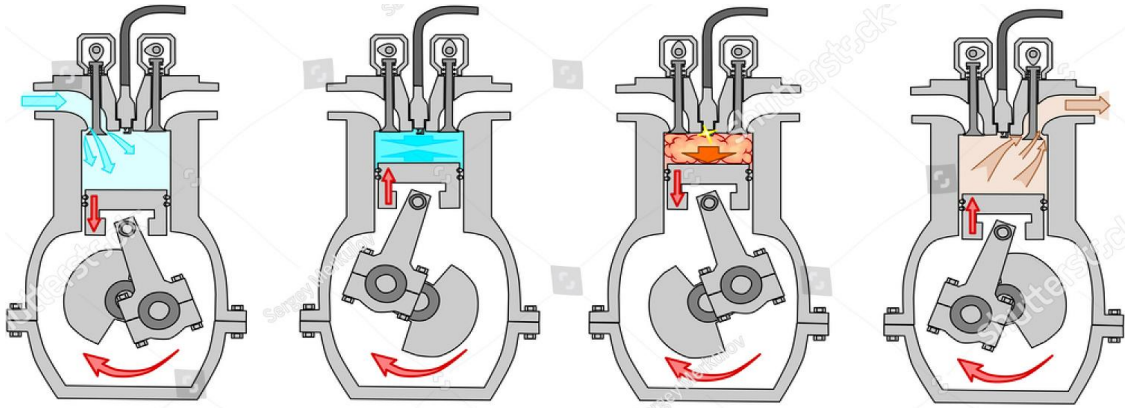

Photo source: https://www.shutterstock.com/ru/image-vector/4-stroke-internal-combustion-engine-diagram-555576940

Ishchi siklning bir qismida, ya’ni porshenning bir yo`lida tsilinidr ichida bajarilgan ishga **«takt»** deyiladi.

Dvigatelning bir ishchi sikli porshenning ikki yulida (tisrakli valning bir aylanishida) bajarilsa, bunday dvigatelni **ikki taktli**, agarda porshenning to`rt yo`lida (tirsakli valning ikki aylanishida) bajarilsa, **to`rt taktli** dvigatel deyiladi [1].

Dvigatel ko’rsatkichlari

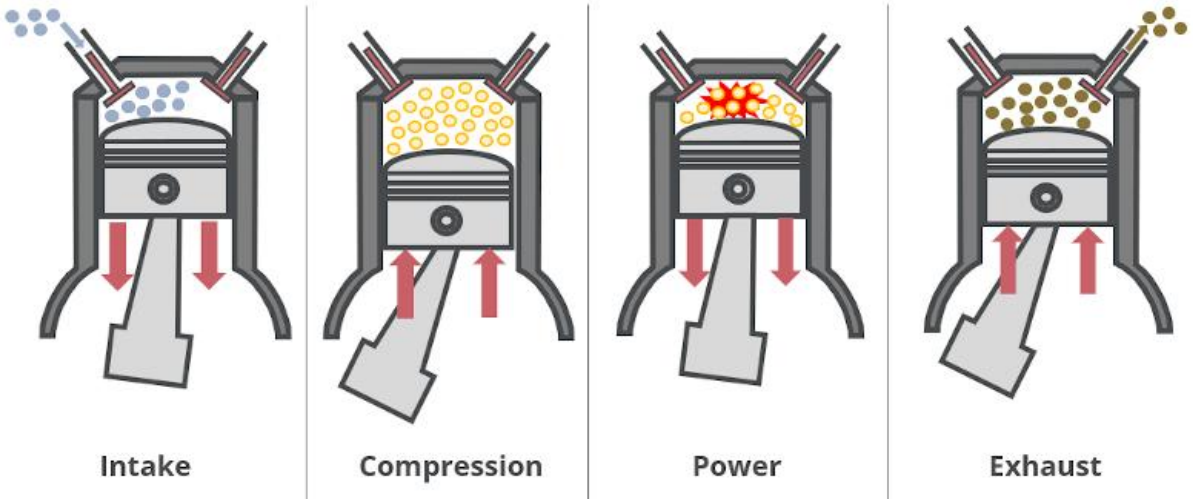

Photo source: https://www.adis99.it/ProductDetail.aspx?iid=99493163&pr=59.88

4 taktli dvigatellarning haqiqiy ishchi sikli porshenni to`rt marta harakatlanishi natijasida hosil bo`ladi: **kiritish, siqish, yonish-kengayish va chiqarish;**

Ikki taktli dvigatellarda porshenni **ikki marta** harakatlanishi natijasida bitta haqiqiy ishchi sikl bajarilad [1].

Dvigatel ko’rsatkichlari

Porshenni tirsakli val o`qidan eng uzoqlashgan (yuqoriga chiqib qaytadigan) nuqtasi yuqori chekka nuqta (**yu.ch.n**) deyiladi.

Porshenning val o`qiga eng yaqinlashgan (pastga tushib qaytadigan) nuqtasi pastki chekka nuqta (**p.ch.n**) deyiladi.

Chekka nuqtalar orasidagi masofani porshen yo`li (S) deyiladi [1].

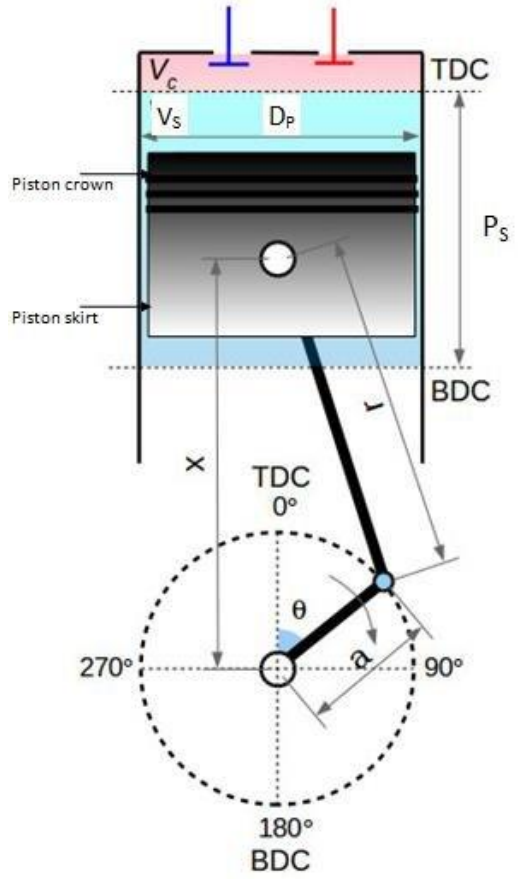

Photo source:
https://www.researchgate.net/publication/357808362_DESIGN_OF_067HP_GASOLINE_GENERATOR_PISTONS/figures?lo=1

Karbyuratorli dvigatelning ishchi sikli

Kiritish takti - silindrni yonuvchi aralashma bilan to`ldirish uchun zarur. Yonilg`i aralashmasi silindrga kiritish klapani porshen yu.ch.n. ga yetib kelmasdan ochiladi. Porshen yu.ch.n. dan p.ch.n. ga yetganda silindr yonilg`i aralashmasi bilan to`ladi, porshen p.ch.n. dan bir oz yu.ch.n. tomon siljiganda kiritish klapani yopiladi.

Kiritish taktini oxirida bosim 0,07-0,09MPa (0,7-0,9kgk/sm^2), aralashmaning harorati 340..380K (70-1100 C) bo`ladi [1].

Photo source:
https://www.mechanicalbooster.com/2014/02/how-does-four-stroke-petrol-engine-works.html/intake-stroke-copy-1

Karbyuratorli dvigatelning ishchi sikli

Siqish takti - yonuvchi aralashmasining hajmini kamaytirish natijasida uning ichki energiyasini ko`paytirib, uni yonishga tayyorlaydi. Porshen p.ch.n. dan yu.ch.n. tomon siljiganda aralashma siqiladi. Bu vaqtda kiritish va chiqarish klapanlari yopiq bo`ladi.

Siqish takti oxirida aralashmaning bosimi 1,2-1,7MPa (12-17kgk/sm^2), harorati esa, 570-670K (300-4000 C) bo`ladi. Siqish taktining oxirida porshen yu.ch.n. ga yetib kelmasdan elektr svechasida uchqun paydo bo`ladi, natijada silindrda siqilgan yonuvchi aralashma alangalanadi [1].

Photo source:
https://www.mechanicalbooster.com/2014/02/how-does-four-stroke-petrol-engine-works.html/intake-stroke-copy-1

Karbyuratorli dvigatelning ishchi sikli

**Ish yo`li (yonish va kengayish) taktida** aralashmaning yonishidan hosil bo`lgan kimyoviy issiqlik energiyasi foydali mexanik energiyaga aylanadi.

Bunda ikkala klapan yopiq holatda bo`ladi. Takt boshlanishida silindr ichidagi alangalangan gazlar yonib ko`p miqdorda issiqlik chiqaradi va gazning bosimi ko`tariladi (3,5-5,0 MPa), (35-50kgk/sm$^2$), harorati esa, 2270-2670K (2000-24000 C) gacha ko`tariladi.

SHu bosim ta’sirida porshen yu.ch.n. dan p.ch.n. ga harakatlanadi, bunda ish yo`li takti bajariladi. SHu taktining oxirida silindrdagi gaz bosimi 400-500KPa (4,5-5,0 kgk/sm^2) gacha, harorati esa, 1300-1500K (1030-18300 C) gacha kamayadi [3].

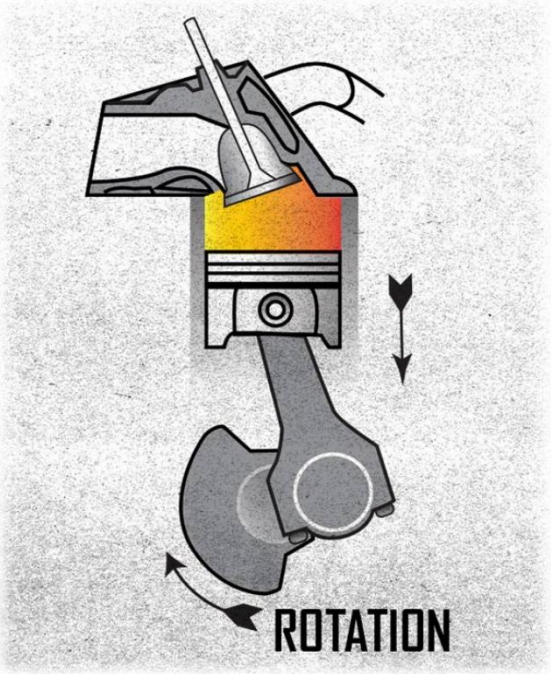

Photo source: https://www.cycleworld.com/what-is-four-stroke-piston-engine-cycle/

Karbyuratorli dvigatelning ishchi sikli

Chiqarish takti - silindrlarni ishlatilgan gazlardan tozalash takti hisoblanadi. Chiqarish klapani porshen p.ch.n. ga yetib kelmasdan ochiladi. Porshen yu.ch.n. ga harakatlanib, yongan gazni tashqi muhitga qisib chiqaradi. CHiqarish klapani porshen yu.ch.n. dan p.ch.n. tomon biroz siljiganda yopiladi.

Bu taktning oxirida silindr ichida qolgan gazlarning bosimi 0,11-0,12MPa (1,1-1,2 kgk/sm^2), harorati esa, 770-1100K (500-8300 C) bo`ladi. Keyin silindrlardagi taktlar yuqorida bayon etilgan tartibda yana takrorlanadi [1].

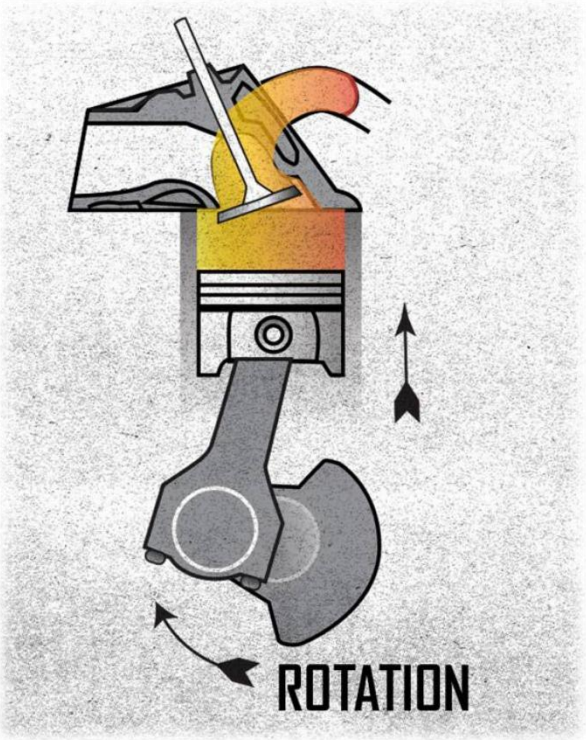

Photo source: https://www.cycleworld.com/what-is-four-stroke-piston-engine-cycle/

Dizel dvigatelining ishchi sikli

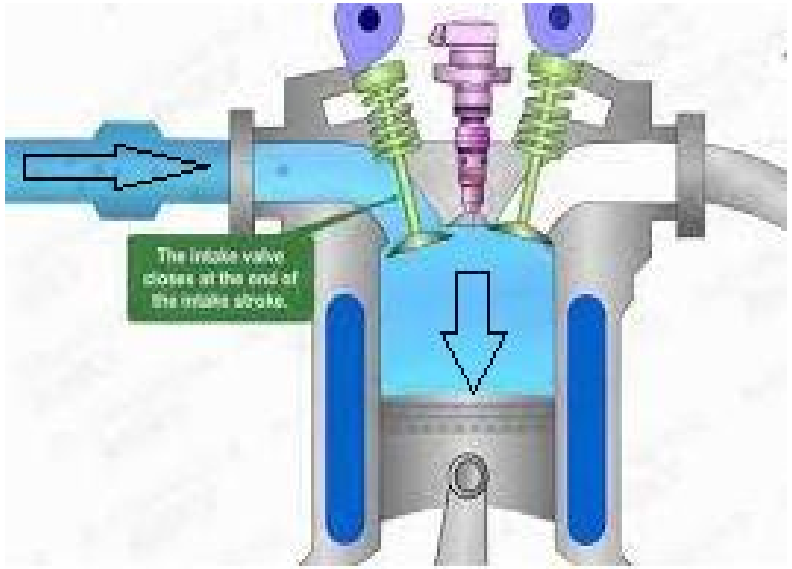

Photo source: https://www.youtube.com/watch?v=fTAUq6G9apg

Kiritish takti - porshen p.ch.n. dan yu.ch.n. ga harakatlanganda, kiritish klanani porshen yu.ch.n. ga yetib kelmasdan ochiladi va silindrga kiritish klapani orkali changdan tozalangan havo so'riladi va porshen p.ch.n. dan bir oz o`tgandan keyin klapan yopiladi.

Kiritish taktining oxirida silindr ichidagi havo bosimi 0,08-0,09MPa (0,8-0,9kgk/sm^2), harorati esa, 320-340K (50-700 C) bo`ladi [1].

Dizel dvigatelining ishchi sikli

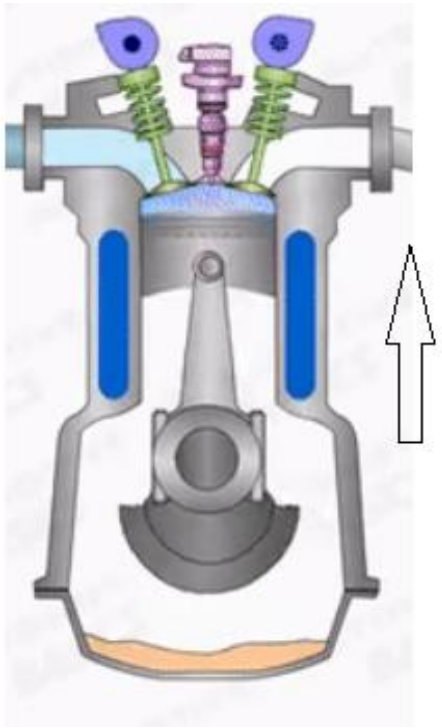

Photo source: https://extrudesign.com/4-stroke-diesel-engine/

Siqish taktida ikkala klapan yopiq holatda bo`ladi, porshen p.ch.n. dan yu.ch.n. ga harakatlanganda silindrdagi havo siqiladi. Siqish takti oxirida havo bosimi 3000-4000kPa (30-40 kgk/sm$^2$), harorati esa, 770-1000K (500-7300 C) gacha ko`tariladi.

Shu payt silindrga forsunka orqali yuqori bosimli yonilg`i nasosi yordamida 20MPa (200kgk/sm$^2$) bosim ostida yonilg`i purkaladi. Purkalgan yonilg`i o`ta qizigan havo bilan aralashib, o`z-o`zidan alangalanadi [4]

Dizel dvigatelining ishchi sikli

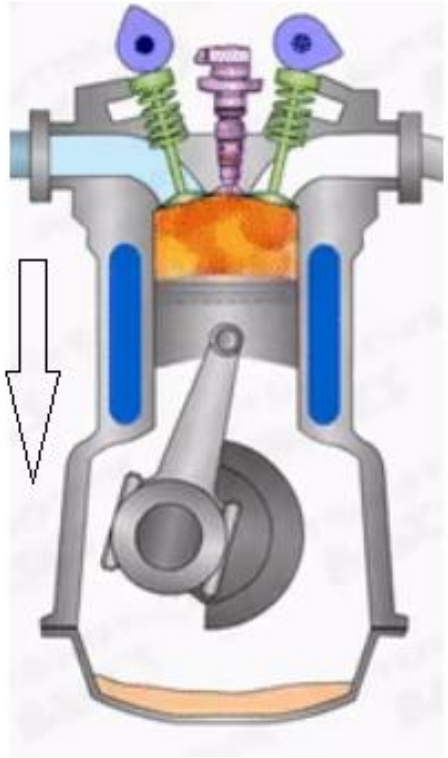

Photo source: https://extrudesign.com/4-stroke-diesel-engine/

Kengayish taktida ikkala klapan yopiq holatda bo`ladi. Bu taktning boshlanishida alangalangan aralashmaning yonish jarayoni porshen yu.ch.n. dan biroz pastga tushgunicha davom etadi. Bu paytda silindr ichidagi bosim 5,5-8,0 MPa (55-80 kgk/sm$^2$), harorat 1900-2200K (1630-19300 C) bo`ladi. Yuqori bosimga ega bo`lgan gazning ta’siri natijasida porshen yu.ch.n. dan p.ch.n. ga harakatlanib, foydali ish bajaradi.

Porshen p.ch.n. ga yaqinlashganda, gazlarning kengayishi natijasida, ularning silindrdagi bosimi 3,0-4,0 MPa (30-40kgk/sm^2)gacha harorati esa, 900-1200K (630-9300 C) gacha pasayadi.

Dizel dvigatelining ishchi sikli

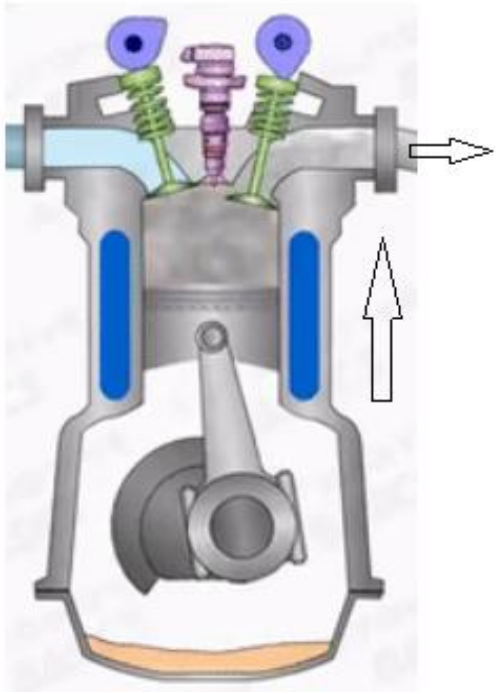

Photo source: https://extrudesign.com/4-stroke-diesel-engine/

Chiqarish taktida chiqarish klapani porshen p.ch.n. ga yetib kelmasdan bir oz oldin ochilgan bo`ladi. Porshen p.ch.n. dan yu.ch.n. ga harakatlanib, ishlatilgan gazlarni silindr ichidan chiqarish klapani orqali tashqi muhitga chiqarib yuboriladi.

Takt oxirida silindrda qolgan gazlarning bosimi 0,11-0,12 MPa (1,1-1,2 kgk/sm^2) ga, harorati esa, 700-900 K (430-6300S) ga teng bo`ladi. Tirsakli valning bundan keyingi aylanishida dvigatelning ish sikli yuqoridagi tartibda yana davom etadi [5]

Dvigatel ishchi sikli diagrammasi

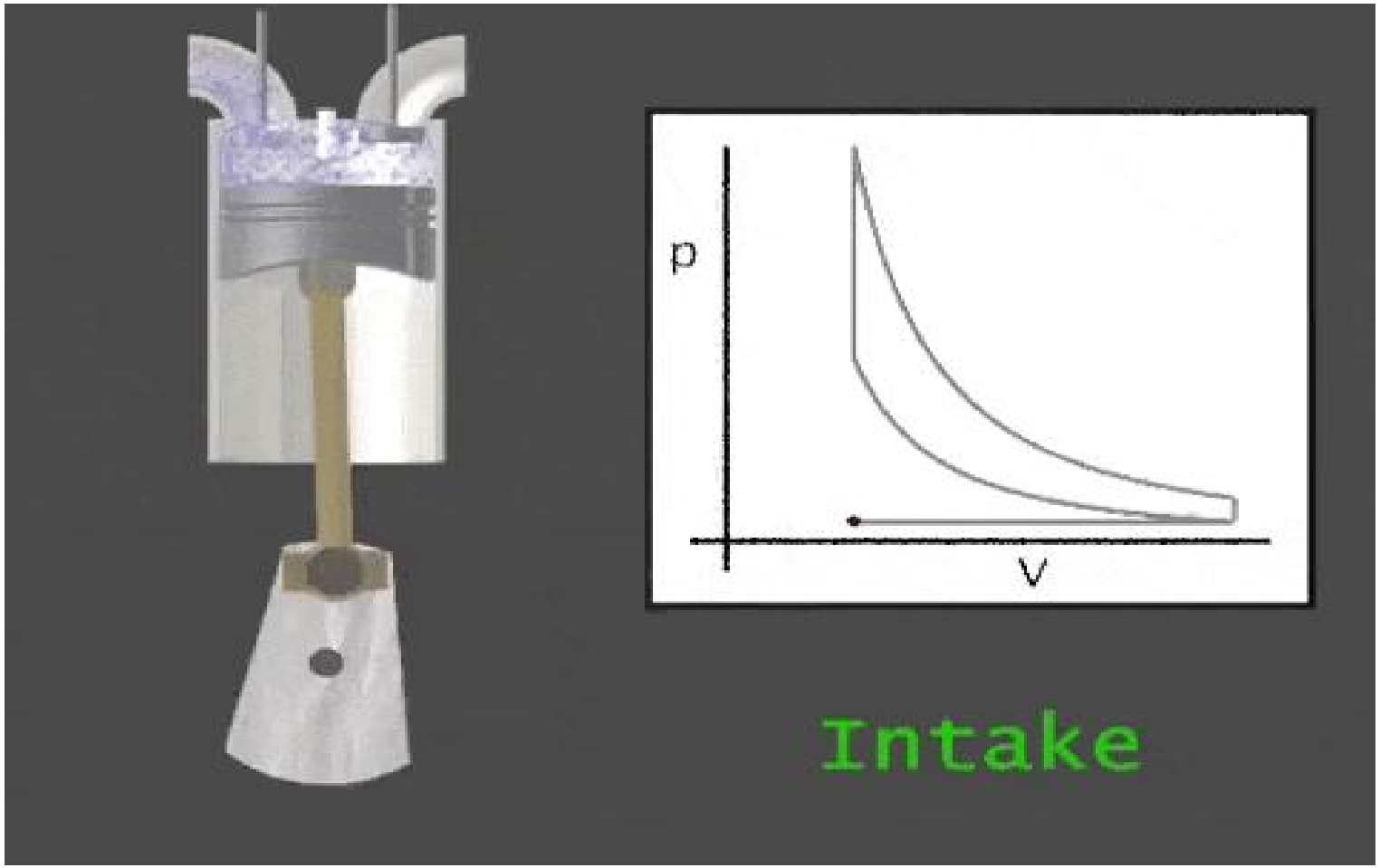

Photo source: https://gfycat.com/ko/confusedpalegreatdane

Ikki taktli dvigatel

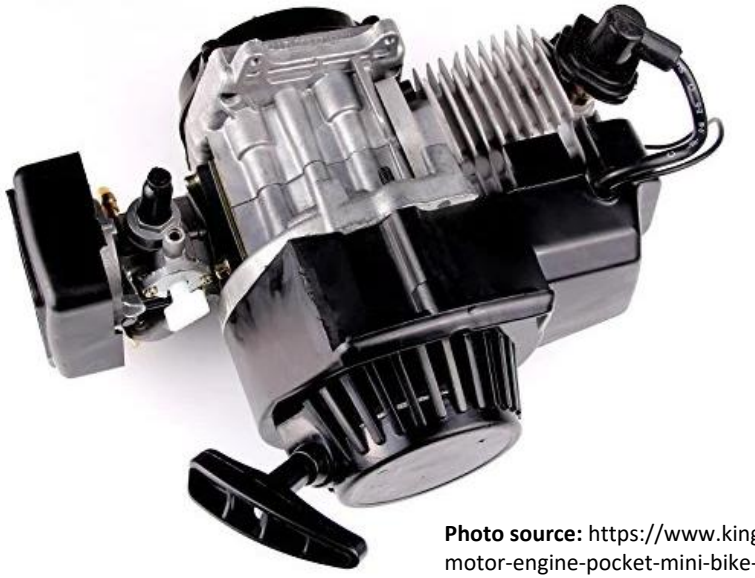

Photo source: https://www.kingsmotorbikes.com/products/aurelio-tech-49cc-2-stroke-new-motor-engine-pocket-mini-bike-scooter-atv-h-en02

Ikki taktli dvigatelning ish sikli porshenning ikki yurishida yoki tirsakli valning bir marta aylanishi natijasida sodir bo`ladi. Bu yerda ham xuddi to`rt taktli dvigatellar kabi, yonuvchi aralashmasi silindr tashkarisida yoki ichida tayyorlanadi. SHunga qarab shu sikl bo`yicha ishlovchi dvigatellar karbyuratorli yoki dizel bo`lishi mumkin.

Bu dvigatellarda ishlatilgan gazlarni tashqariga haydash va silindrni tozalash uchun yonuvchi aralashma (karb. dvigatel), yoki havo oqimidan (dizelda) foydalaniladi [3].

Ikki taktli dvigatelning ishchi sikli

1-takt porshen p.ch.n. dan yu.ch.n ga harakatlanganda boshlanadi. Bu paytda *kiritish* va *chiqarish* darchalari ochiq. Nasos yordamida kiritish darchasi orqali silindrga yonuvchi aralashma yoki havo kiritiladi, ular esa silindr ichida qolgan gazlarni tashqariga chiqarib yuboradi.

Porshen yuqoriga harakatlanayotganda o`z devorlari bilan kiritish va chiqarish darchalarini to`sadi. Shu vaqtdan boshlab qisish jarayoni boshlanadi va porshen yu.ch.n. ga yetay deganda, qisish kamerasiga elektr uchqunini yoki yonilg`ining mayda zarrachalarini forsunka yordamida purkaladi (dizelda), natijasida qisish kamerasidagi zaryad alangalanadi [1].

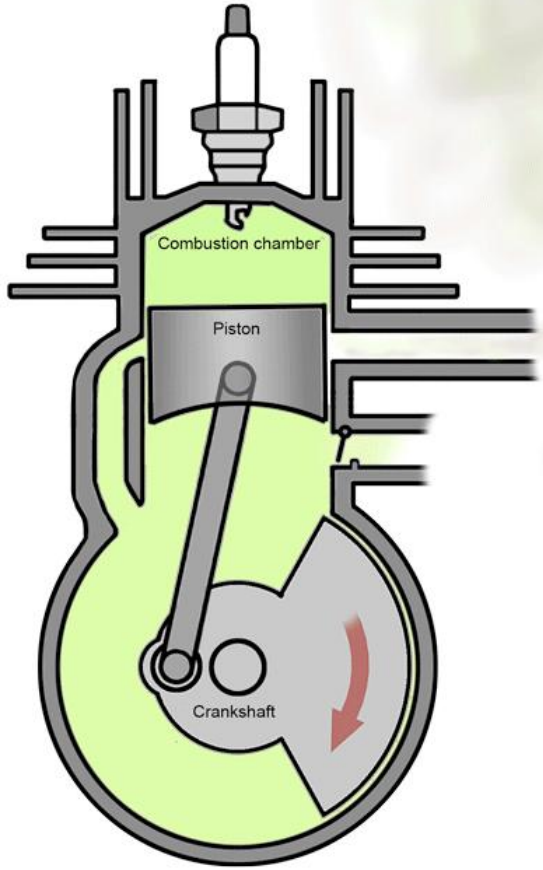

Photo source: https://www.pinterest.com/pin/572801646334757058/

Ikki taktli dvigatelning ishchi sikli

2-taktda porshen yu.ch.n. dan p.ch.n. ga harakat qiladi. Bunda qisish taktining oxirida boshlangan yonish jarayoni davom etadi, natijada silindrda ko`p miqdorda issiqlik ajraladi va gazlar bosimi tahsirida porshen p.ch.n. ga qarab harakatlanadi.

Bu vaqt silindrda kengayish jarayoni boshlanadi, porshenni harakatlanishi davom etib avval uni devorlari chiqarish darchasini ochganda porshen tepasidagi yuqori bosimli gaz darchadan chiqa boshlaydi. So`ngra kiritish darchasi ochilib, silindrga nasos yordamida yangi zaryad yuboriladi, u esa ishlatilgan gazlar bilan qisman aralashib, ularni chiqarish darchasi orqali tashqariga qisib chiqaradi.

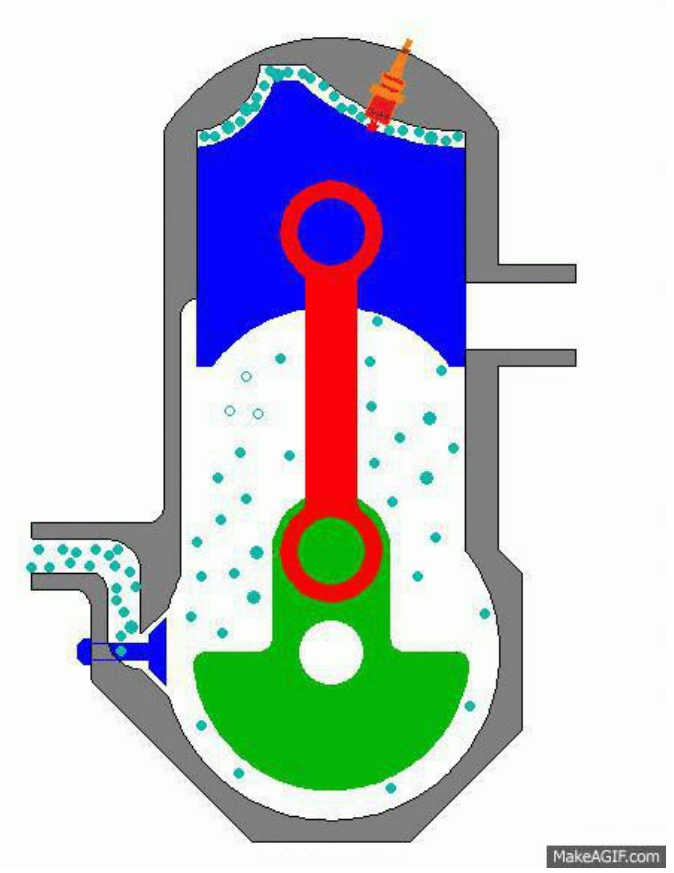

Photo source: https://makeagif.com/gif/motor-2t-sZjmdU

Ikki taktli dizel dvigatelning ishchi sikli

Photo source: https://makeagif.com/gif/2-stroke-engine-GHFqhJ

Foydalanilgan adabiyotlar

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